ROHDE&SCHWARZ

Test and Measurement
Division

Operating Manual

Software Options:

GSM400/GT800/850/900/1800/1900-MS for CMU-B21

R&S® CMU-K20/-K21/-K22/-K23/-K24/-K26
1115.5900.02/6007.02/6107.02/6207.02/6307.02/6507.02

Including the following extensions:

GPRS/EGPRS Software Extension
R&S® CMU-K42/-K43
1115.4691.02/1115.6907.02

AMR GSM for CMU 200
R&S® CMU-K45
1150.3100.02

Smart Alignment @ GSM-MS
R&S® CMU-K47
1157.4477.02

Dual Transfer Mode
R&S® CMU-K44
1157.4277.02

Printed in Germany

throughout this manual, CMU-K20 to CMU-K26 and CMU-K42 to CMU-K47 is generally used as an abbreviation for software options R&S® CMU-K20 to R&S® CMU-K26 and R&S® CMU-K42 to R&S® CMU-K47.
The Universal Radio Communication Tester R&S® CMU 200 is abbreviated as CMU200.

Tabbed Divider Overview

Safety Instructions
Certificate of Quality
List of R&S Representatives

Contents of Manuals for Universal Radio Communication Tester CMU

Tabbed Divider

Contents of Manuals for Universal Radio Communication Tester CMU

The user documentation for the R&S CMU 200/300 is divided in a Quick Start Guide, the operating manual for the basic instrument (including options CMU-B41, CMU-B17) and separate manuals for individual software and hardware options. The complete documentation is available on CD-ROM, stock no. PD 0757.7746.2x.

For an overview and order information about printed manuals refer to the beginning of the Quick Start Guide. The latest revisions of all manuals are also posted on the CMU Customer Web on GLORIS.

Operating Manual CMU-K20/-K21/-K22/-K23/-K24/-K26 (Software Options: GSM400/GT800/900/1800/1900/850-MS for CMU-B21)

The present operating manual describes the application of CMU for GSM mobile tests including the GPRS/EGPRS and AMR software extensions and options *Smart Alignment @ GSM-MS* (R&S CMU-K47) and *Dual Transfer Mode* (R&S CMU-K44). It gives comprehensive information about the installation of the required software options and about manual and remote control of the instrument. Typical measurement tasks are explained in detail using the functions offered by the graphical user interface and a selection of program examples.

The manual is organized as follows:

Chapter 1	Describes the steps necessary for installing the software and putting the instrument into operation.
Chapter 2	Gives an introduction to the application of the CMU for GSM mobile station tests and presents typical measurement examples.
Chapter 3	Gives an overview of the user interface and describes the concepts of measurement control and instrument configuration.
Chapter 4	Represents the reference chapter providing detailed information on all functions of the user interface and their application including the supplementary options R&S CMU-K42/-K43 (GPRS, EGPRS) and R&S CMU-K45 (AMR GSM).
Chapter 5	Describes the basics of remote control of the instrument for GSM base station tests.
Chapter 6	Lists all remote control commands for GSM mobile station tests including options R&S CMU-K42/-K43 (GPRS, EGPRS) and R&S CMU-K45 (AMR GSM). At the end of the chapter the commands are grouped together according to their function (measurement groups or configurations) and sorted in alphabetical order.
Chapter 7	Contains program examples.
Chapter 8	Describes manual and remote control of option R&S CMU-K47, *Smart Alignment @ GSM-MS*.
Chapter 8	Describes manual and remote control of option R&S CMU-K44, *Dual Transfer Mode*.
Chapter 10	Contains an index for the operating manual.

What's new in this Revision...

This operating manual describes version V3.80 of the GSM-MS firmware package. Compared to previous versions, this new firmware provides numerous extensions and improvements. The most important new features described in this manual are listed below.

New Features	Description	Refer to...
Dual Transfer Mode	Combined circuit switched and packet data connection for (E)GPRS tests, option R&S CMU-K44.	Chapter 9
(E)GPRS Application Testing	Support for option R&S CMU-K92, providing integration of the R&S CMU200 into a LAN for data test applications. The option is described in a separate manual, stock no. 1157.4148.12.	Chapter 4 GSM Mobile Tests (Signalling) → Connection Control, Misc.
I/Q Analyzer	Graphical analysis of the I/Q amplitudes of the measured 8PSK-modulated signal	Chapter 4, GSM Module Tests (Non Signalling) → Modulation Measurements
Retriggered Power vs. Slot measurement	Average burst power of a series of possibly non-equidistant bursts with decreasing levels.	Chapter 4, GSM Module Tests (Non Signalling) → Power Measurements
Demodulated Bits	Display of the demodulated bits of the measured 8PSK-modulated signal	Chapter 4, GSM Module Tests (Non Signalling) → Modulation Measurements
New packet data parameters	The *Timing Advance, IMSI Request, IMEI Request* parameters are also available for packet data connections	Chapter 4, GSM Mobile Tests (Signalling)
Enhanced Meas. Reports	Display of the *Enhanced Measurement Reports* for circuit switched connections (parameters Mean BEP, CV BEP, Number of Received Blocks)	GSM Mobile Tests (Signalling) → Receiver Quality Measurements
USF BLER only	New measurement mode for *Receiver Quality* measurements on packet data channels improves the *USF BLER* measurement	GSM Mobile Tests (Signalling) → Receiver Quality Measurements
L3 Message Log	The *Packet Downlink Ack/Nack* messages received from the mobile are included in the Layer 3 message log, to be analyzed with accessory R&S CMU-Z49	GSM Mobile Tests (Signalling) → Receiver Quality Measurements
Invalid Result Detect Timeout	New parameter for *Power* and *Modulation* measurements, can reduce measurement times	Chapter 4, GSM Module Tests (Non Signalling) → Power Measurements
Output triggers	New output triggers to monitor CTRL_ACK radio blocks and multiframes. The *Spectrum* measurement can be controlled by means of the *Ctrl. Ack* triggers.	Chapter 4, GSM Mobile Tests (Signalling) → Connection Control – Trigger
BEP Period	New *Network* parameter for packet data connections	Chapter 4, Options and Extensions GPRS Signalling and EGPRS → Network Parameters

Frequently Used Abbreviations

AB	*Access Burst*
Abs.	*Absolute*
ACK	*Acknowledged mode*
AGC	*Automatic Gain Control*
AMR	*Adaptive Multi-Rate (codec)*
AOC	*Advice of Charge*
Atten.	*Attenuation*
Aux TX	*Additional RF generator (signal)*
BA	*BCCH Allocation*
Bandw.	*Bandwidth*
BCC	*Base Transceiver Station Color Code*
BCCH	*Broadcast Control Channel*
BCCH	*Broadcast Control Channel*
BEP	*Bit Error Probability*
BER	*Bit Error Rate*
BLER	*Block Error Ratio*
BS	*Base (Transceiver) Station*
BS	*Base (Transceiver) Station*
BS-AG-BLKS-RES	*Basic Services Access Grant Blocks Reserved*
BS-PA-MFRMS	*Basic Service Paging Blocks Available per Multiframes*
BTS	*Base Transceiver Station*
Chan.	*Channel*
CRC	*Cyclic Redundancy Check*
CV BEP	*Coefficient of Variation of the BEP*
DBLER	*Data Block Error Rate*
Disp.	*Display (Mode)*
Err.	*Error*
EVM	*Error Vector Magnitude*
Ext.	*Extended (phase error measurement)*
Ext.	*External*
FAC	*Final Assembly Code*
FACCH	*Fast Associated Control Channel*
FER	*Frame Erasure Rate*
Freq.	*Frequency*
GPRS	*General Packet Radio Service*
GSM	*Global System for Mobile Communication, Groupe Spécial Mobile*
IF	*Intermediate Frequency*
IMEI	*International Mobile Equipment Identity*
IMSI	*International Mobile Subscriber Identity*
Lev.	*Level*
Magn.	*Magnitude*
Max.	*Maximum (e.g. Level)*
Max./Min.	*Maximum/Minimum*
MCC	*Mobile Country Code*
MNC	*Mobile Network Code*
MOC	*Mobile Originated Call*
MS	*Mobile Station*
MSIN	*Mobile Subscriber Identity Number*
MTC	*Mobile Terminated Call*
NB	*Normal Burst*
Ovw.	*Overview*
PCL	*Power Control Level*
PDTCH	*Packet switched Data Traffic Channel*
PDU	*Protocol Data Unit*
PRBS	*Pseudo Random Bit Sequence*
PSR	*Pseudo Random*
PTP	*Point to Point (GPRS services)*
RACH	*Random Access Channel*
RBER	*Residual Bit Error Rate*
Rcv.	*Receiver*
Ref.	*Reference (marker)*
Rel.	*Relative*
RF	*Radio Frequency*
RMS	*Root Mean Square (averaging)*
SDCCH	*Stand-alone Dedicated Channel*
Seq.	*Sequence*
SMS	*Short Message Service*
SNR	*Serial Number*
SVN	*Software Version Number*

TAC	*Type Approval Code*
TBF	*Temporary Block Flow*
TDMA	*Time Division Multiple Access*
TLLI	*Temporary Link Level Identity*
Trg.	*Trigger*
TSC	*Training Sequence (Code)*
USF	*Update State Flag*
Vect.	*Vector*

Contents

1 Installation and First Steps

This chapter describes how to install, update or enable software options *GSM400/850/900/1800/1900-MS* for the Universal Radio Communication Tester CMU200.

Before proceeding to perform any of the steps described in this manual, please make sure that the instrument is properly connected and put into operation according to the instructions given in chapter 1 of the CMU200 manual. The hardware and software options available are shown in the *Startup* menu. The status of the software options required for GSM mobile tests is indicated in the lines *CMU-K20 GSM400-MS, CMU-K21 GSM900-MS, CMU-K22 GSM1800-MS, CMU-K23 GSM1900-MS, CMU-K24 GSM850-MS, CMU-K26 GSM GT800-MS,* and the supplementary options such as *CMU-K42 GPRS for GSM MS:*

- If a version number is indicated, the CMU is ready to perform GSM mobile tests. In this case you may skip this chapter, except if you wish to update the current software version or activate another version.
- If *disabled* is indicated, the software option must be enabled using a key code; see section *Creating a new Software Configuration* on page 1.4.
- If *not installed* is indicated, the software must be installed via the PCMCIA interface or the floppy disk drive, see below.

Software Installation or Update

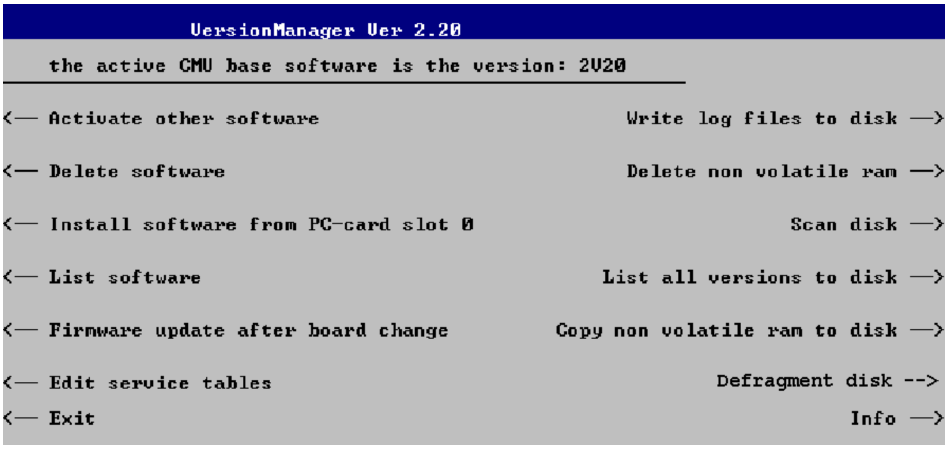
The CMU is always delivered with the latest software version available. New CMU software versions are available for download on the R&S Lotus Notes Service board. To be loaded via the PCMCIA interface, the software must be copied to one or several flash disks/memory cards or PCMCIA hard disks. An appropriate memory card CMU-Z1, order no. 1100.7490.02, can be obtained from Rohde & Schwarz.

Note: *If your CMU is equipped with a floppy disk drive (option CMU-U61), a set of installation floppy disks must be generated instead of a flash disk. All other steps do not depend on the storage medium.*

The software options *GSM400/850/900/1800/1900-MS, GSM GT800-MS,* and supplementary options such as *GPRS for GSM MS (CMU-K42)* are part of a single software package termed *GSM MS*, so they must be installed or updated together. They can be enabled and operated separately, see section *Enabling Software Options* on page 1.6. To install the GSM MS software proceed as follows:

- ➢ Switch off the CMU.
- ➢ Insert the flash disk into one of the two slots of the PCMCIA interface.
- ➢ Switch on the CMU.

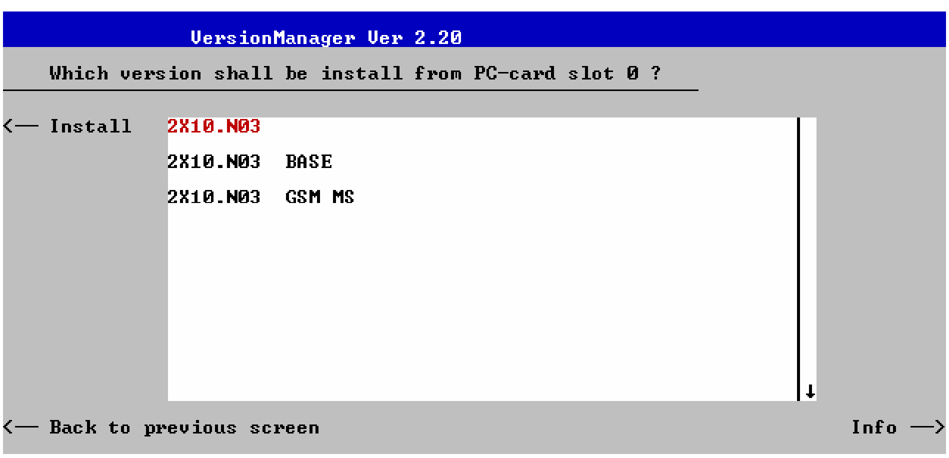
The installation is started automatically while the CMU performs its start-up procedure. To this end the *VersionManager* is called up (for a detailed description of the *VersionManager* refer to chapter 1 of the CMU operating manual or to the on-line help accessible via *Info):*



Softkey no. 5 on the left softkey bar, *Install software...,* is used to install new software from an external storage medium. The CMU automatically recognizes the storage medium and indicates the corresponding slot number: Slot 0 or 1 denotes the left or right slot of the PCMCIA interface. If a floppy disk is used the menu option reads *Install software version <version> from floppy.*

➢ Press left softkey no. 5 *(Install software...)* to start the installation.

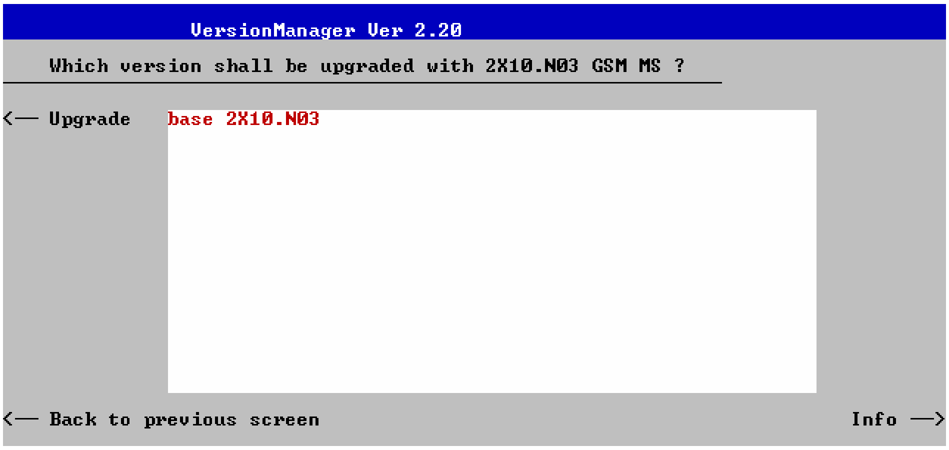
If your storage medium contains several installation versions, the software version selection dialog is opened:



➢ Use the rotary knob or the cursor keys to scroll the list and select the GSM MS version you intend to install.

➢ Press *Install* to start the installation.

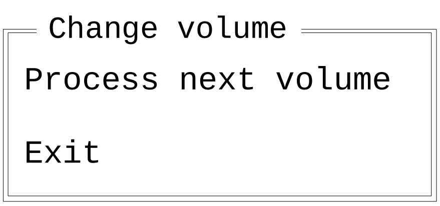
The installation is started. To be operable on your instrument, a network option must be combined with a compatible version of the CMU base software. Any base software version installed on the CMU hard disk can be combined with one or several network options to form an independent software configuration. If none of the configurations is compatible to the new GSM MS option, the *VersionManager* displays an error message and takes you back to the software selection dialog; see section *Creating a new Software Configuration* on page 1.4. Otherwise, the following upgrade selection dialog is opened:



The upgrade selection dialog displays a list of base software versions that can be combined with the new GSM MS software.

➢ Select the appropriate base version and press *Upgrade*.

The new GSM MS option is added to the configuration or updates the previous GSM MS version of the configuration. To indicate that the storage medium must be changed the CMU issues the *Change volume* message:

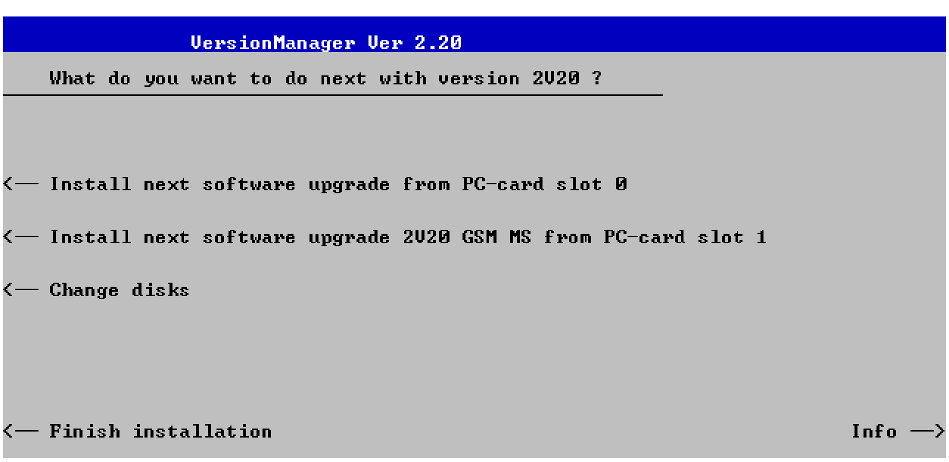


➢ Replace the current disk with the disk requested.

➢ Use the cursor up/down keys to select "Process next volume" (default setting).

➢ Press *ENTER* to confirm that the new disk has been inserted and to continue the installation.

After processing the last disk the CMU displays the following screen:



➢ If you wish to install or upgrade other software versions, press left softkey no 4 or 5 *(Install next software...)* or insert new storage medium into the PCMCIA slot or floppy disk drive and press *Change disks*.

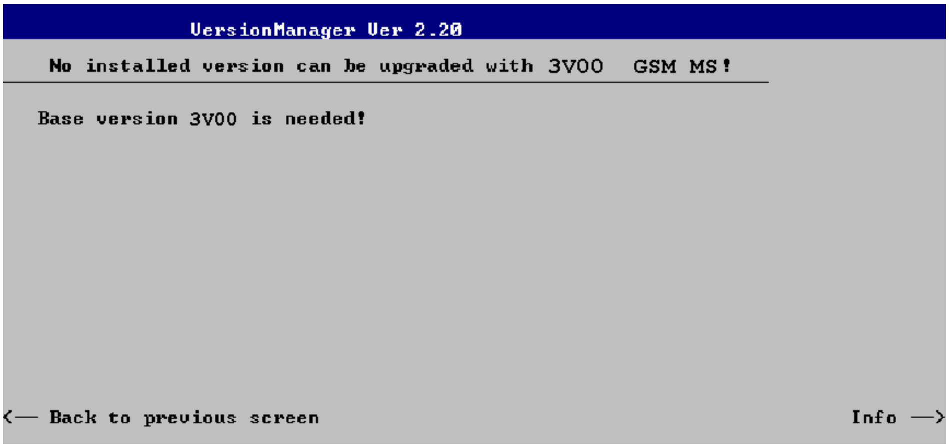
➢ To finish the installation, remove all disks from the drive and press *Finish installation*.

The *VersionManager* is closed and the CMU is rebooted. The new firmware options are now operational and listed in the *Menu Select* menu together with their version number. Besides, the last software configuration installed is automatically taken as the active one in the next measurement session.

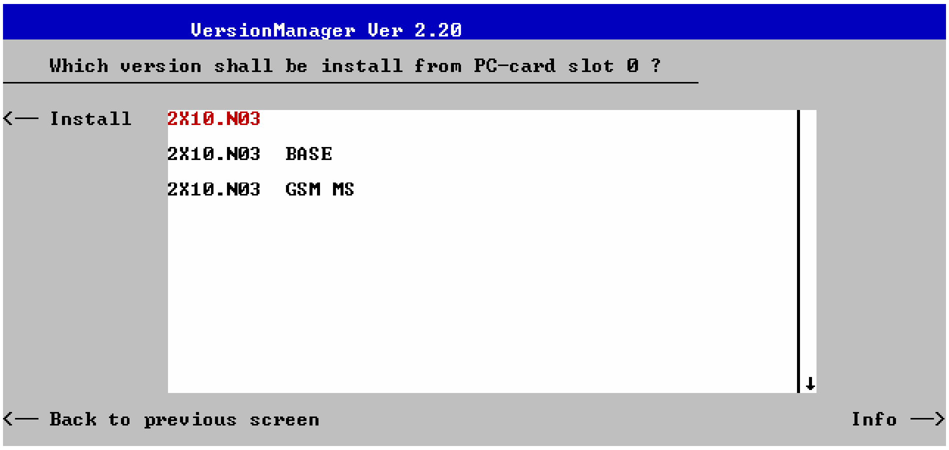
Creating a new Software Configuration

The CMU handles base software versions and network options on a separate basis. Different versions of the base software can be combined with different options to create new firmware configurations. For example, it is possible to update the base software without affecting the associated network options or vice versa. Moreover, the same base software version can be installed several times and combined with different network options (and vice versa), so it may enter into several firmware configurations.

If no compatible base software version can be found on the hard disk, then the CMU will refuse to install a new GSM MS software option selected in the software selection dialog (see previous section). Instead, it displays the following error message:



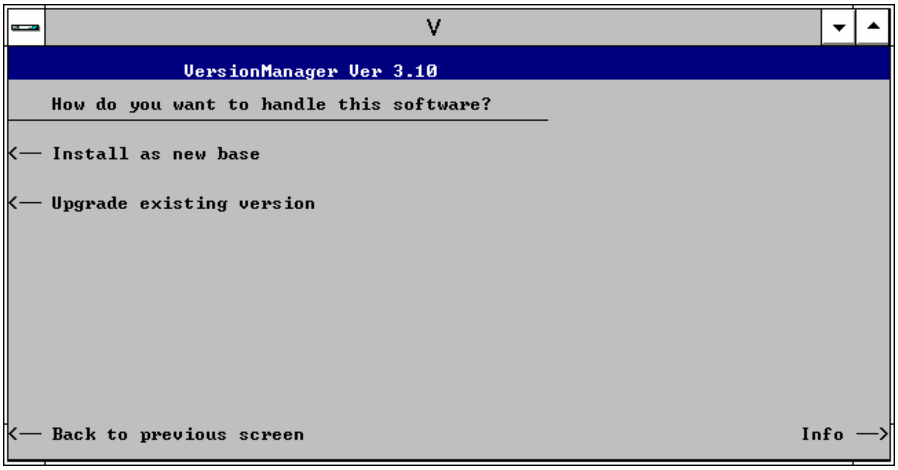
➢ Press *Back to installation* to return to the software version selection dialog.



➢ Select a base software version that is compatible to your GSM MS software option and press *Install*.

Note: *As a rule, firmware versions for the base system and for network options are compatible if they differ only in the last digit. GSM firmware versions 3.10 to 3.19 (if available) can be run together with base system version 3.10 to 3.19 (if available).*

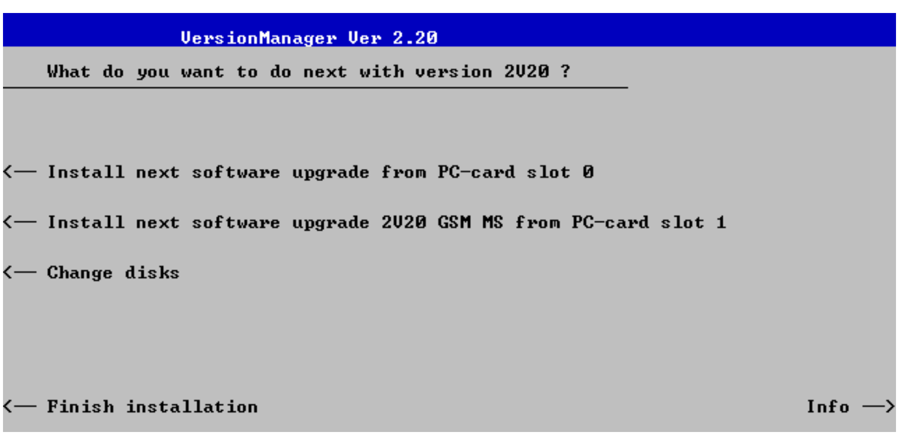
With a new base software version, it is possible to either update an existing configuration or create a new one. A dialog selecting between the two alternatives is opened:



Note: *This dialog is skipped if the new base software version is not compatible with any of the existing configurations. An incompatible new base software must be installed as a new base software.*

- If you wish to add a new configuration to your hard disk, press *Install as new base*.
- To upgrade an existing configuration with the selected base software version in order to make it compatible to the new GSM MS software option, press *Upgrade existing version*. The existing version to be upgraded must be selected in an additional dialog.

The installation is performed as described in section *Software Installation or Update*. After adding the new base software as a new configuration or updating the existing configuration, the CMU displays the following screen:



- Press left softkey no 4 or 5 *(Install next software...)* and proceed as described in section *Software Installation or Update* to install the new GSM MS version and assign it to the new configuration.

Enabling Software Options

A new CMU software option purchased is ready to operate after it is enabled by means of a key code supplied with the option. This key code is to be entered into the *Option Enable* popup window which in turn can be opened via from the *Setup – Options* menu. For details refer to Chapter 4 of the CMU200/300 operating manual.

Note: *The software options* GSM400/GT800/850/900/1800/1900-MS *and the supplementary options described in this manual, e.g.* GPRS and EGPRS for GSM MS (CMU-K42/-K43), *are part of a single software package termed* GSM MS*, so they must be installed or updated together. However, they must be enabled and operated separately. Software installation and enabling of software options are completely independent from each other.*

Contents

2 Getting Started

The following chapter presents a sample GSM mobile test with the universal radio communication tester CMU. It is intended to provide a quick overview of the function groups *GSM400/GT800/850/900/1800/1900-MS Non Signalling* and *GSM400/GT800/850/900/1800/1900-MS Signalling* and their functionality and to lead through some basic tests that are commonly performed on GSM mobile phones.

Before starting any measurement with the R&S CMU, please note the instructions given in chapter 1 of the operating manual for the CMU basic unit for putting the instrument into operation. In chapters 2 to 4 of that manual you will also find information on customizing the instrument and the display according to your personal preferences. For installation instructions for the GSM-MS software options refer to chapter 1 of the present manual.

The tests reported below include

- Connection of the phone and selection of the GSM function group,
- Power and modulation measurements in *Non Signalling* mode,
- Selection and measurement of signalling parameters,
- BER tests.

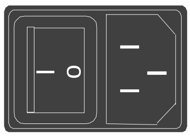
The steps to perform are explained on the left side of each double-page together with the results obtained on the CMU screen. On the right side, additional information is given. We also point out alternative settings and related measurements which could not be reported in detail.

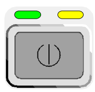
The principles of manual operation are discussed in chapter 3. For a systematic explanation of all menus, functions and parameters including GSM background information refer to the reference part in chapter 4.

Tip: *The Measurement Wizard (see p. 2.27 ff.) provides predefined settings for typical test scenarios. For many applications, selecting a predefined setting is the simplest and fastest way of configuring the instrument.*

Preparing a GSM Mobile Phone Test

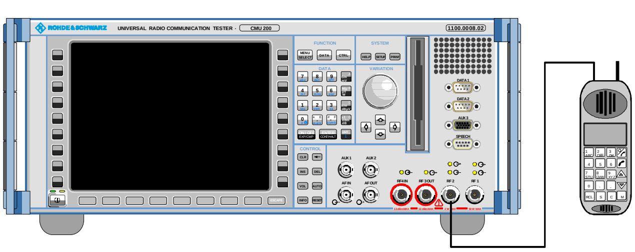
This chapter describes how to use the CMU for GSM mobile phone tests. As a prerequisite for starting the session, the instrument must be correctly set up and connected to the AC power supply as described in chapter 1 of the operating manual for the CMU basic unit. Furthermore, the GSM software must be properly installed following the instructions given in chapter 1 of the present manual.





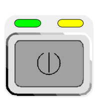
Step 1

- Switch on the CMU using the mains switch at the rear. ①
- Check the operating mode of the instrument at the *ON/STANDBY* key on the front panel.②



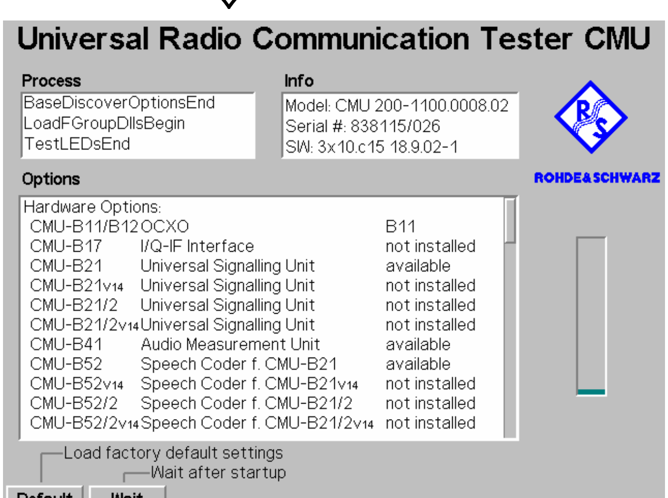
Step 2

- Connect the bi-directional RF connector RF 2 of the CMU to the antenna connector of the mobile phone. ③
- Supply the mobile phone with the correct operating voltage (battery or power supply).④



Step 3

- Switch on the CMU by means of the *ON/STANDBY* key on the front panel.



The startup menu is displayed while the CMU performs a power-up test. ⑤

After a few seconds the CMU displays the last menu used in the previous session.

- Press the *RESET* key to open the *Reset* popup menu.
- Select *Reset* and press the *ENTER* key.
- In the popup window opened, select *Yes* to confirm the instrument reset.

The CMU indicates that it performs a general reset of all device settings and is then ready to carry out the following steps. The *Reset* popup menu is closed automatically.

Additional Information...

... on Step 1

① **Mains switch on the rear panel**

When the mains switch at the rear is set to the OFF position, the complete instrument is disconnected from the power supply. When it is set to the ON position, the instrument is in standby mode or in operation, depending on the position of the *ON/STANDBY* key on the front panel.

② ***ON/STANDBY* key on the front panel**

The *ON/STANDBY* key at the front of the instrument determines whether the instrument is in standby mode or in operation.

Standby mode:
Only the reference frequency oscillator is supplied with operating voltage, and the orange LED (STANDBY) is illuminated.

Operation:
The green LED (ON) is illuminated and all modules of the instrument are supplied with operating voltage.

Alternative Settings and Measurements

☞ chapter 1 of CMU manual

... on Step 2

③ **RF connection of the mobile phone**
A high-quality cable should be used for this connection, ideally with an attenuation of less than 0.5 dB. For portable phones, the car installation set supplied by telephone manufacturers can be used.

④ **Power supply for the mobile phone**
In case the mobile phone is operated from an external power supply, make sure that it is capable of supplying the maximum peak current required. As GSM mobile phones generate pulse-like RF signals, they often feature a pulse-shaped current consumption. Problems may arise if power supplies are used which cannot provide such currents with a constant voltage.

The CMU provides two bidirectional RF connectors RF1 and RF2 differing by their permissible input and output levels. RF1 is the recommended standard connector for GSM mobile phones, RF2 for handheld phones (see data sheet).

The unidirectional connectors RF4 IN and RF3 OUT are intended for connection of modules requiring high input levels or modules with low RF output levels. RF4 IN and RF3 OUT can also be used to connect GSM mobiles off the air via antennas.

Input and output connectors can be selected in the *RF* tab of the *Connect. Control* menu.

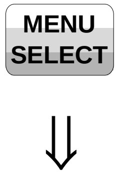
... on Step 3

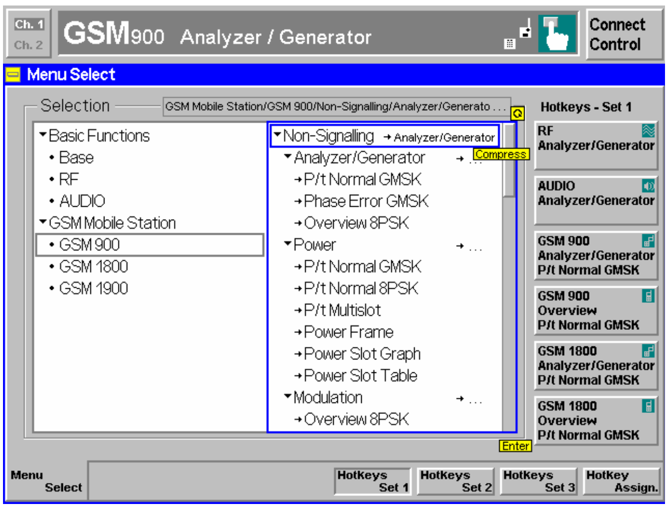
⑤ **Startup menu**
The startup menu displays the following information:

- The startup procedure (*Process)*
- Instrument model, serial number and version of the CMU base software *(Info)*
- Installed hardware and software options and equipment *(Options)*. Available software options are listed with their version numbers.
- Progress of the startup procedure (*Startup* bar graph).

☞ chapter 4 of CMU manual

That chapter also contains information on customizing the CMU.





Step 4

➢ Press the *Menu Select* key to open the *Menu Select* menu.①

The *Menu Select* menu indicates the function groups available. If a function group is selected the corresponding modes and measurement menus are indicated.

➢ Select the GSM900-MS function group.

➢ Select the *Non-Signalling* mode

➢ Select the *Analyzer/Generator* menu.

➢ Press the *Enter* key to activate the measurement selected and open the *Analyzer/Generator* menu.

Additional Information...

... on Step 4

① **Menu Select menu**

The *Menu Select* menu shows all function groups installed on your CMU. All function groups GSMxxx-MS are subdivided in the two measurement modes *Non Signalling* and *Signalling*, each containing a number of measurement menus.

Alternative Settings and Measurements

☞ chapter 3

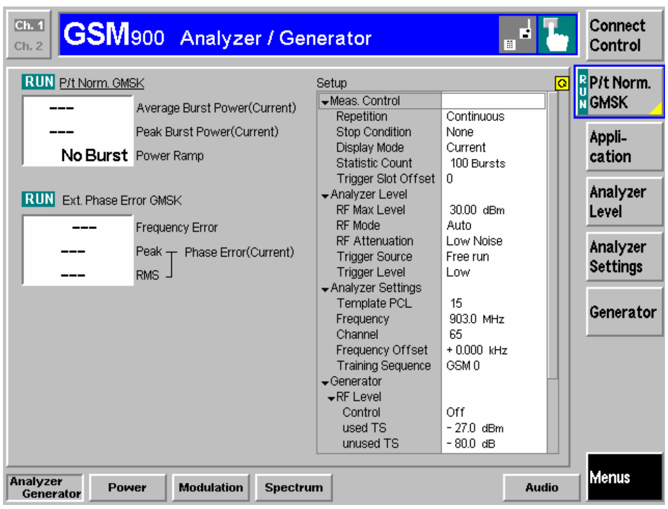
☞ chapter 4

Frequently used measurement menus can be stored together with their function group and mode and assigned to one of the eight hotkeys. When needed for the next time, they can be called up by a single keystroke. See also chapter 4 of the CMU manual.

Non Signalling Mode

In the *Non Signalling* mode, a GSM-specific RF signal can be generated and a RF signal with GSM characteristics can be analyzed. Compared to the *Signalling* mode test times may be reduced considerably. Moreover, the measurements are not restricted to the specified channel and MS output power ranges of the network. The most common application is module test and test of mobiles in a special *test mode*.

In our example we use the GSM signal generated by the CMU itself to demonstrate the main features of the *Non Signalling* mode. This is analogous to the *RF* measurement example in the CMU operating manual.

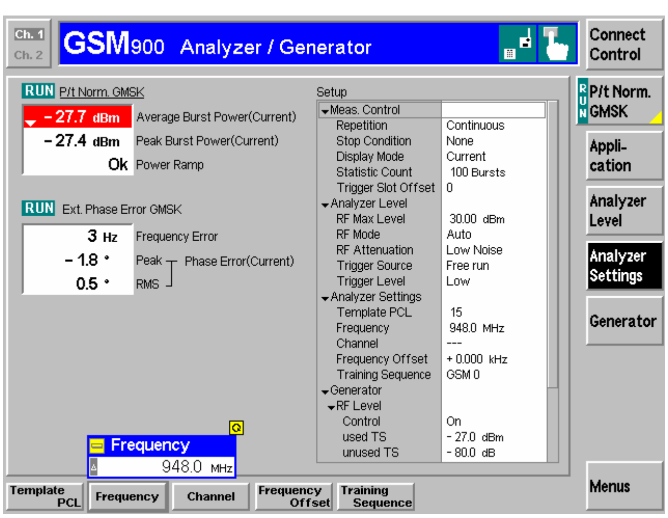


Step 1

The *Analyzer/Generator* menu contains softkeys and hotkeys to configure the RF generator signal of the CMU and to define the RF analyzer settings.②

Moreover, the current measurement results for power, frequency and phase errors of the received signal are displayed. ③

At present, all parameters are set to default values. They can be directly changed by means of the softkeys and hotkeys. User-defined parameters will be saved to the non-volatile RAM for later sessions when the CMU is switched off.



- ➢ Proceed as outlined in section *RF Non Signalling Measurements*, chapter 2 of CMU200 operating manual to connect RF1 to RF2 via a coax cable. Open the *Connection Control* menu and perform the appropriate RF input and output settings.
- ➢ Adapt the *Analyzer Settings – Frequency* setting to the expected input signal frequency (default generator frequency).
- ➢ Press *Generator – RF Level* and the ON/OFF key to switch on the generator.

The analyzer adapts itself to the RF input level (autoranging). ④

The measurement results are indicated in the *P/t Norm. GMSK* and *Ext. Phase Error GMSK* output fields.

- ➢ Select (press) the *Power/t Norm. GMSK* softkey.

Additional Information...

... on Step 1

② Analyzer/Generator menu

The *Analyzer/Generator* menu contains three with associated hotkeys used to

- Define the RF input signal path and the trigger settings *(Analyzer Level)*
- Set the CMU RF analyzer *(Analyzer Settings)* and determine the RF input signal that can be measured
- Control the RF generator *(Generator)* and define the parameters of the RF output signal generated.

The assignment between carrier frequency and channel number is according to GSM specifications. As the CMU simulates a base station, the generator signal corresponds to the downlink (signal direction from the base station towards the mobile station), the signal analyzed corresponds to the uplink (signal direction from the mobile station towards the base station). The channel/frequency assignment changes accordingly.

The RF frequency can be set in multiples of 200 kHz. With an additional *Frequency Offset*, an RF signal with an arbitrary frequency that is in the range supported by the tester can be generated and analyzed. In general, the RF generator level is set to be different for the used timeslot and unused timeslots. The level of the unused timeslots is defined relative to the level in the used timeslot.

Alternative Settings and Measurements

☞ chapter 4, p. 4.2 ff.

The *Analyzer/Generator* settings are also provided in the *Analyzer* and *Generator* tabs of the *Connection Control* menu. See also notes on *Softkeys and hotkeys* on p. 2.11.

Selecting a definite training sequence (TSC) or bit modulation or transmission mode in the *Generator Modulation* panel implies that signals with these characteristics are generated.

Selecting a definite TSC in the *Analyzer Settings* panel implies that only signals with this TSC are analyzed.

③ Measurement and Generator State

The state of the *Power/t Norm. GMSK* measurement is indicated in the corresponding softkey (measurement control softkey) and above the output fields for the results. The state of the RF generator is indicated in the *Generator – RF Level* softkey.

For ongoing measurements, the results in the output fields are constantly updated. All measured quantities refer to the current burst. The default tolerance template for the power ramp is defined according to GSM specifications. For various reasons, an output field may fail to show a valid measurement result (indication "---"):

- The analyzer settings do not match the properties of the input signal.
- The input signal is missing.
- The measurement is switched off *(OFF* is indicated in the softkey controlling the measurement).

The current options for the measurement status are *ON* (default) and *OFF*. A third state, *HLT*, occurs after a single-shot measurement is terminated (see below).

Once selected, the *Power* or *Modulation* measurement can be switched off and on again by means of the toggle key *ON/OFF*.

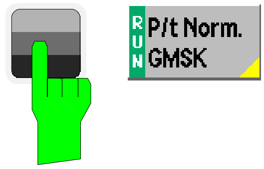
Generators may also be switched on (state *ON)* and off (state *OFF)* by means of the *ON/OFF* key.

④ Max. Level

The autoranging mechanism adjusts the RF input path to the applied signal. Alternatively, the expected signal level (for GMSK-modulated GSM signals, the average RF input level plus an appropriate margin of a few dB) can be set via Analyzer Level – RF Max. Level.

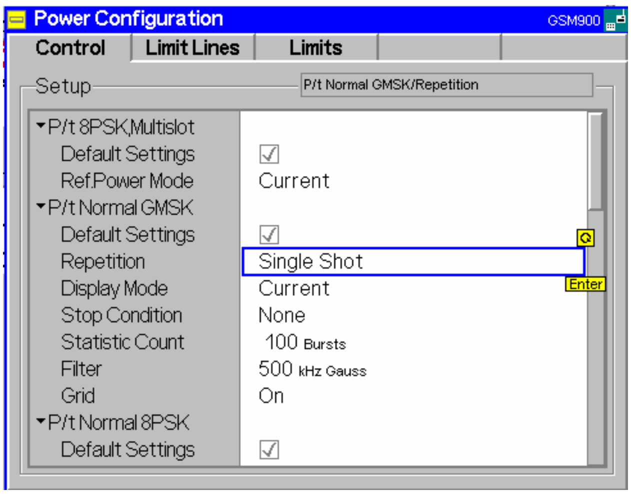
☞ Chapter 4, p. 4.82 ff.

The permissible range *Max. Level* depends on the RF connector and the external attenuation used.



Step 2

➢ Press the selected *Power/t Norm. GMSK* softkey again to call up the *Power Configuration* menu.



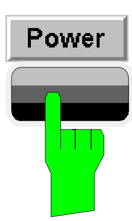
In the *Control* tab, the *Power Configuration* menu defines the scope of the *Power* measurement. The settings offered in this menu are discussed in section *General Settings* in chapter 3. We pick just one example, limiting the number of bursts measured.①

➢ Press the *ON/OFF* key or the rotary knob to expand the table.

➢ Select *Single Shot* in the *Repetition* line.②

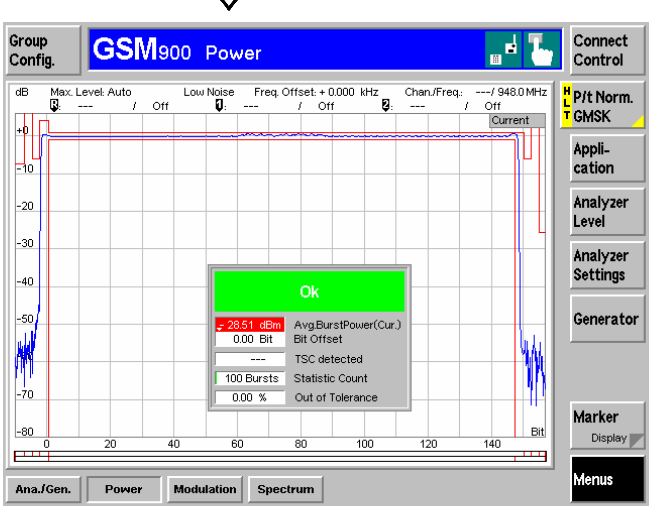
➢ Press the *ESCAPE* key or the *Power* softkey again to close the *Power Configuration* menu and return to the main menu.

The *Power* measurement is stopped after one statistic count. The status indication next to the *Power* softkey is set to *HLT*.③



Step 3

➢ Press the *Power* hotkey to switch over to the graphical menu *Power*.



The *Power* menu shows the power of the current burst as a function of time. ④

Together with the burst power, a tolerance template as specified in the GSM standard (here: for GMSK-modulated normal bursts) is displayed. Settings (at present, the default settings) and scalar results are displayed in two parameter lines above the diagram and in a message box positioned in the center of the diagram.

Various tools allowing to take a closer look at the measurement results are provided in the graphical measurement menu.

Additional Information...

... on Step 2

① **Power Configuration menu**

The *Power Configuration* menu contains three tabs defining

- Measurement control and statistical settings *(Control),*
- The tolerance template for the burst *(Limit Lines),*
- PCL-dependent limits for the average burst p*ower (Limits)*

② **Repetition mode and Stop Condition**

If no stop condition is imposed *(Stop Condition = None),* the *Repetition* mode determines whether the measurement is

- Continued until explicitly stopped by the operator *(Continuous),*
- Stopped after one statistic count *(Single Shot).*

By default, a statistic count comprises 100 bursts. With *Stop Condition = On Limit Failure*, the measurement is stopped after the first burst which is out of tolerance.

③ **Measurement in the HLT state**

The average and peak power of the last burst measured is indicated in the output fields *Average* and *Peak*.

In contrast, the modulation measurement is still running. The results for the frequency and phase errors are periodically updated.

... on Step 3

④ **Power menu**

The diagram in the *Power* menu, application *Power/t Norm. GMSK* shows a normal burst with a length of 148 bits (plus a guard period of 8.25 bits). The time scale of the diagram ranges from –10 bits to 156¾ bits covering the useful part, the rising and falling edges of the burst. The ordinate ranges from –80 dB to +10 dB, the 0-dB reference level is equal to the carrier power.

Note that settings made previously (*Power Configuration* menu) are preserved in the whole measurement group. Accordingly, the status of the measurement is still *HLT.* The diagram is fixed showing the last burst measured.

Alternative Settings and Measurements

☞ chapter 3.

Settings made in the *Power Configuration* menu apply to power measurements only.

Settings made in the *Connect. Control* menus apply to the entire function group and mode *GSM900-MS Non Signalling*.

☞ chapter 3.

The *Statistic Count* is defined in the *Control* tab of the *Power Configuration* menu.

The stop condition *On Limit Failure* should be selected if the limit check represents the main purpose of the measurement.

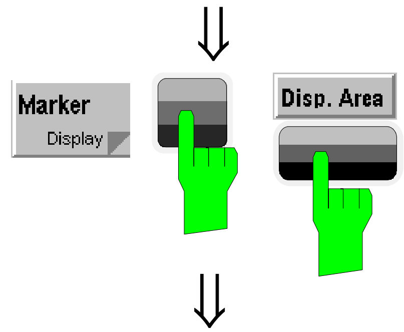
The limits can be modified in the *Limit Lines* tab of the *Power Configuration* menu.

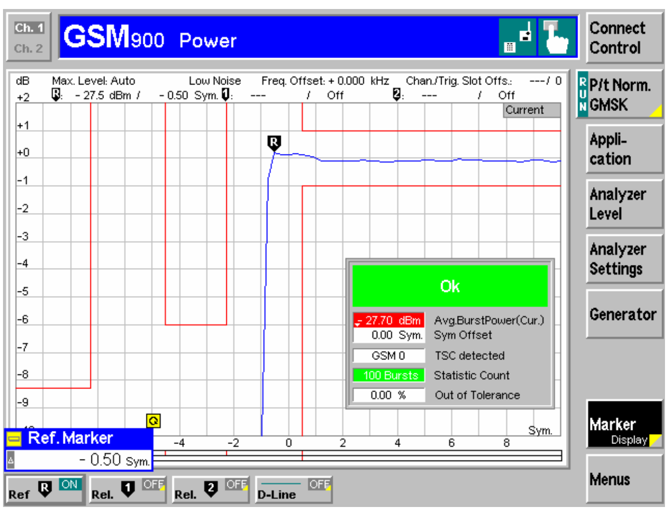
☞ CMU manual

See the sections on measurement control in chapter 3 and 5.

☞ chapter 4, p. 4.9 ff.

The GSM power template is defined relative to the carrier power. For low signal powers, a looser absolute limit is to be applied at the beginning and the end of the power ramp (areas 1, 2, 7, and 8). This yields the distorted template that we observe in the present example.





Step 4

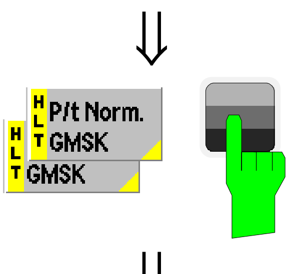
- ➢ Press the *Marker/Display* softkey twice to change the hotkeys displayed below the diagram.①
- ➢ Press the *Display Area* hotkey to open a window offering a list of different zoom areas.

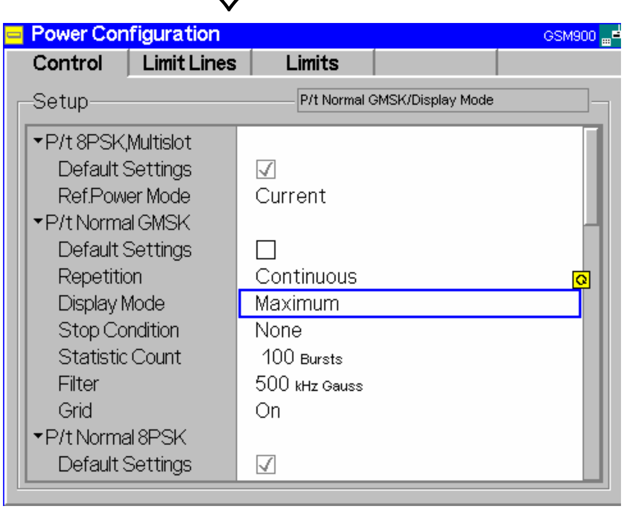
If you select *Left Upper Corner* the CMU zooms in on the left upper corner of the burst.

- ➢ Press the *Display/Marker* softkey twice and the *Ref R* hotkey. Enter an abscissa value (in bits) to position a reference marker onto the trace.②

The coordinates (time and burst power) of the reference marker are displayed in the second parameter line.

For the next step we'll take advantage of the fact that the configuration menu is accessible from the graphical menu as well.





Step 5

- ➢ Press the *Power/t Norm. GMSK* softkey twice to reopen the *Power Configuration* menu.
- ➢ Press *ENTER* or the rotary knob to expand the table.
- ➢ Select *Continuous* from the *Repetition* field to restart the measurement and confirm with *ENTER* or by pressing the rotary knob.
- ➢ From the *Display Mode* field, select *Maximum*.③
- ➢ Press *ESCAPE* or the *P/t Norm. GMSK* softkey again to close the configuration menu.

Instead of the current burst power, the diagram shows the maximum burst power measured at each time. As no stop condition is set, the measurement will be running until it is explicitly terminated.

Additional Information...

... on Step 4

① Softkeys and hotkeys

To enlarge the diagram area of the graphical measurement menus the left softkey column is suppressed. The functionality of each softkey on the right side is extended by hotkeys assigned to the softkeys. These hotkeys are displayed across the hotkey bar below the diagram when the softkey is selected.

Some of the softkey/hotkey combinations offer settings that can be also accessed via configuration menus. For example, the *Analyzer Level* settings are equivalent to the settings in the *Input Level* and *Trigger* section in the *Analyze*r tab of the *Connection Control* menu. Identical settings overwrite each other; the last value entered is valid for the whole function group and test mode.

② Markers

Markers are a graphical tool used to locate points on a trace and read out their coordinates. A reference marker and two delta markers may be defined in the *Power* menu.

The reference marker measures the absolute level of the trace, the delta markers and measure the absolute level or (if set to relative) the distance between their position and the reference marker.

... on Step 5

③ Display mode

If the measurement extends over several bursts the CMU calculates four different traces one of which can be selected in the *Display Mode* field. The purpose of the four traces is to give an overview of the range and arithmetic mean of the levels detected at any point on the time axis. The following traces can be displayed:

Current	Current burst level
Maximum	Maximum of all burst levels measured
Minimum	Minimum of all burst levels measured
Average	Weighted average of all burst levels measured, see averaging prescription in chapter 3.

The *Statistic Count* input field defines how many evaluation periods form a statistics cycle. For *GSMxxx-MS Non Signalling* measurements an evaluation period is equal to the propagation time of a normal burst (this definition holds even if a continuous carrier signal is transmitted). In our example the statistics cycle comprises 100 bursts (default value).

Alternative Settings and Measurements

☞ chapter 4, p. 4.9 ff.

The *Analyzer Level* softkey configures the input level and external attenuation as well as the trigger settings.

The *Analyzer Settings* softkey determines which kind of RF signal can be analyzed.

The *Generator Settings* softkey determines the RF signal generated.

The *Marker/Display* softkey sets markers and D-lines and determines the display area.

☞ chapter 4, p. 4.9 ff.

In addition to markers, a D-line can be used to measure a particular level in the diagram.

☞ chapter 3.

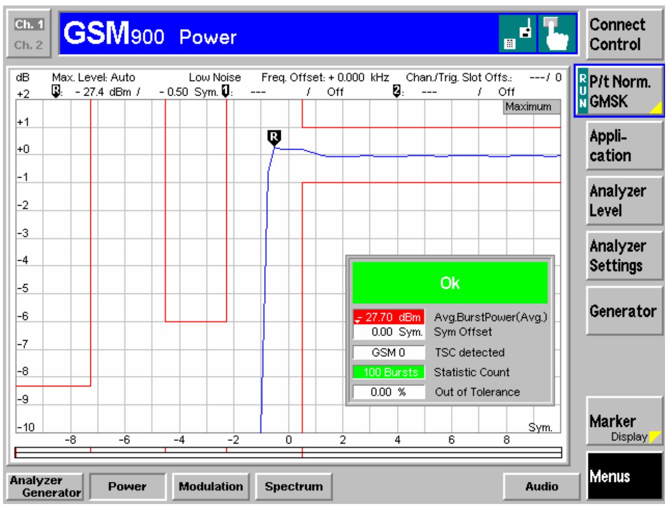
To refine the statistical evaluation, a suitable combination of the statistic count, repetition mode, stop condition and display mode can be selected.

☞ chapter 4, p. 4.29 ff.

In addition to the *Power/t Norm. GMSK* measurement, several test *applications* assessing the behavior of the average burst power over several timeslots *(P/Slot Graph, P/Slot Table)* or frames *(P/Frame)* can be selected (softkey *Application)*.

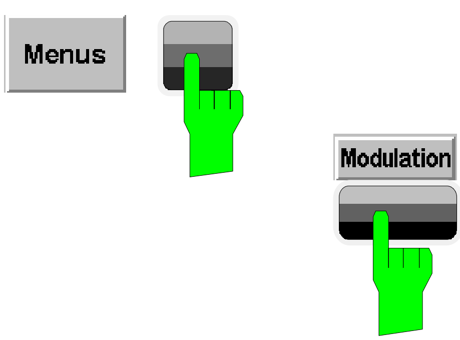
Step 6

➢ Press the ESCAPE key to close the *Power Configuration* menu and return to the main menu.



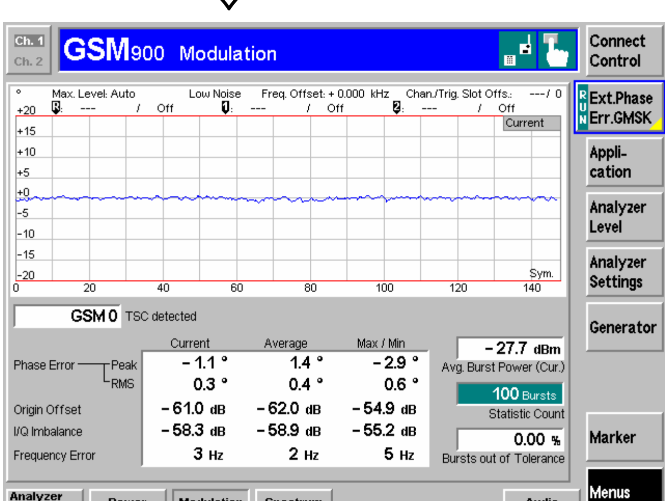
The trace is now continuously measured and updated in the display. With the display mode *Maximum,* which is indicated in the upper right corner of the diagram, trace values will be replaced only if a current measured value at a particular test point exceeds all values measured before at the same test point.

Step 7



➢ Press the *Menus* softkey to display the measurement groups available in the hotkey bar.

➢ Press the *Modulation* hotkey to open the *Modulation* menu.



The *Modulation* menu displays the results of the phase and frequency error measurement.①

The trace represents the phase error of the current burst as a function of time.②

Below, a table displays the extreme value of the phase error and the RMS phase error, the origin offset, the I/Q imbalance, and the frequency error. ③

The detected training sequence (TSC), average power of the current burst and the statistic count are shown in addition.

Additional Information...

... on Step 7

① **Phase and frequency errors**

GSM equipment can use different modulation schemes; the basic scheme is GMSK modulation, which is a constant-envelope, binary, differential phase-shift keying scheme. It is important that the modulation scheme is adhered to as strictly as possible. GSM specifies a peak phase error of max. 20°, a RMS-weighted phase error of max. 5° and a frequency error of max. 0.05 ppm of the transmit frequency.

The limits may be modified in the *Limits* tab of the *Modulation Configuration* Menu which is opened by pressing the selected *Ext. Phase Err. GMSK* softkey once again. The *Modulation Configuration* menu is analogous to the *Power Configuration* menu explained on the previous pages. According to the requirements of the measurements the two configuration menus differ in two points:

- Phase errors are relevant within the useful part of the burst. Therefore, a fixed upper and lower limit for the phase error is specified. It is not necessary to discriminate between different areas of the burst (see item ② below).
- The absolute value of the phase error is a measure of the quality of modulation, whereas the sign is of secondary interest. This is why the display modes *Minimum* and *Maximum* can not be selected separately, the CMU displays the extreme values instead (display mode *Minimum/Maximum*).

② **Measurement curve**

The diagram in the *Modulation* menu shows the useful part of a normal burst with a length of 148 bits, The time scale of the diagram, ranging from 0 bits to 146¾ bits, is thus shorter than in the *Power/t Norm. GMSK* diagram. The ordinate is symmetric around 0 , ranging from –20 dB to +20 dB.

③ **Statistical quantities**

The table below the phase error diagram gives an overview of the phase error averaged over the current burst *(Phase Error RMS),* the extreme value of the current phase error *(Phase Error Peak),* the current Origin Offset and I/Q Imbalance, the current frequency error, and the statistical distribution of these three quantities. The values in the three columns are calculated as follows:

- The *Current* column contains the frequency error, RMS-averaged phase error and peak *(Max./Min.)* phase error for the current burst.
- The *Average* column contains the three quantities averaged over the last statistics cycle.
- The *Maximum* column contains the extreme values of the three quantities within all bursts measured.

Alternative Settings and Measurements

☞ chapter 4, p. 4.42 ff.

The measurement principle for phase and frequency errors is explained at the beginning of section *Measurement Menu (Modulation – GMSK).*

For configuration settings see section *Measurement Configurations (Modulation Configuration).*

As a second modulation scheme, the CMU supports 8PSK-modulated traffic channels (in the so-called EDGE channels).

☞ chapter 4, p. 4.45 ff.

☞ chapter 3.

In this chapter a comprehensive description of measurement control and on the definition of statistical quantities is given.

☞ chapter 4, p. 4.45 ff.

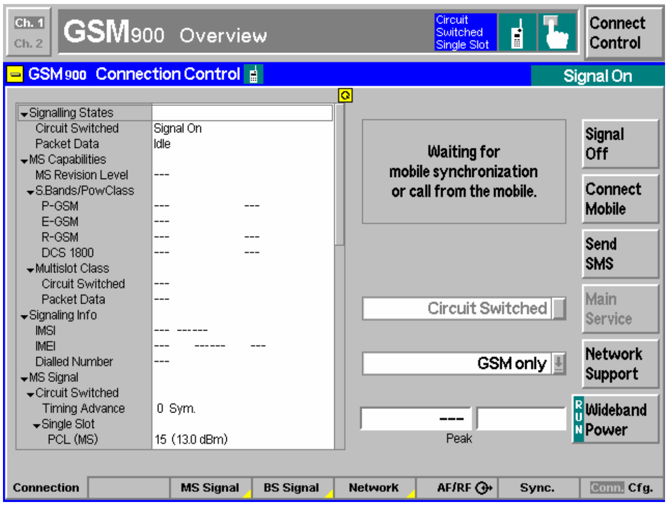
As a last measurement group in *Non Signalling* mode, the *Spectrum* measurement assesses the off-channel power due to the modulation and due to switching.

Signalling Mode

In the *Signalling* mode the CMU first transmits a control channel signal to which the mobile is able to synchronize. A call can then be established from either the CMU or the mobile. The measurement must be synchronized to the signal transmitted by the mobile; an external trigger signal can not be used.

Call Setup and Signalling Parameters

The signalling processes and configurations are controlled via the *Connection Control* popup menu. A control channel signal is switched on and the second of several *Connection* tabs contained in the *Connection Control* popup menu is automatically displayed when the *Connection* test mode is selected (see *Menu Select* menu on page 2.4; for the following examples, *GSM1800-MS Signalling Meas*. with the *Overview* menu was selected, and another *RESET* was performed).



Step 1

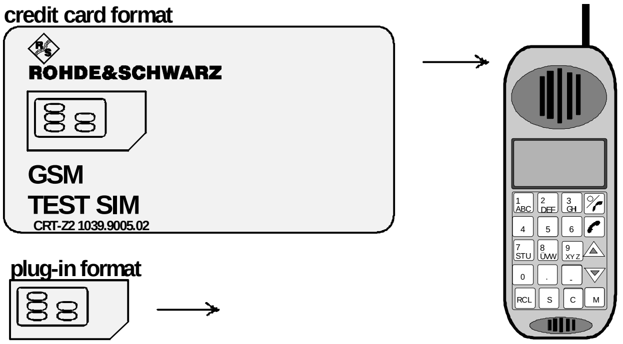
The *Connection (Signal On)* tab indicates the current signalling states, the characteristics of the mobile phone and those of the signals generated by the CMU ① and the MS under test.

In addition the network identity and the characteristics of the input and output connectors are shown. ②

The softkeys on the right side of the menu lead to other signalling states. The *Main Service* and *Network Support* softkeys are for switchover to GPRS signalling tests. ③

The *Wideband Power* softkey shows the current status of the wideband peak power measurement and its ratio to the maximum input power *(Max. Level)* set in the *MS Signal* tab menu. At present, the wideband power measurement is switched on, however, no signal is received because no call connection with the mobile phone has been established.

⇓



Step 2

- ➢ Insert a test SIM card of the appropriate size into the phone and switch on.④
- ➢ If requested, enter the PIN number followed by #.
  (PIN No. of Rohde & Schwarz test SIM card: 0000). ⑤
- ➢ Make sure that your mobile is connected to RF 2 (default input/output).

⇓

Additional Information...

... on Step 1

① **BS Signal**

The CMU is able to generate two different RF carrier signals (traffic channel and BCCH control channel) which can be configured separately. This allows a complete simulation of what happens in a real GSM network.

② **Network Identity, RF**

The network is identified by the three code numbers MCC (mobile country code), MNC (mobile network code) and NCC (national color code). These codes are transmitted to the mobile station on the control channel. The CMU uses the default settings shown in the diagram on the left side.

Input/output connectors suitable for the type of measurements and signal levels must be chosen – see section *RF connection* on page 2.3. An external input/output attenuation value can be specified in order to compensate for known attenuations of the input/output signal like those caused by cables.

② **GPRS signalling**

With option CMU-K42 the CMU is also able to set up a TBF connection to a GPRS mobile phone and perform transmitter and receiver tests in a GPRS test mode.

... on Step 2

④ **SIM card, test SIM**

Two types of SIM card are specified for use in the GSM system, one the size of a credit card and the considerably smaller plug-in SIM of about 15 x 20 mm. One SIM card must be inserted in the mobile phone in order to set up a call. However, it is also possible to make an emergency call without any card by entering 112.

⑤ **Pin number**

Use care when entering the PIN number as only three false tries are allowed before the card is automatically blocked. It can be unblocked by entering the PUK number which is either known or can be obtained from the company that issued the card. See also the appropriate section in the operating manual of your mobile phone.

Alternative Settings and Measurements

☞ chapter 4, p. 4.184 ff.

The control and traffic channels are configured in the *BS Signal* tab of the *Connection Control* menu. To access this card press the associated hotkey.

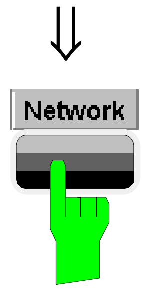
☞ chapter 4, p. 4.192 ff.

The network identity and other parameters characterizing the network are configured in the *Network* tab of the Connection Control menu. To access this card press the associated hotkey (see below).

Input/output connectors and external attenuations are configured in the *RF /* tab.

☞ chapter 4, p. 4.213 ff.

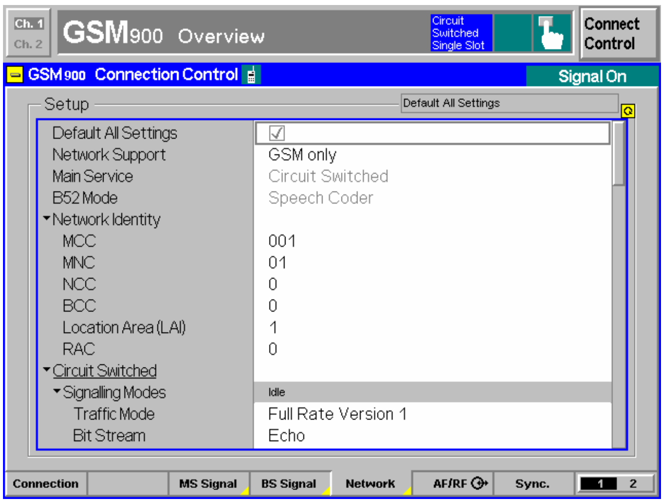
Most mobile phones require a so-called test SIM card in order to test the sensitivity (bit error rate and related quantities) in a test mode. A test SIM card is available from Rohde & Schwarz with the designation CRT-Z2 (id. no. 1039.9005.02). It features credit card size and can be easily converted to "plug-in" format.



Step 3

➢ Press the *Network* hotkey.

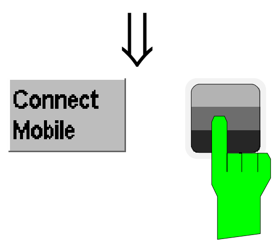
The *Network* tab is displayed.



The *Network* tab defines a variety of parameters concerning the network and the operating mode of the mobile station.

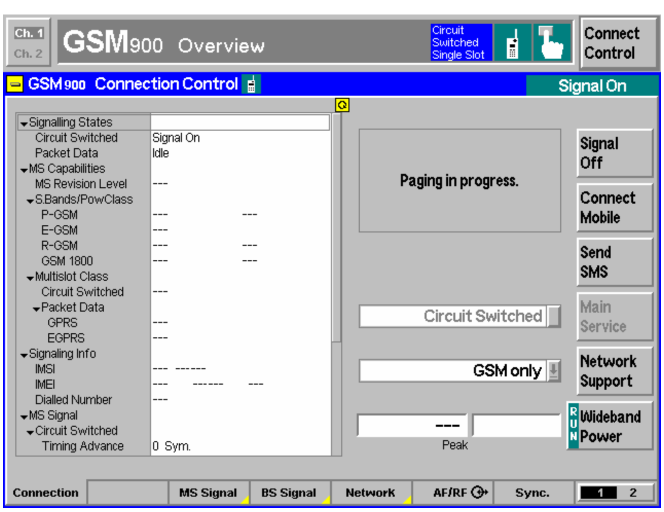
The purpose of these settings is to simulate the operating conditions of a mobile station in the GSM network as realistically as possible. Many of the settings have a direct impact on the speed of the *Signalling* measurements. ③

➢ Press the *Connection* hotkey to return to the *Connection (Signal On)* tab.



Step 4

➢ Press the *Connect Mobile* softkey.



The header message *Paging in progress* is displayed. When the mobile has synchronized to the BS signal and starts ringing, the *Connection (Alerting)* tab is displayed. ①

The *Connection (Alerting)* tab indicates the most important parameters characterizing the mobile phone *(MS Capabilities)*. ②

Additional Information...

... on Step 3

③ **Network parameters**

The purpose of network parameter settings in the mobile test can be rather different from the original purpose (in the real GSM network). We illustrate this with two examples:

The *BA list (base station allocation list)* informs the mobile about the channels available in a given area. The mobile uses the BA list to determine to which RF channel it will receive the next handover request. The CMU uses the *BA list* to test a mobile when the synthesizer is jumping continuously from channel to channel and the software has to organize this, to evaluate and report the results.

In the *DTX (discontinuous transmission)* mode the mobile transmits traffic channel frames only when there is voice or data to be transmitted. This mode is used mainly in order to save mobile battery power. In the test mode, a DC current measurement during DTX will provide information about a possible leaking component of the mobile. No continuous *Power* measurements can be done while DTX is enabled.

... on Step 4

① **Location update**

The information transmitted by the CMU on the control channel requests the mobile phone to perform a location update procedure after switching-on. This is similar to a registration procedure in analog and other digital networks and serves to inform the base station that a certain mobile has been switched on now and is available for calls.

② **MS Capabilities**

The *MS Capabilities* list shows the basic properties of the connected mobile station which are transmitted to the CMU.

- The *international mobile subscriber identity (IMSI)* consists of the 3-digit mobile country code, the 2-digit mobile network code and the 10-digit mobile subscriber id. no.
- The *international mobile station equipment identity (IMEI)* consists of the 6-digit type approval code, the 2-digit final assembly code, the 6-digit serial no. and the 1 or 2-digit software version no.

The following hardware-related parameters determine the maximum output power of the mobile station:

- Power class (1 to 5)
- MS revision level (phase I or II)

Alternative Settings and Measurements

☞ chapter 4, p. 4.192 ff.

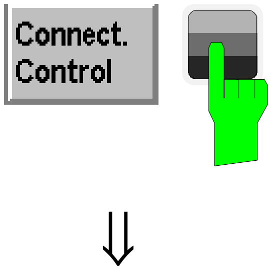
☞ chapter 4, p. 4.192 ff.

The *Location Update* parameter in the *Network* tab determines in which cases a location update is performed.

☞ chapter 4, p. 4.167 ff.

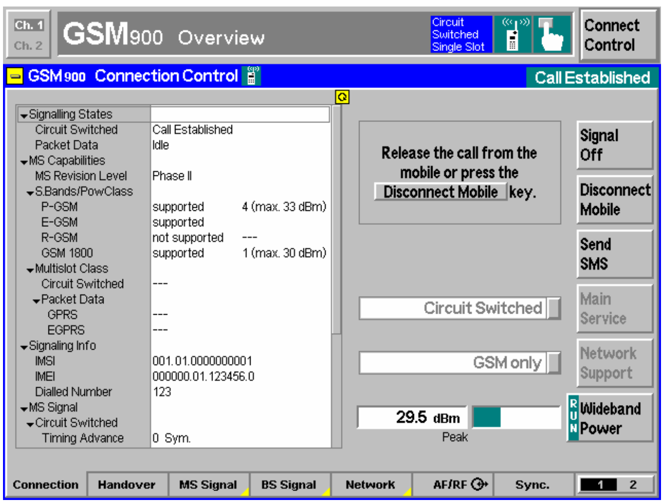
A comprehensive list of mobile station properties is displayed in the *Call Established* signalling state.

Power classes and GSM revision levels are listed with their maximum output power in section *Limits for the Average Burst Power* in chapter 4.



Step 5

- ➢ Accept the call at your phone.
- ➢ Press *Connect. Control* to reopen the *Connection Control* menu.



The *Connection (Call Established)* presents a comprehensive list of the signalling parameters for the current connection (see *MS Capabilities* on page 2.17).

The power control level of the mobile station ① and the parameters of the traffic channel signals transmitted by the CMU ② can still be configured in the *MS Signal* and *BS Signal* tabs of the *Connection Control*, respectively.

- ➢ Press the *Escape* key to close the *Connection Control* menu and return to the *Overview* menu.

Additional Information...

Alternative Settings and Measurements

... on Step 5

① **Power control level (PCL)**

Dynamic power control is used in GSM networks to reduce the output power of the mobile station as far as possible. In practice the base station sets the mobile power on a dimensionless scale of *power control levels (PCL)* ranging from 0 to 31. In GSM900, PCL 0 corresponds to the largest nominal output power (39 dBm), power control levels between 16 and 31 can be set for phase II mobiles only.

In contrast to the PCL the *power class* characterizes the nominal maximum output power of the mobile. Depending on the power class of the mobile the range of possible PCL settings may be restricted.

☞ chapter 4, p. 4.127 ff.

PCL levels and power classes are listed in section *Limits for the Average Burst Power* in chapter 4.

② **Traffic channel**

The channel number of the BS traffic channel signal is defined according to GSM specifications as explained for the *Non Signalling* mode (downlink, see *Analyzer/Generator menu* on page 2.7).

The traffic channel can be fixed or changed periodically (frequency hopping). Frequency hopping is defined by means of one of the four hopping sequences A, B, C, D.

With the CMU basic unit timeslots 2 to 6 may be selected for the traffic channel because the timeslots 0, 1, and 7 are occupied by the BCCH and for reconfiguring.

☞ chapter 4, p. 4.184 ff.

Besides the four GSM standard hopping sequences A to D arbitrary sequences consisting of up to 64 channel numbers may be defined and used.

Out-of-tolerance power measurements

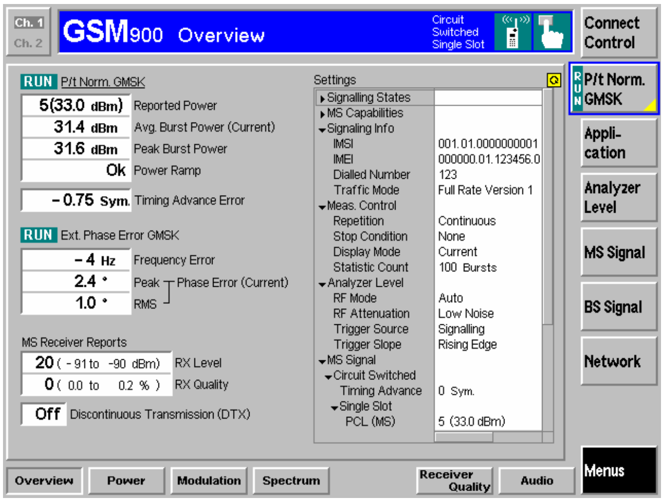
If a power measurement is out of tolerance, please ensure that the attenuation of any cables and/or antenna couplers used is being taken into account by the CMU. As some GSM power levels must be within ±2 dB of the nominal value given in the specifications, even a small attenuation can result in an out-of-tolerance measurement.

External attenuation values for each input/output may be entered in the *RF* ⊙→ tab of the *Connect. Control* menu

The cables, RF connections and antenna couplers must also be in good condition for satisfactory measurements. Dirty or broken RF connections can cause problems at the high frequencies used by GSM networks.

Receiver Reports and Power Measurements

Besides the signalling parameters discussed above the receiver reports of the mobile station are transmitted to the CMU. Power and modulation measurements can be performed as in the *Non Signalling* mode.

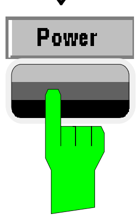


Step 1

The *Overview* menu indicates the most important settings in the function group *GSM900-MS Signalling* and the main results of the *Power* and *Modulation* measurements (output fields *Ext. Phase Err. GMSK).* Moreover the receiver reports of the mobile station are displayed. ①

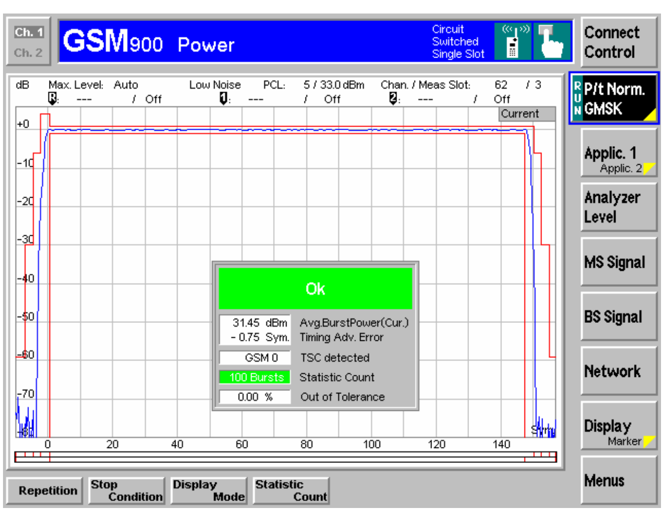
Power and *Modulation* measurements can be performed in close analogy to the measurement of GSM signals in the *Non Signalling* mode. The differences between the two modes are related to the settings which can be made at the mobile station.

⇓



Step 2

➢ Press the *Power* hotkey to switch over to the graphical menu *Power*.



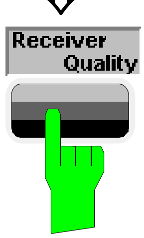
The *Power* menu shows the power of the current burst as a function of time. Like in the *Non Signalling* mode the menu contains an *Application (Applic. 1 or 2)* softkey.

➢ Press the *Applic. 1* softkey to change the hotkeys displayed below the diagram.②

➢ Press the *P/PCL* hotkey to measure the average burst power as a function of the mobile's power control level.

➢ Press the *MS Signal* softkey to check the PCL *(PCL* hotkey) and traffic channel number *(Channel* hotkey) set. ③

⇓



Step 3

➢ Press the *Menus* softkey and the *Receiver Quality* hotkey to switch over to the *Receiver Quality* menu.

Additional Information...

... on Step 1

① MS Receiver Reports

GSM mobile phones continuously measure the signal strength and quality of several nearby base stations. The measured values for the active base station (serving cell BTS) are regularly sent to the CMU in the so-called measurement reports.

The received signal input level (RX Level) is expressed in terms of dimensionless power levels ranging from 0 to 63. These levels depend linearly on the absolute signal levels measured in dBm. A high power level implies a high received signal input level.

The received signal quality (RX Quality) is expressed in terms of dimensionless quality levels (actually “error levels”) ranging from 0 to 7. The quality levels depend linearly on the logarithm of the bit error rate. A high quality level implies a high bit error rate and thus a poor received signal quality.

Alternative Settings and Measurements

☞ chapter 4, p. 4.154 ff.

The exact definition of RX Level and RX Quality is given in section *Panel MS Rcv. Reports – Received Results of the Mobile Phone.*

The dependence of RX Level and RX Quality on the CMU’s output level can be quickly checked by varying the *TCH Level* in the used timeslot.

Different TCH levels can be set in the used timeslot and in the unused timeslots. This is useful for some tests specified by GSM.

... on Step 2

② P/PCL Measurement

The *P/PCL* measurement forms the second application in the measurement group *Power*. In this application, the average burst power of the mobile can be measured over the whole range of power control levels and for up to three different channels at once. The PCLs and channels to be measured can be selected; the total measurement time is below 3 s.

☞ chapter 4, p. 4.112 ff.

The different „applications“ *Power/t Norm. GMSK, P/PCL* etc. split up the measurement group *Power* in several related subgroups.

For a general discussion of measurement control and applications see chapters 3 and 5.

③ PCL/Channel and Trigger

The PCL set for the mobile station and the traffic channel number can be checked and modified, if required, in the *Power* menu. This is in contrast to the *Non Signalling* mode where no settings concerning the device under test can be made.

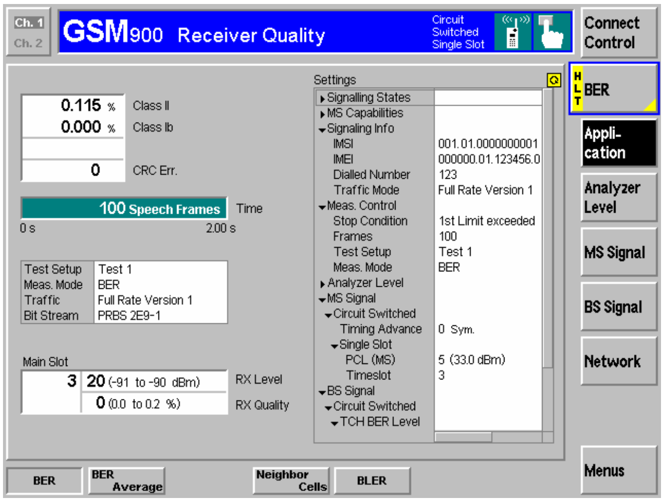
Finally the two modes differ in the trigger modes available: In the *Non Signalling* mode an external trigger signal may be used whereas in the *Signalling* mode the measurements must be triggered by the input signal *(Free Run*, *RF Power, IF Power* mode) or by the CMU's signalling unit *(Signalling* trigger).

☞ chapter 4, p. 4.113 ff.

The frame trigger signal *(Signalling* trigger mode) is also fed to pin 2 of the AUX 3 connector where it can be tapped off to synchronize external devices to the CMU's TDMA timing.

Receiver Quality Measurements

Receiver Quality measurements evaluate parameters which characterize the quality of transmission on the complete signal path between CMU and mobile station. To this purpose the bits sent to the mobile station are looped back and retransmitted. The CMU compares the bits received with those sent and can thus calculate the percentage of faulty bits. Most but not all mobiles require a test SIM card to enter the loop-back mode (see *SIM card, test SIM* on page 2.15).

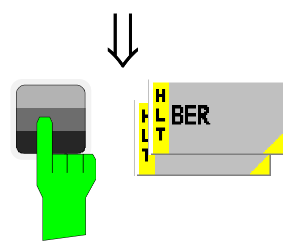


Step 1

The *Receiver Quality* menu controls the receiver quality tests and displays the measurement results together with the *RX Level* and *RX Quality* of the serving cell. This facilitates a comparison between the results reported by the mobile (RX Quality) and the sensitivity test results.

➢ Press the *Application* softkey to display all applications of the *Receiver Quality* measurement group. Select *BER*. ①

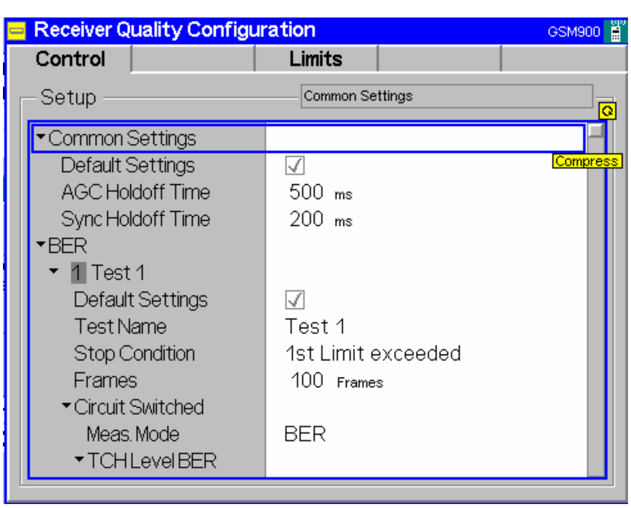
➢ Press the *BER – Meas. Mode* hotkey and select *Burst by Burst*. ②



Step 2

➢ Press the selected *BER* softkey again.

The *Receiver Quality Configuration* menu is opened.



The *Control* tab contains the parameters configuring the *Receiver Quality* measurement. Most parameters are equal or analogous to the ones used in *Power* or *Modulation* measurements. Major differences occur in the measurement modes available (*Control* tab, ②) and in the definition of the statistics count. ③

Additional Information...

Alternative Settings and Measurements

... on Step 1

① **Applications**

Within the *Receiver Quality* measurement group, the repetition modes *BER* (single shot bit error rate tests) and *BER Average* (continuous bit error rate tests) are treated as different applications. For single shot measurements, up to ten different test setups with independent parameters can be configured (see *Control* tab in the *Receiver Quality Configuration* menu).

☞ chapter 4, p. 4.145 ff.

For a general discussion of measurement control and applications see chapters 3 and 5.

② **Measurement Mode**

A number of different quantities characterizing the quality of transmission are defined:

- Bit error rate (for class II and class Ib bits)
- Residual bit error rate (for class II and class Ib bits)
- Frame erasure rate

The type of quantities measured depends on the measurement mode *(BER, RBER/FER*, or *Burst by Burst).* In the *Burst by Burst* mode which is specified for GSM phase II and phase II+ mobiles, only bits without error protection are transmitted. This enhances the speed of the bit error rate test (fast BER test).

☞ chapter 4, p. 4.145 ff.

The bit classes and measured quantities are explained at the beginning of section *Measurement Menu Receiver Quality*.

... on Step 2

③ **Statistics**

In the framework of sensitivity tests the basic evaluation period is equal to the frames used by the speech coder and consisting of 260 bits. Bursts and TDMA frames are irrelevant.

A statistics cycle thus consists of a definite number of frames.

☞ chapter 3 and 4.

Failed Receiver Quality Test

If a BER test fails check the following:

1. Ensure that the attenuation of any antenna coupler and/or cables used is being taken into account by the CMU. During the test the mobile receiver is being tested with very low RF signal levels, and even a small attenuation can cause the CMU to show a fail indication.

2. An external signal from a real network may interfere with the signal sent from the CMU to the mobile, in particular during BER tests where the output level of the CMU is reduced to as low as -104 dBm. The BER test should ideally be performed in a shielded room, however, if this is not possible, the channel(s) used for the test should be changed. If different results are obtained on neighboring channels, the problem is likely to be due to external interferences.

Condensed Measurement Examples

The measurement examples outlined on the following pages describe special applications of the R&S CMU in *Signalling* test mode. Some of the applications require supplementary software options.

Multislot Measurements with Mixed Modulation Schemes

In an EGPRS test mode connection (with option R&S-CMU-K43), a packet switched data channel is allocated between the CMU and the MS under test. The MS uses the enabled timeslots for the transmission of 8PSK modulated bursts. In addition, it is periodically stimulated to transmit a single GMSK-modulated burst.

In a *P/t Multislot* measurement, it is possible to specify the modulation scheme for each measured timeslot of an uplink multislot configuration. Only a burst sequence with matching modulation pattern will be measured. This feature can be used to pick out the occasional GMSK burst events in the uplink signal and obtain the burst power of 8PSK- and GMSK modulated bursts in a single measurement.

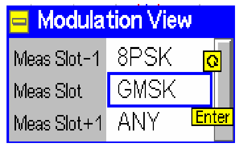
Measurement task Measure the power of the GMSK-modulated bursts that the MS transmits while it operates in EGPRS mode. Display the power together with the power of the adjacent (8PSK-modulated) bursts and perform a limit check for all bursts.

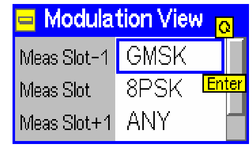
Connection To set up the appropriate EGPRS connection…

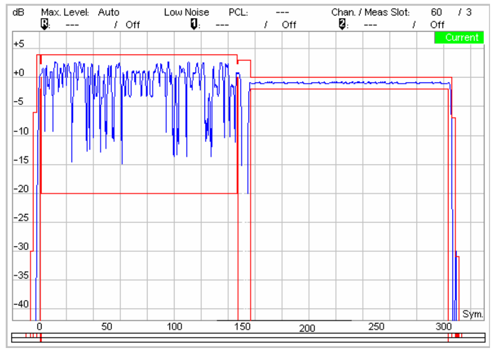
1. Connect the mobile to the CMU and switch on.
2. In the *Menu Select* menu, select the appropriate GSM band and the measurement menu *Signalling – Power – P/t Multislot.*
3. In the *Connection* tab of the *Connection Control* menu opened, select *Network Support: GSM + EGPRS, Main Service: Packet Data.*
4. Select one of the test modes A or B for transmitter or loopback tests *(Service Selection: Test Mode A* or *Test Mode B).* If you select test mode B, then open the *Network* tab of the *Connection Control* menu and set *Test mode with ACK* in the *Packet Data* section to *On.*
5. Set up the EGPRS connection to the mobile until the CMU enters the *TBF Established* state and the *Connection Control* menu is closed automatically.

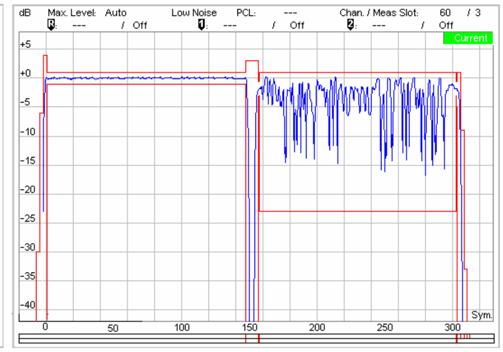
Measurement configuration After closing the *Connection Control* menu, the measurement menu for the *P/t Multislot* application is shown with default settings. To adjust the UL and DL signal and display settings…

6. Press *MS Signal – Slot Config.* and enable 2 or more consecutive uplink timeslots.
7. Press the *P/t Multislot* measurement control softkey and adjust the *Slot Count* and *Meas. Slot* to your UL signal configuration.
8. Press *Display – Modulation View* and select *GMSK* modulation for one of the measured and displayed timeslots.









The GMSK and 8PSK bursts are displayed together with the appropriate limit line template. In the examples above both bust types pass the limit check.

Continuous Access Burst Measurement

In packet data mode (with option R&S CMU-K42/-K43), it is possible to use access bursts for the transmission of CONTROL_ACK_TYPE messages. This means that access bursts occur periodically so that the *P/t Access GMSK* application is inappropriate. The bursts can be measured using the *P/t Multislot* application.

Measurement task

Stimulate a GPRS/EGPRS mobile phone to transmit periodic access bursts while it is in packet data connected *(TBF Established)* mode and measure the transmitted burst power.

Test Settings

To generate the periodic access bursts…

1. Connect the mobile to the CMU and switch on.
2. In the *Menu Select* menu, select the appropriate GSM band and the measurement menu *Signalling – Power – P/t Multislot.*
3. In the *Connection* tab of the *Connection Control* menu opened, select *Network Support: GSM + GPRS* or *GSM + EGPRS, Main Service: Packet Data.*
4. Select one of the test modes A or B for transmitter or loopback tests *(Service Selection: Test Mode A* or *Test Mode B).* If you select test mode B, then open the *Network* tab of the *Connection Control* menu and set *Test mode with ACK* in the *Packet Data* section to *On.*
5. Set up the EGPRS connection to the mobile until the CMU enters the *TBF Established* state and the *Connection Control* menu is closed automatically.

Evaluation

6. In the *P/t Multislot* menu, set *Network – Control ACK Type* to *Access Bursts.*
7. Press *Display/Marker – Modulation View* and select *Access B(ursts)* for the *Meas. Slot.*

The measured slot is shown in the right half of the *P/t Multislot* diagram. On this slot the mobile transmits 4 access bursts per second, carrying one CONTROL_ACK_TYPE message.

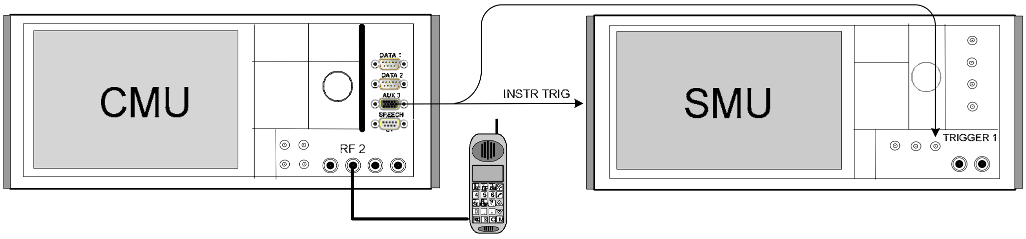
Frequency Hopping Trigger

In *Signalling* mode, a hopping trigger is available at pin 4 of the *AUX3* connector at the front of the instrument. The hopping trigger signal is a TTL trigger signal with a periodicity of 1 TDMA frame that is generated while the mobile under test is connected and frequency hopping is enabled; see the description of the *Connection Control – Trigger* tab in Chapter 4.

Measurement task

Monitor the frequency hopping sequence that the CMU uses while a mobile is connected. Synchronize the frame timing and frequency of the GSM signal generated by an R&S SMU or R&S SMIQ signal generator to the CMU's BS signal.

Test Setup



To set up and connect your equipment…

1. Connect pin no. 4 of the AUX 3 connector at the front panel of the CMU to the two BNC connectors INSTR TRIG on the rear panel and TRIGGER 1 on the front panel of the R&S SMU. If you use an R&S SMIQ, connect the two rear panel connectors PARDATA (pin 14) and TRIGGER.

Signals received at INSTR TRIG (TRIGGER) control the list mode of the SMU (SMIQ), switching the RF channels and levels. Signals received at TRIGGER 1 (PARDATA) control the baseband signals of the SMU/SMIQ.

2. Enter the GSM Signalling test mode, open the *BS Signal* tab of the *Connection Control* menu and select a hopping frequency according to your network (**example: 1 2 3 4 5** for GSM900).
3. Connect the mobile to the CMU and switch on.
4. Establish a connection (signalling states *Call Established* or *TBF Established).*

Signal Generator Settings

The settings are analogous for both signal generators.

For a R&S SMU

A: In menu *Baseband Block – GSM/EDGE – Trigger Marker*, select:

Trigger mode: *Armed Retrigger*
Source: *External Trigger 1*

B: In menu *RF Block – List Mode, select:*

Load the frequency list and enter the frequency sequence **5 1 2 3 4**.

Mode: *External Step*

State: *On*

For a R&S SMIQ:

A: In menu *DIGITAL STD – GSM/EDGE:* select:

TRIGGER MODE: *ARMED RETRIG*
TRIGGER SOURCE: *EXT*

B: In menu *LIST, select:*

SELECT LIST, enter the frequency sequence **5 1 2 3 4** and confirm with LEARN.

MODE: *EXT STEP*

Analysis

5. Access the *BS Signal* tab again and switch frequency hopping on.
6. Observe the signal generated by the R&S SMU/SMIQ.

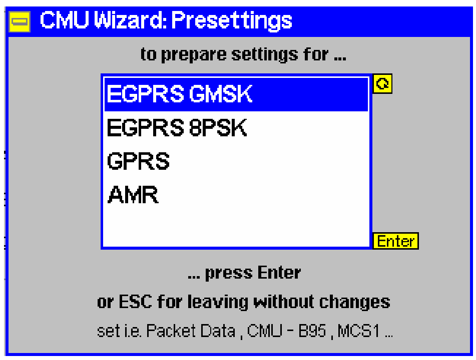
On receiving a trigger pulse from the R&S CMU, the signal generator switches to the next entry in its frequency list, so its effective hopping sequence is **1 2 3 4 5.** The frame timing and frequency of the generator signal is synchronous to the CMU's BS signal.

Measurement Wizard

The measurement wizard provides predefined settings for typical test scenarios. For many applications, selecting a predefined setting represents the simplest and fastest way of configuring the instrument. Moreover all settings can be further refined after the wizard has prepared a basic measurement configuration.

Practical use

1. To call up the wizard, enter the GSM Signalling test mode and press the *CTRL* key on the front panel of your R&S CMU.



2. Use the cursor keys at the front panel to scroll the list and select your scenario.
3. Press *ENTER* to start the wizard and configure the CMU or *ESCAPE* to close without changing any instrument settings.

The actions and settings performed by the wizard are listed in **Table 2-1** below.

Tip: *The wizard functions are also accessible from the Presettings section in the Menu Select menu. Selecting one of the presettings is equivalent to selecting a scenario and pressing the ENTER key in the wizard menu.*

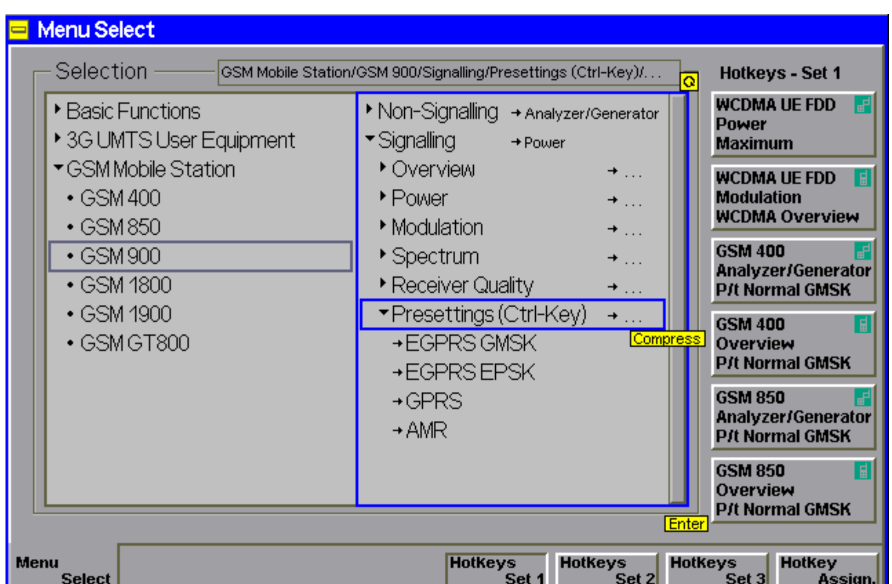


Table 2-1 Predefined settings of the measurement wizard

Test scenario	**Parameters**
EGPRS GMSK (only with options R&S CMU-K43 or R&S CMU-K0)	– Switch BS Signal off (signalling state *Signal Off*) – Open the *Connection Control – Connection* tab – Select *Network Support: GSM + EGPRS* – Select *Main Service: Packet Data* – Enable Auto Slot Config. – Enable *Best Meas Menu (E)GPRS (Misc.* tab) – With hardware option R&S-B95/B96 (Aux TX): Set *BS Signal – Control Channel – Aux TX – Channel Type: BCCH.* Otherwise set *BS Signal – Packet Data – Traffic Channel – RF Channel* to the main TX control (BCCH) channel number. – Set *Network – B52 Mode: Multislot Support* (if option R&S CMU-B52 is available) – Select *Network – Packet Data – Coding Scheme: MCS1* – Select the best measurement menu for EGPRS according to the current *Traffic Mode* (see table in section Display Control (Connection Control – Misc.) in Chapter 4. – Select *P/t Norm. GMSK* as the default application of the *Overview* measurement – Select *Ext.Phase Error GMSK* as the default application of the *Modulation* measurement – Switch BS Signal on (signalling state *Signal On*)
EGPRS 8PSK (only with options R&S CMU-K43 or R&S CMU-K0)	– Switch BS Signal off (signalling state *Signal Off*) – Open the *Connection Control – Connection* tab – Select *Network Support: GSM + EGPRS* – Select *Main Service: Packet Data* – Enable Auto Slot Config. – Enable *Best Meas Menu (E)GPRS (Misc.* tab) – With hardware option R&S-B95/B96 (Aux TX): Set *BS Signal – Control Channel – Aux TX – Channel Type: BCCH.* Otherwise set *BS Signal – Packet Data – Traffic Channel – RF Channel* to the main TX control (BCCH) channel number. – Set *Network – B52 Mode: Multislot Support* (if option R&S CMU-B52 is available) – Select *Network – Packet Data – Coding Scheme: MCS9* – Select the best measurement menu for EGPRS according to the current *Traffic Mode* (see table in section Display Control (Connection Control – Misc.) in Chapter 4. – Select *P/t Norm. 8PSK* as the default application of the *Overview* measurement – Select *Ext.Phase Error 8PSK* as the default application of the *Modulation* measurement – Switch BS Signal on (signalling state *Signal On*)
GPRS (only with options R&S CMU-K42 or R&S CMU-K0)	– Switch BS Signal off (signalling state *Signal Off*) – Open the *Connection Control – Connection* tab – Select *Network Support: GSM + EGPRS* (if none of the options CMU-K43 or R&S CMU-K0 is available, select *GSM + GPRS)* – Select *Main Service: Packet Data* – Enable Auto Slot Config. – Enable *Best Meas Menu (E)GPRS (Misc.* tab) – With hardware option R&S-B95/B96 (Aux TX): Set *BS Signal – Control Channel – Aux TX – Channel Type: BCCH.* Otherwise set *BS Signal – Packet Data – Traffic Channel – RF Channel* to the main TX control (BCCH) channel number. – Set *Network – B52 Mode: Multislot Support* (if option R&S CMU-B52 is available) – Select *Network – Packet Data – Coding Scheme: CS1* – Select the best measurement menu for EGPRS according to the current *Traffic Mode* (see table in section Display Control (Connection Control – Misc.) in Chapter 4. – Select *P/t Norm. GMSK* as the default application of the *Overview* measurement – Select *Ext.Phase Error GMSK* as the default application of the *Modulation* measurement – Switch BS Signal on (signalling state *Signal On*)

Test scenario	Parameters
AMR (only with options R&S CMU-K45 or R&S CMU-K0)	– Switch BS Signal off (signalling state *Signal Off*) – Open the *Connection Control – Connection* tab – Select *Main Service: Circuit Switched* – Set *Network – Traffic Mode: AMR Full Rate* – Select the *BER* application of the *Receiver Quality* measurement – Switch BS Signal on (signalling state *Signal On*)

Contents

3 Manual Control

This chapter gives a brief survey of the operating concept and the structure of the user interface for GSM mobile phone tests. The CMU was designed for maximum operating convenience and flexibility. All instrument functions are grouped together in menus, each of them provides a number of related configuration settings or displays a group of measured quantities. All menus show a similar structure so that many settings, once defined, can be used in several measurements. Switchover between the different menu groups and test modes *(Signalling – Non Signalling)* is possible at any time.

In the following, the different measurement modes and measured quantities are discussed. Settings and measurement parameters frequently encountered are explained from a general point of view.

The formal aspects of measurement control are discussed in more detail in chapter 5 *(Remote Control – Basics)*. For a presentation of the CMU's control elements, menu types and dialog elements within the menus refer to chapter 3 of the operating manual for the CMU basic unit.

Menu Structure

The menus used to control GSM measurements can be arranged in different ways. From the functional point of view, they form the following groups:

- The function groups *GSM400-MS, GSM GT800-MS, GSM850-MS, GSM900-MS, GSM1800-MS* and *GSM1900-MS*
- The two test modes *Signalling* and *Non Signalling*
- General configurations *(Connection Control)*, configurations specific to a measured quantity *(Power Configuration, Modulation Configuration, Spectrum Configuration, Receiver Quality Configuration)*, and menus displaying the results of the measurement *(Analyzer/Generator, Overview, Power (P/Time, P/Slot, P/Frame etc.)*, Modulation *(Extended Phase Error, Overview, EVM, Phase Error, Magnitude Error)*, *Spectrum (due to Modulation* and *due to Switching), Receiver Quality)*

In a more formal sense, the CMU uses main menus, popup menus, graphical measurement menus and dialog windows of various size. This aspect is discussed in chapter 3 of the operating manual for the CMU basic unit.

Test Modes

GSM measurements are performed in one of the two modes *Signalling* or *Non Signalling*. The *Non Signalling* mode is typically used for module tests or test of mobiles in a special "test mode". The *Signalling* mode serves to measure the mobile phone performance under realistic operating conditions where the CMU mimics a GSM base transceiver station.

Definition

The term signalling denotes all actions necessary to establish, control and terminate a communication between the base station and the mobile phone. The signalling messages conveyed allow the mobile station and the network to discuss the management of issues either related to the user or concerning technical aspects of the communication.

Non Signalling Mode

In *Non Signalling* mode, the CMU generates an RF signal conforming to GSM specifications and analyzes the signal with GSM characteristics (i.e. with definite level in the designated channel and in the adjacent channels, definite phase and frequency, and bit content) retransmitted by the device under test. No signalling parameters are transferred so that test times can be reduced considerably. The test signal may be inside or outside the designated GSM channel range.

Normal burst signals are generated and analyzed. Various transmitter quality measurements (burst power versus time in one or several timeslots, average burst power in subsequent timeslots or frames, phase and frequency errors, error vector magnitude, I/Q imbalance and origin offset in the constellation diagram, adjacent channel power due to switching and due to modulation) can be performed. GMSK and 8PSK-modulated signals are supported. The measurement may be triggered by an additional external signal.

Signalling Mode

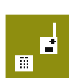
In *Signalling* mode, the CMU starts to transmit a signal using a control channel. In subsequent steps, the mobile synchronizes to the control channel, decodes the information transmitted, and performs a location update so that a call can be delivered from either the mobile or the CMU.

The CMU is able to configure a broad range of network parameters and to determine the parameters characterizing the mobile. Measurements of the burst power versus time in one or several consecutive timeslots, of the average burst power in consecutive timeslots or frames, the modulation parameters (phase and frequency errors, I/Q imbalance and origin offset in the constellation diagram), the adjacent channel power due to switching and due to modulation, and of the bit error rate can be performed for normal bursts and access bursts. GMSK and 8PSK-modulated signals are supported.

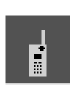
If option CMU-K42 is installed in addition, the CMU can also establish a TBF connection to a mobile station operating in packet-data (GPRS) mode. Single-slot and multislot measurements can be done in the GPRS test mode.

Symbols for Signalling Mode and State

The *signalling mode* and *state* is indicated to the left of the operating mode in each main menu and graphical measurement menu (see chapter 3 of CMU operating manual). The following symbols occur in the GSM-MS function groups:

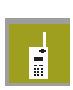


Non signalling mode; module tests

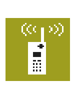


Signalling mode, Signal Off

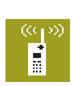
Signalling mode, Signal On or GPRS Idle (symbol blinks)



Signalling mode, Synchronized or GPRS Attached



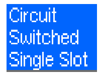
Signalling mode, Alerting or GPRS Connecting TBF (symbol blinks)



Signalling mode, Call Established or GPRS TBC Established

Symbols for service and slot configuration

In *Signalling mode,* an additional icon shows the main service *(Circuit Switched* or *P.D* for *Packet Data),* the (E)GPRS coding scheme, the *Slot Mode (Single Slot/Multislot),* the number of downlink and uplink timeslots used, and the *Service Selection* for packet data services. The following examples show two different configurations.



Circuit switched main service, single slot mode.

Packet data main service, EGPRS modulation and coding scheme MCS 9, multislot mode with 3 downlink and 2 uplink channels, *Service Selection* for BLER tests.

Configurations

The CMU offers a wide range of settings for the RF signal generator and analyzer, the signalling procedures, and the individual measurements. Configurations can be set either for the whole function group *(Connection Control)* or for a particular measurement.

Connection Control

The *Connect. Control* softkey is located on the right side of the title bar of each main and graphical measurement menu. It opens a popup menu with several tabs controlling

- The signal generators and analyzers of the instrument *(Analyzer* and *Generator* in Non Signalling, *MS Signal* and *BS Signal* in Signalling mode)
- The CMU receiver settings and input path configuration (included in *Analyzer, MS Signal)*
- The RF connectors to be used and the external attenuation *(RF Input/Output)*
- The reference signal and the system clock *(Sync.)*
- The trigger settings *(Trigger)*
- In *Signalling* mode, all actions changing the CMU's signalling state *(Connection)*
- In *Signalling* mode, a handover *(Handover)* to another network
- In *Signalling* mode, parameters of the network and the mobile station under test *(Network)*

All settings made in the *Connect. Control* menu apply to the whole function group. Many of them can be accessed and overwritten, however, by means of the softkeys and hotkeys offered in the graphical measurement menus.

Configurations of measurements

A popup menu offering specific settings is assigned to each measurement group *(Power, Modulation, Spectrum,* and *Receiver Quality).* The following parameters can be defined:

- The repetition mode, the stop condition, the statistic count and the display mode for the measurement *(Control)*
- Tolerances for the measured quantities *(Limits, Limit Lines)*

These settings are explained in more detail below (see section *General Settings* on page 3.5).

Configuration via hotkeys

The softkeys and associated hotkeys in the graphical measurement menus provide the most important configurations for the current measurement; see chapter 4 and chapter 3 of the CMU200 operating manual. Settings may via hotkeys supersede the corresponding *Connection Control* settings.

Measurement Groups

Measurement results are indicated in two different ways:

- Discrete values and parameters are displayed in output fields, lists and tables. In remote control, these results are referred to as scalars.
- Measurement curves (traces) are displayed in a Cartesian coordinate system, the time forming the x-axis scale. Relatively small sets of test points are generally viewed in a bar graph. In remote control, results of this type are referred to as arrays.

While the measurement is running in repetition mode *continuous* (see page 3.6), the indicated results are constantly updated. As shown in the table below, some of the measurement groups are different for the two test modes.

Table 3-1 Measurement groups in *Signalling* and *Non Signalling* mode

Non Signalling **(GMSK and 8PSK-modulated signals supported)**	**Signalling** **(GMSK and 8PSK-modulated signals supported)**
Analyzer/Generator Shows the settings for the signals generated and analyzed by the instrument and presents an overview of the basic scalar power and modulation results.	**Overview** Shows the settings for attempting a connection to the mobile and presents an overview of the basic scalar power and modulation results. The receiver parameters and various signalling parameters reported by the mobile station are indicated in addition.
Power Application *P/t Norm. GMSK/8PSK:* Diagram showing the power of a GMSK or 8PSK-modulated burst signal as a function of time. The peak power, statistical results and the results of the limit check are indicated in addition. Single points of the trace may be evaluated using graphical tools (markers, D-Line). Application *P/t Multislot:* Diagram showing the trace of the measured burst power as a function of time in up to 4 consecutive timeslots. The peak power, statistical results and the results of the limit check are indicated in addition. Single points of the trace may be evaluated using graphical tools (markers, D-Line). Application *P/Frame:* Table showing the average burst power in a particular timeslot and in 128 consecutive TDMA frames. Application *P/Slot Graph:* Bar graph showing the average burst power in 8 consecutive timeslots. Application *P/Slot Table:* Table showing the average burst power in up to 512 consecutive timeslots.	**Power** Application *P/t Norm. GMSK/8PSK:* Diagram showing the power of a GMSK or 8PSK-modulated burst signal as a function of time. The peak power, statistical results and the results of the limit check are indicated in addition. Single points of the trace may be evaluated using graphical tools (markers, D-Line). Application *P/t Multislot:* Diagram showing the trace of the measured burst power as a function of time in up to 4 consecutive timeslots. The peak power, statistical results and the results of the limit check are indicated in addition. Single points of the trace may be evaluated using graphical tools (markers, D-Line). Application *P/t Access GMSK:* Diagram showing the power of a single GMSK-modulated access burst as a function of time including limit check. Application *P/Frame:* Table showing the average burst power in a particular timeslot and in 128 consecutive TDMA frames. Application *P/Slot Graph:* Bar graph showing the average burst power in 8 consecutive timeslots. Application *P/Slot Table:* Table showing the average burst power in up to 512 consecutive timeslots. Application *P/PCL:* Table showing the average burst power as a function of the PCL of the mobile phone.

Non Signalling (GMSK and 8PSK-modulated signals supported)	**Signalling (GMSK and 8PSK-modulated signals supported)**
Modulation Application *Ext. Phase Err. GMSK:* Diagram showing the phase error within the burst as a function of time. The frequency error, average and RMS phase error, I/Q imbalance and origin offset in the constellation diagram, statistical results and the results of the limit check are indicated in addition. Application *Overview 8PSK:* Table showing a statistical evaluation of 8PSK modulation parameters. Application *EVM 8PSK:* Diagram showing the error vector magnitude (EVM) within the burst as a function of time plus a statistical evaluation of 8PSK modulation parameters. Application *Magn. Error 8PSK:* Diagram showing the magnitude error within the burst as a function of time plus a statistical evaluation of 8PSK modulation parameters. Application *Phase Error 8PSK:* Diagram showing the phase error within the burst as a function of time plus a statistical evaluation of 8PSK modulation parameters.	**Modulation** Application *Ext. Phase Err. GMSK:* Diagram showing the phase error within the burst as a function of time. The frequency error, average and RMS phase error, I/Q imbalance and origin offset in the constellation diagram, statistical results and the results of the limit check are indicated in addition. Application *Overview 8PSK:* Table showing a statistical evaluation of 8PSK modulation parameters. Application *EVM 8PSK:* Diagram showing the error vector magnitude (EVM) within the burst as a function of time plus a statistical evaluation of 8PSK modulation parameters. Application *Magn. Error 8PSK:* Diagram showing the magnitude error within the burst as a function of time plus a statistical evaluation of 8PSK modulation parameters. Application *Phase Error 8PSK:* Diagram showing the phase error within the burst as a function of time plus a statistical evaluation of 8PSK modulation parameters.
Spectrum Diagram showing the amount of energy that spills outside the designated channel and the power vs. time at off-carrier frequencies. The off-channel spectrum is caused by the modulation (spectrum due to modulation) and to the bursty nature of the RF signal (spectrum due to switching). Statistical results and the results of the limit check are indicated in addition. A special mode for spectrum due to switching measurement on multislot configurations is available.	**Spectrum** Diagram showing the amount of energy that spills outside the designated channel and the power vs. time at off-carrier frequencies. The off-channel spectrum is caused by the modulation (spectrum due to modulation) and to the bursty nature of the RF signal (spectrum due to switching). Statistical results and the results of the limit check are indicated in addition. A special mode for spectrum due to switching measurement on multislot configurations is available.
–	**Receiver Quality** Table showing the results of the bit error rate test including the limit check and the receiver parameters reported by the mobile station. Bit error rates for different bit classes, the residual bit error rate and frame erasure rate, the raw bit error rate, the data block error rate and the USF BLER/False USF Detection can be assessed in various measurement modes. The Block Error Rate (BLER) can be measured on (E)GPRS channels.

A graphical overview of the menus is given at the end of this chapter.

General Settings

A number of settings can be made in several of the configuration menus assigned to the measurement groups *Power*, *Modulation, Spectrum,* and *Receiver Quality*. In combination, these settings define the scope of the measurement, i.e. the number of bursts measured and the results displayed. The following brief overview is intended to avoid confusion of terms.

Application

Applications are different measurements belonging to the same measurement group. They effectively split up a measurement group into various related sub-groups which can be configured separately.

They are selected via the *Application* softkey in the measurement menus.

Statistic Count / Statistics Cycle

The statistic count is equal to the integer number of evaluation periods which form one statistics cycle. An evaluation period corresponds to the duration of a burst (measurement groups *Power*, *Modulation, and Spectrum)* or a speech frame (measurement group *Receiver Quality).* Depending on the *repetition mode* (see below), a measurement may extend over one or several statistics cycles.

The *statistic count* is set in the *Control* tab of the configuration popup-menus assigned to each measurement group.

Repetition Mode

The *repetition mode* defines how many statistics cycles are measured if the measurement is not stopped by a limit failure (see stop condition *On Limit Failure* below). Two modes are available for all measurements:

Single Shot	The measurement is stopped after one statistics cycle
Continuous	The measurement is continued until explicitly terminated by the user; the results are periodically updated

A third repetition mode is available in remote control:

Counting	Repeated single shot measurement with a fixed number of statistics cycles

The *repetition mode* is set in the *Control* tab of the configuration popup-menus assigned to the three measurement groups *Power*, *Modulation,* and *Spectrum.* In the *Receiver Quality* menu, the repetition mode can be set via the *Application* softkey*.*

Note: *In contrast to other measurement settings, thee repetition modes in manual and remote control are independent and do not overwrite each other. In most measurements, the default repetition mode in manual control is* Continuous *(observe results over an extended period of time), the default mode in remote control is* Single Shot *(perform one measurement and retrieve results).*

Stop Condition

For *Power, Modulation, and Spectrum* measurements, two stop conditions can be selected:

None	The measurement is performed according to its repetition mode, regardless of the measurement results,
On Limit Failure	The measurement is stopped as soon as one of the limits is exceeded, regardless of the repetition mode set. If no limit failure occurs, it is performed according to its repetition mode.

For *Receiver Quality* measurements, the stop condition *None* (see above) and two further conditions can be selected:

1st Limit exceed.	The measurement is stopped as soon as one of the limits is exceeded
All Limits exceed.	The measurement is stopped as soon as all limits defined are exceeded. Again, if no limit failure occurs, it is performed according to its repetition mode.

The *Stop Condition* is set in the *Control* tab of the configuration popup-menus assigned to each measurement group.

Display Mode

In graphical measurement diagrams, the *Display Mode* defines which of the measured and calculated traces is displayed if the measurement extends over several bursts. In general, traces are evaluated at a set of fixed, equidistant test points (samples). After n bursts, n measurement results per test point have been taken. After a single shot measurement extending over c bursts, c measurement results per test point have been taken.

Current The current burst, i.e. the last result for all test points, is displayed.

Minimum At each test point, the minimum value of all bursts measured is displayed.

Maximum At each test point, the maximum value of all bursts measured is displayed.

Max./Min. At each test point, the extreme value of all bursts measured is displayed, i.e. the maximum or minimum, whichever has a larger absolute value.

Average At each test point, a suitably defined average over all bursts measured is displayed; see paragraph on *Calculation of average quantities* below.

Note the difference in the calculation of *Average* on one hand, *Minimum, Maximum* and *Max./Min.* on the other hand, if the measurement extends over more than one statistic count (repetition mode *Continuous,* measurement time longer than one statistic count).

After evaluation of the different traces, the burst power is logarithmized and plotted in a semi-logarithmic diagram.

The *Display Mode* is set in the *Control* tab of the configuration popup-menus assigned to the measurement groups *Power, Modulation,* and *Spectrum.*

Calculation of average quantities

The *Average* traces in the *Power, Modulation,* and *Spectrum* menus are obtained as follows:

Let c be the number of bursts forming one statistics cycle (one *Statistic Count)* and assume that n bursts have been measured since the start of the measurement. In calculating the *Average* trace, the following two situations are distinguished:

n ≤ c Single shot measurement or continuous measurement during the first statistics cycle: At each test point, *Average* trace no. n is calculated from *Average* trace no. n – 1 and *Current* trace no. n according to the following recurrence:

$$Avg(n) = \frac{n-1}{n} Avg(n-1) + \frac{1}{n} Curr(n) \qquad (n = 1, \ldots, c)$$

The *Average* trace represents the arithmetic mean value over all n bursts measured.

n > c Continuous measurement after the first statistics cycle: At each test point, *Average* trace no. n is calculated from *Average* trace no. n – 1 and *Current* trace no. n according to:

$$Avg(n) = \frac{c-1}{c} Avg(n-1) + \frac{1}{c} Curr(n) \qquad (n > c)$$

Scalar quantities are averaged in analogy to *Average* traces. The formulas hold for n = 1 where the average trace becomes equal to the current trace (statistics off).

Calculation of statistical quantities

In *Power* and *Modulation* measurements the statistical functions *Average, Minimum, Maximum* and *Minimum/Maximum* are applied to a set of test points depending on two independent parameters:

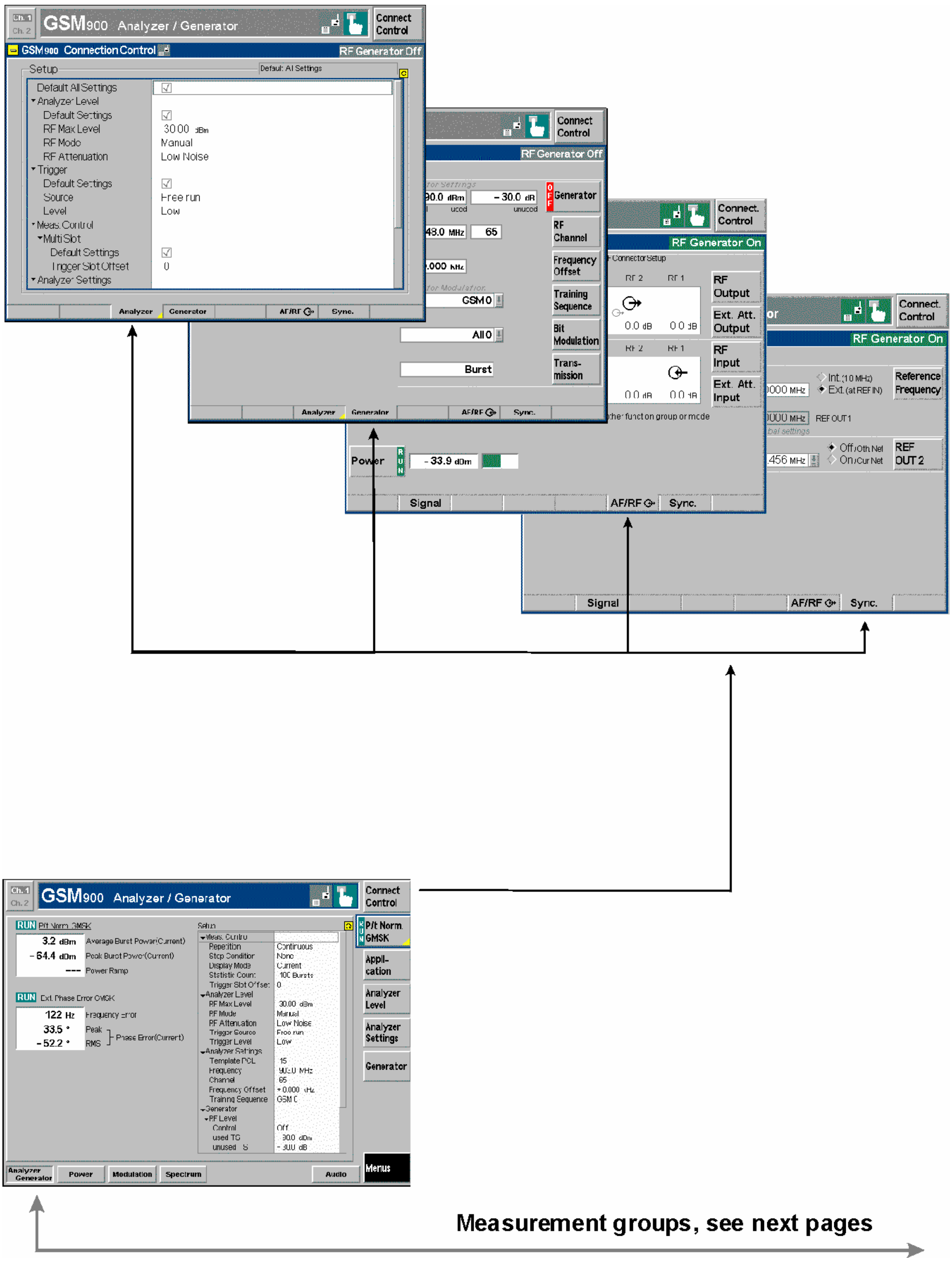
- The time, i.e. the abscissa values t_i, i ranging from 1 to the total number of test points comprising the trace.
- The burst number ranging from 1 to the number n of the current burst.

The result of the statistical operations depends on the parameter range considered and – in the case of statistics functions evaluated over several parameters – on the order of evaluations. This is why the definition of statistical quantities deserves some attention and is explained in the relevant sections in chapter 4. Some particular examples are:

1. In the *Power* menu, the quantity *Average Burst Power* denotes the average power of the current burst. i.e. the arithmetical mean value of all test points t_i located in the useful part of the burst (lower area 1 in the power template in chapter 4).
2. In the *Modulation* menu quantities such as the *Frequency Error*, *Phase Error RMS, Phase Error Peak* etc. are first calculated for the current burst and entered in the *Current* column of the output table. The results in the *Minimum/Maximum* column correspond to the extreme value of the *Current* results calculated over all bursts measured. The results in the *Average* column correspond to the average of the *Current* results calculated according to the prescription in paragraph *Calculation of average quantities* above.

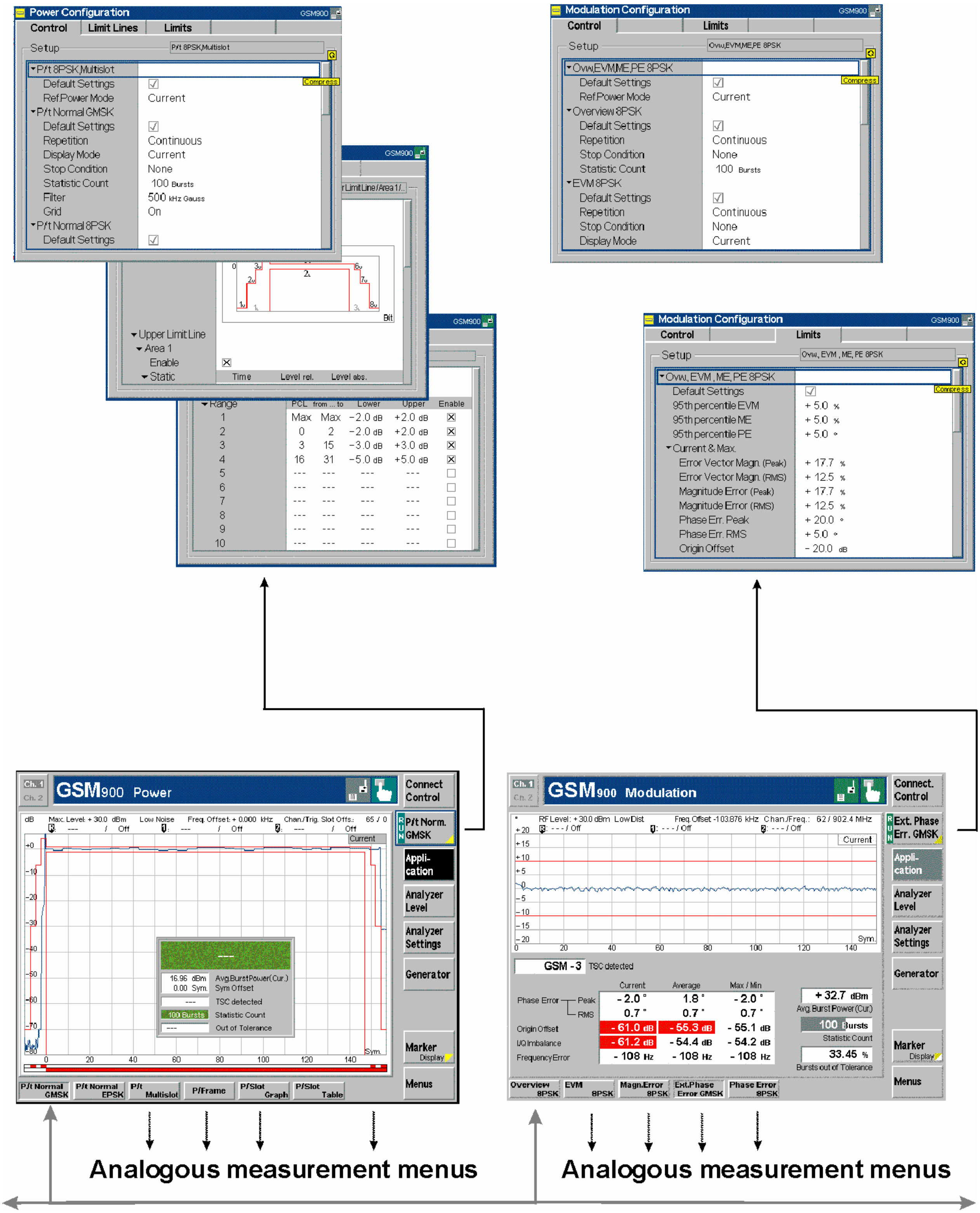
Menu Overview

GSM-MS Non Signalling – General Configurations

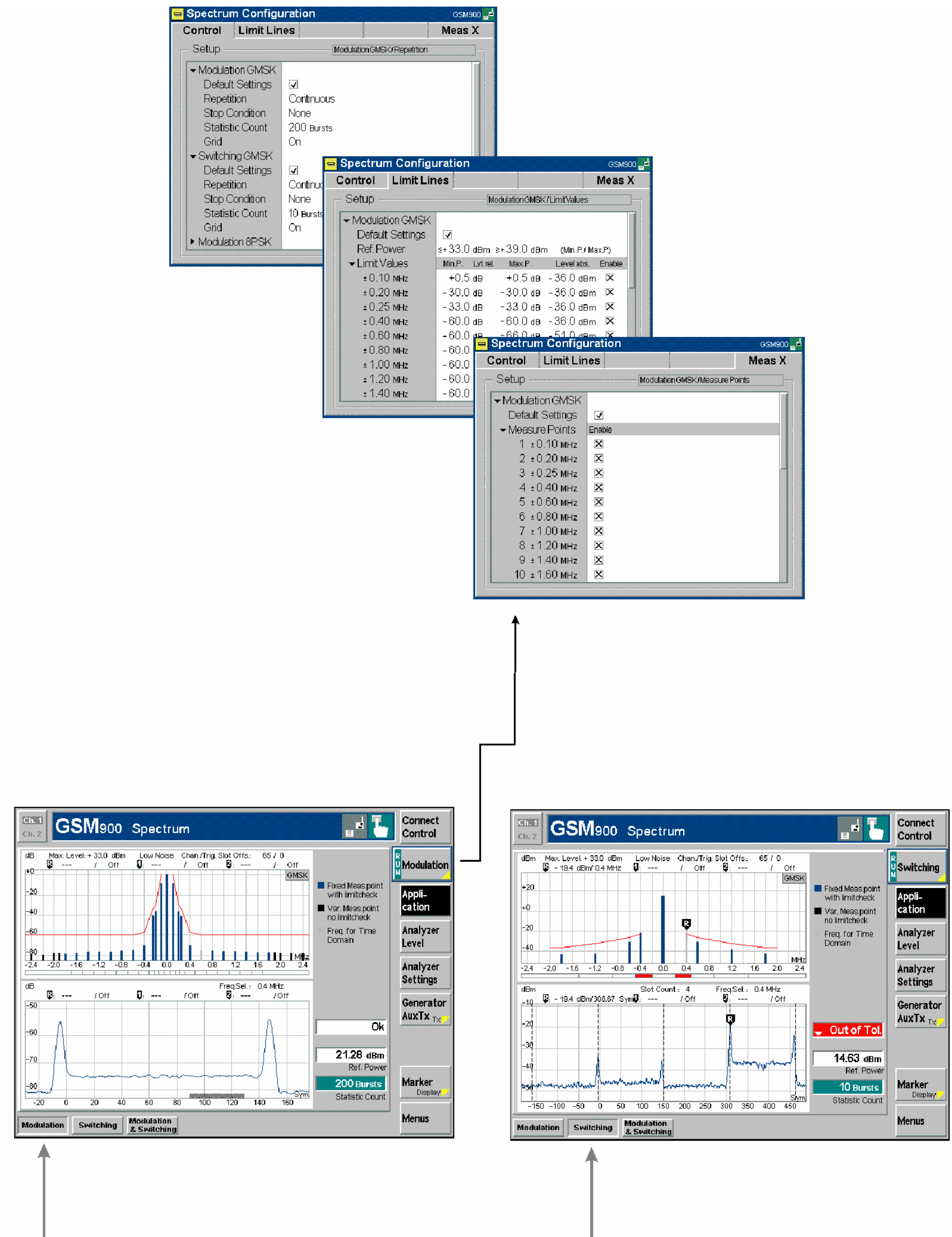


Measurement groups, see next pages

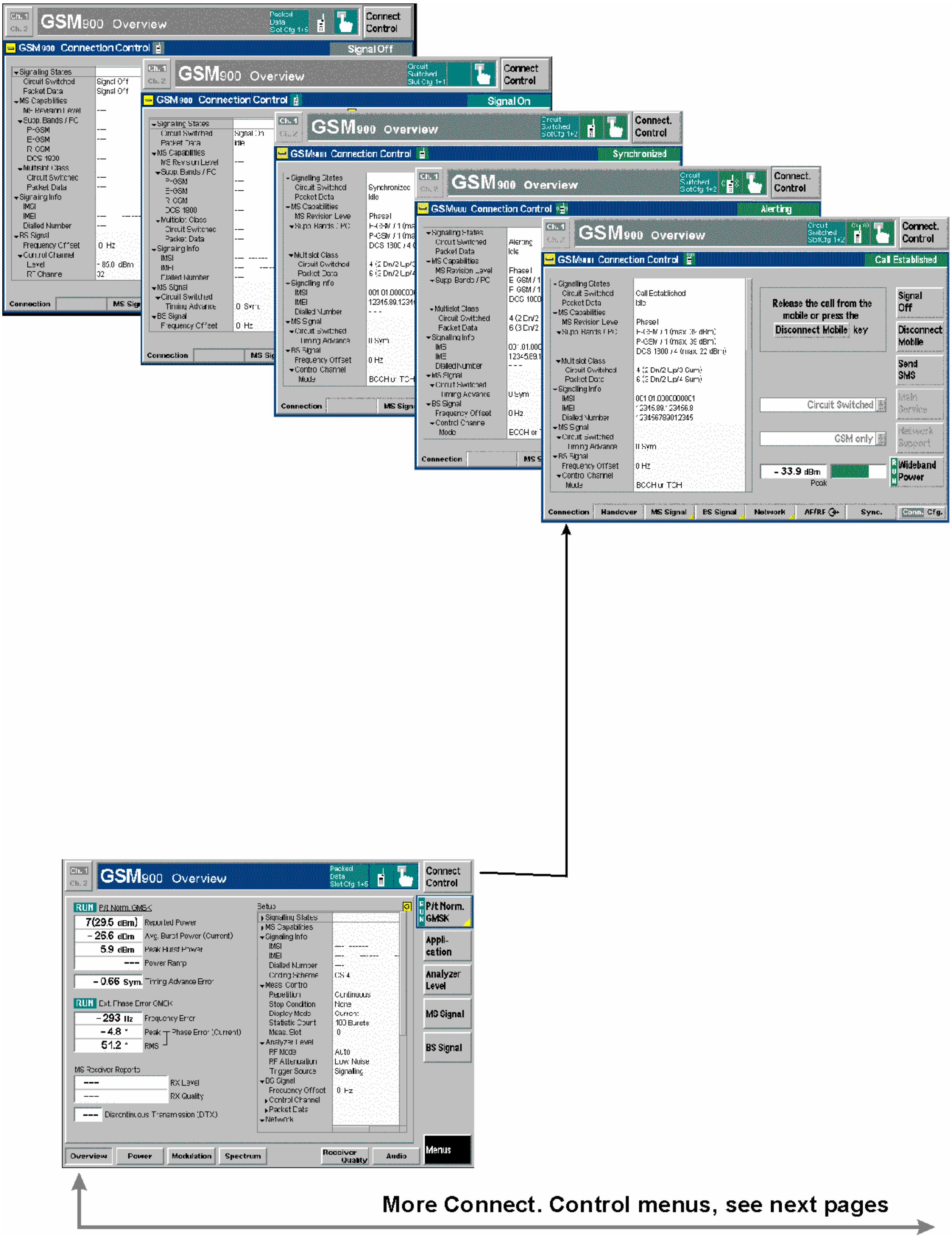
GSM-MS Non Signalling – Power and Modulation



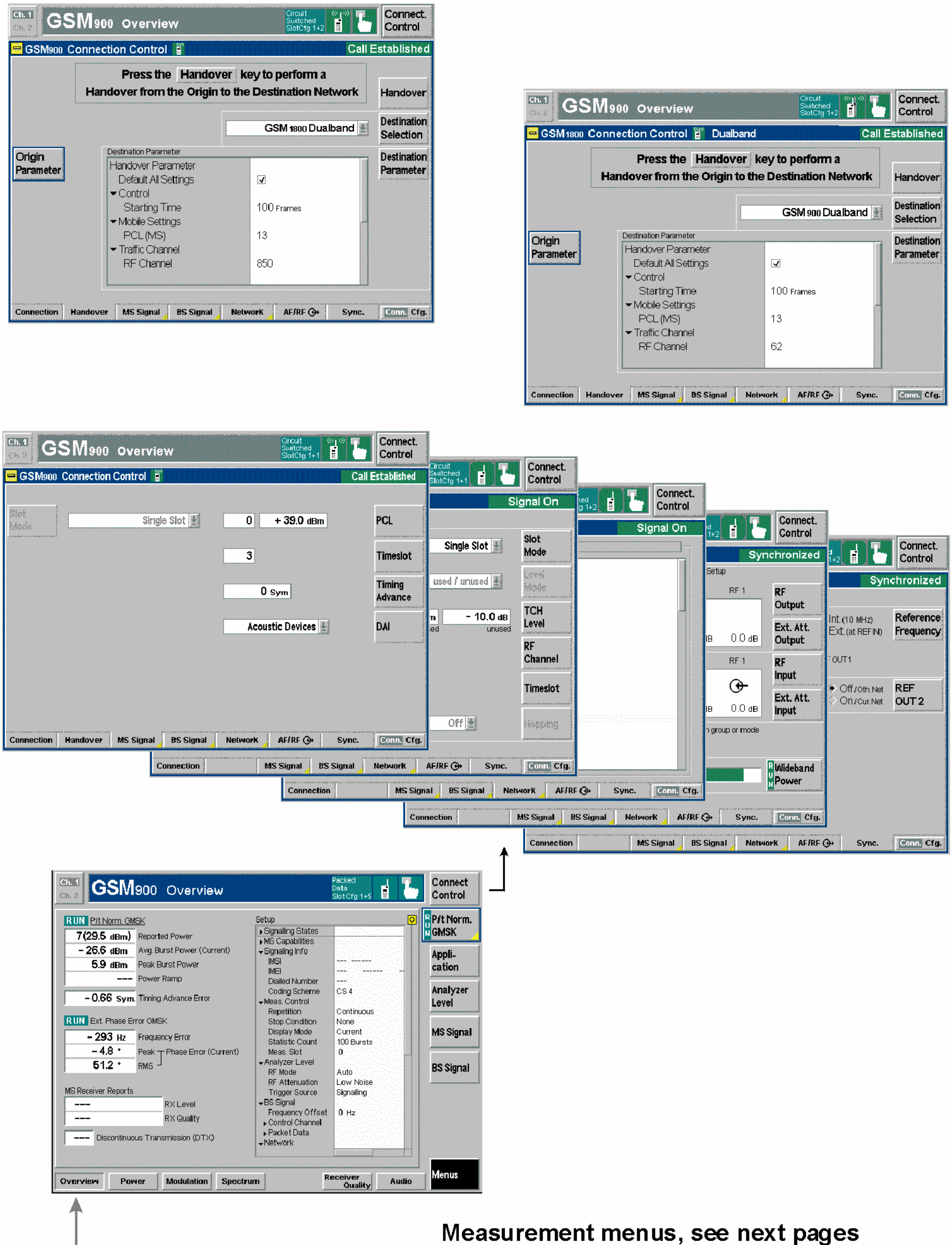
GSM-MS Non Signalling – Spectrum



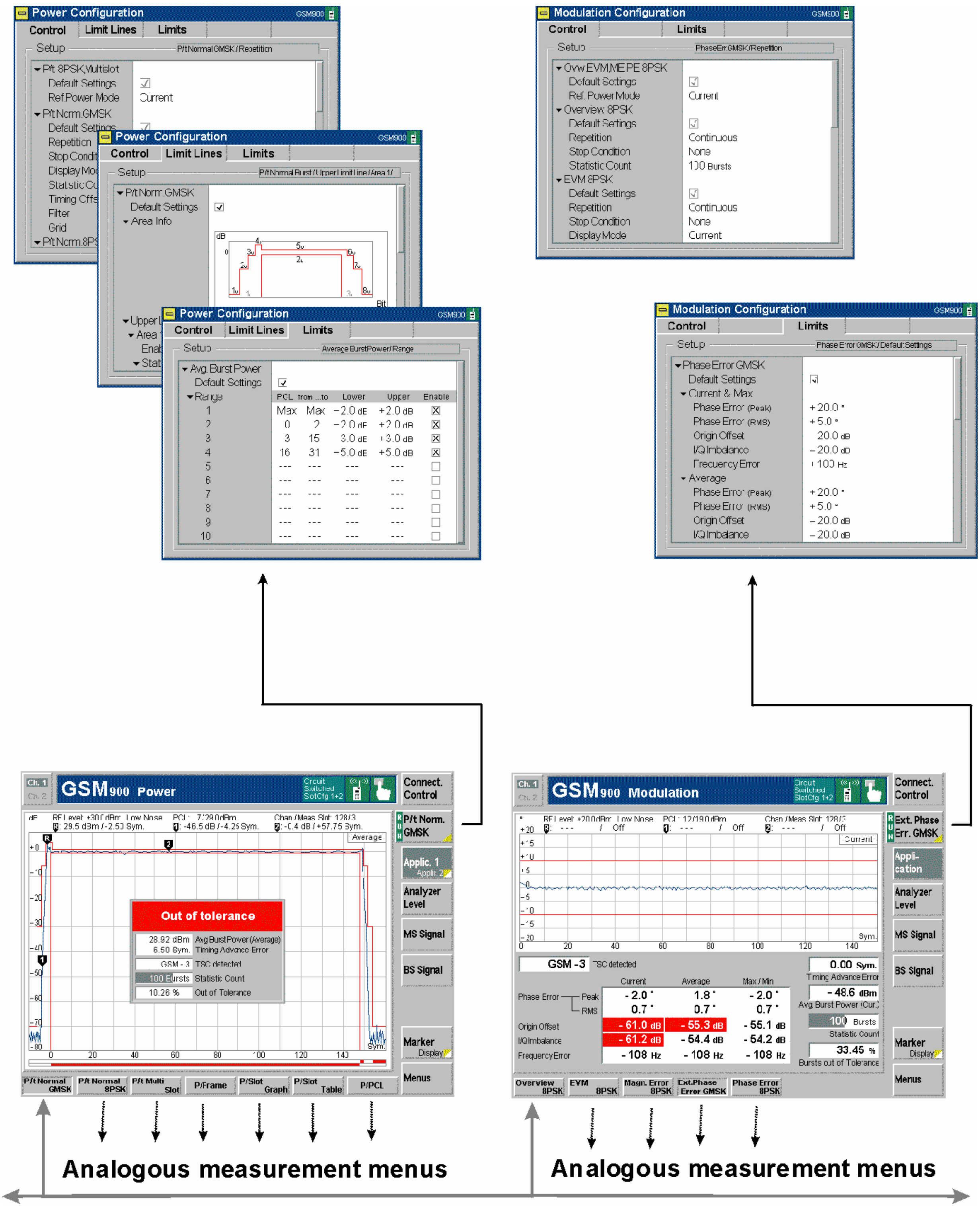
GSM-MS Signalling – General Configurations I



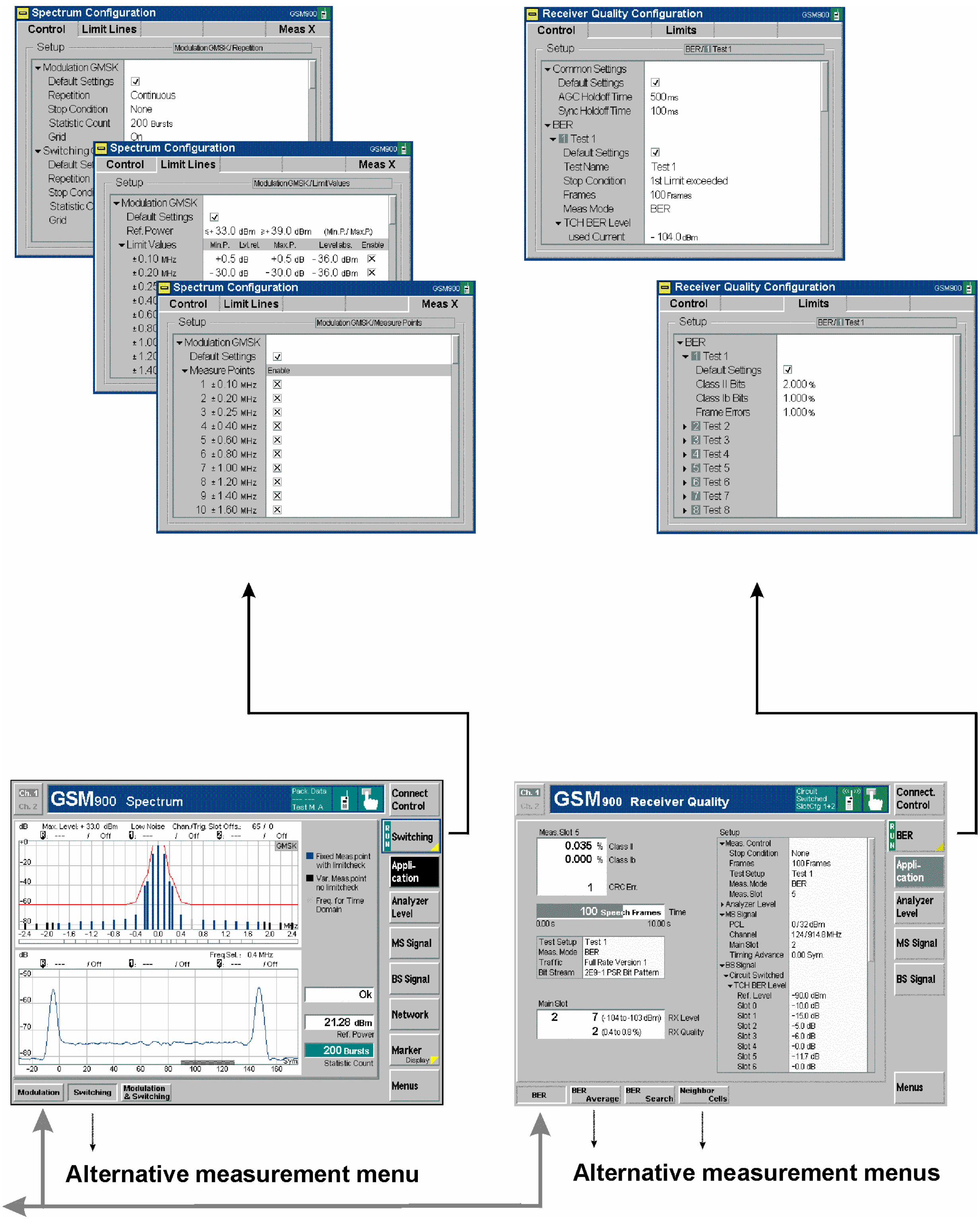
GSM-MS Signalling – General Configurations II



GSM-MS Signalling – Power and Modulation



GSM-MS Signalling – Spectrum and Receiver Quality



Contents

4 Functions and their Application

This chapter explains in detail all functions for the measurement of mobile stations supporting the GSM standard.

The chapter is divided in two sections corresponding to the two function groups for module tests *(GSM400/GT800/850/900/1800/1900-MS Non Signalling)* and for mobile tests including signalling *(GSM400/GT800/850/900/1800/1900-MS Signalling*). Within the two sections, the discussion is structured according to the provided measurements and configurations (see graphical overview at the end of chapter 3). In contrast to chapter 6, *Remote Control – Commands,* general measurement configurations are relegated to the end of each section.

The description of each softkey, select or input field is followed by the corresponding remote-control commands. Similarly, the description of the commands in chapter 6 also contains the corresponding menus of the user interface.

Each menu and each panel is briefly described first and then illustrated together with its call button. The menu functions are explained according to the following scheme:

Softkey	Short function definition

Designation of select/input field	Definition of function.
	Further description of the function: purpose, interaction with other settings, notes...
	Parameter 1 Description of parameter 1
	Parameter 2 Description of parameter 2
	...
	Further description of the parameters: purpose, interaction with other settings, notes...
	
	Remote control
	`Remote-control command (long form)  Parameter1 | Parameter2`
	`...`

For all numerical values, including their ranges and default settings, please refer to the description of the remote-control commands in chapter 6.

The description of the operating concept is to be found in chapter 3 of the operating manual for the CMU basic instrument; besides, a description of measurement control and the essential settings is given in chapter 3 in the present GSM manual. A comprehensive index listing important keywords and the proper names of all menus, dialog elements and softkeys is appended to the end of this manual.

GSM Module Tests (Non Signalling)

The structure of this section is based on the configuration and measurement groups in function group *GSM400/GT800/850/900/1800/1900-MS Non Signalling*, i.e. the menus of the graphical user interface. The menus are described in the following order:

1. Overview of fundamental test settings and measurement results *(Analyzer/Generator* menu)
2. Measurement menus *Power, Modulation,* and *Spectrum:* Purpose of the measurements and relation to the test specifications and conformance requirements, description of measurement results, specific measurement configurations
3. General device configurations *(Connection Control)*

The most important menus within function group *GSM400/GT800/850/900/1800/1900-MS Non Signalling* are shown in an overview at the end of chapter 3 in the present GSM manual.

Analyzer/Generator Menu

The *Analyzer/Generator* menu displays the essential results of the *P/t Norm. GMSK,* the *Ext. Phase Err. GMSK*, and the *Overview 8PSK* applications and provides access to the most important measurement settings. In particular, it configures the signals of the RF generator and defines the properties of the CMU's RF analyzer.

- The measurement control softkey *P/t Norm. GMSK* changes to *Ext. Phase Err. GMSK* or *Overview 8PSK,* depending on the application selected. This softkey controls the measurement, indicates its status *(RUN | HLT | OFF)* and opens the configuration menu *Power Configuration* or *Modulation Configuration*. The hotkeys associated to the measurement control softkey define the scope of the *Power* or *Modulation* measurement.
- The other softkeys on the right side are combined with various hotkeys (e.g. the hotkeys *Template PCL, Frequency, Channel, Frequency Offset,* and *Training Sequence* belong to the softkey *Analyzer Settings).* The softkey/hotkey combinations provide test settings and switch over between different measurements.

Types of settings

The purpose of the *Analyzer/Generator* menu is to provide quick access to the most common *Power* and *Modulation* measurements and to present the basic measurement results at a glance. The three measurement applications *P/t Norm. GMSK, Ext. Phase Err. GMSK*, or *Overview 8PSK* can be selected with the *Application* softkey. The remaining softkeys/hotkey combinations provide two different types of settings:

- General settings are valid for all applications of function group *GSMxxx-MS Non Signalling.* Changing general settings in any application will have an impact on all measurements and applications of the function group. All general settings are also provided in the *Connection Control* menu (see p. 4.82 ff.). Examples of general settings are the RF input level and trigger settings (softkey *Analyzer Level)* and the configuration of the RF generator (softkey *Generator)*.
- Specific settings are relevant for one application only, or they can be set independently for several applications. Changing specific settings in an application will not affect the other measurements and applications of the function group. No specific settings are provided in the *Connection Control* menu (see p. 4.82 ff.). Examples of specific settings are the *Repetition* mode (to be set independently for all applications) and *Template PCL* (relevant for the *P/t Norm. GMSK* application only).

Measurement results	The output fields in the left half of the *Analyzer/Generator* menu show the current measurement results. The results depend on the selected application. They are described in detail in section *Measurement Results* on p. 4.6 f.
	The results displayed in the *Analyzer/Generator* menu represent only a small fraction of the power and modulation results that the CMU is able to acquire. A comprehensive set of test results is displayed in the *Power* and *Modulation* measurement menus; see sections *Power Measurements* on p. 4.8 ff. and *Modulation Measurements* on p. 4.42 ff. In particular, the *Power* and *Modulation* menus show many quantities as functions of time.

The *Analyzer/Generator* menu can be opened from the *Menu Select* menu (with associated key at the front of instrument). The hotkeys associated to the *Menus* softkey switch over between the *Analyzer/Generator* menu and the remaining measurement menus of function group *GSMxxx-MS Non Signalling*.

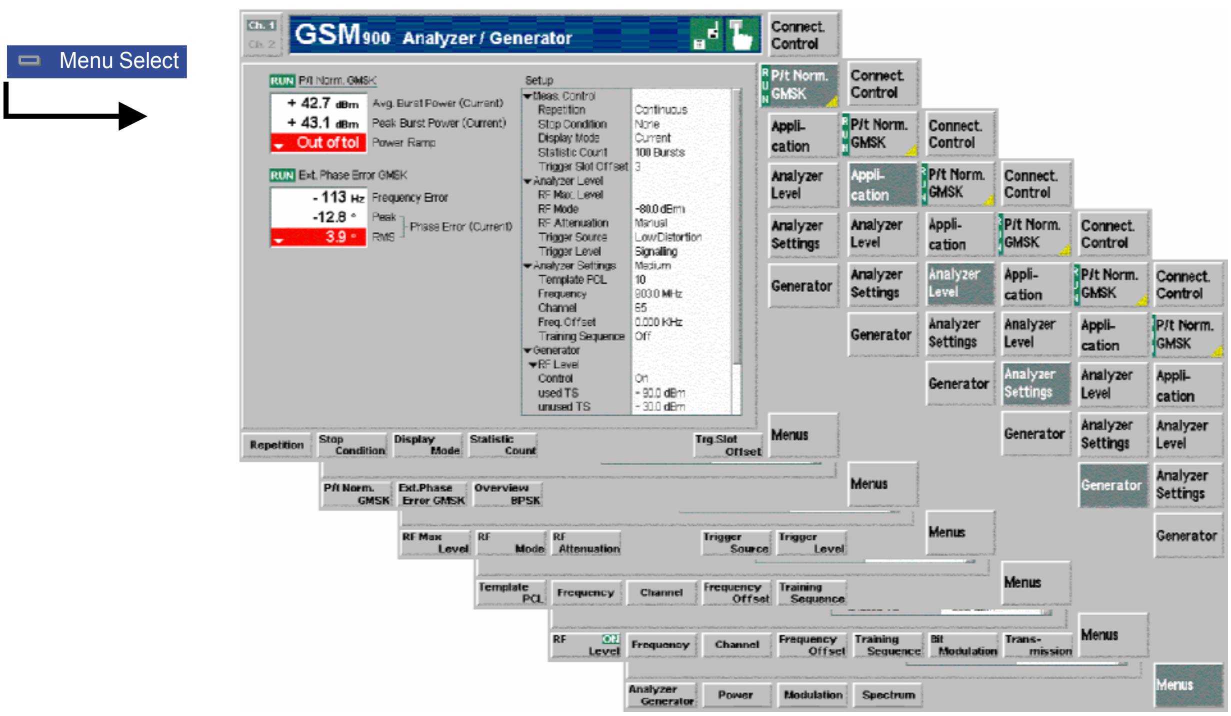


Fig. 4-1 Measurement menu Analyzer/Generator (example: P/t Norm. GMSK)

Test Settings

The settings for the *Analyzer/Generator* menu are accessible via softkey/hotkey combinations. If a softkey (located in the softkey bar on the right side of the menu) is selected and an associated hotkey (displayed across the bottom of the menu) is pressed, a popup window indicating the current setting and enabling an entry will appear.

Example:

Analyzer Settings	The *Analyzer Settings* softkey displays a hotkey bar including the hotkey labeled *Frequency*.

Frequency

The *Frequency* hotkey opens the input window *Frequency*.

Input windows indicate the current parameter value (in this case: the current RF input frequency) or a list of the possible settings. Parameters are changed by

- Overwriting/incrementing numerical values (for numerical parameters)
- Selecting from the list of parameters (for select parameters)

Measurement Control

Each *Analyzer/Generator* application is controlled by means of the measurement control softkey below the *Connect. Control* softkey and the associated hotkeys.

P/t Norm. GMSK

The *P/t Norm. GMSK* softkey (which changes to *Ext. Phase Err. GMSK* or *Overview 8PSK,* depending on the application selected) controls the measurement application and indicates its status *(RUN | HLT | OFF)*. This status can be changed after softkey selection (pressing once) by means of the *ON/OFF* key or the *CONT/HALT* key. The status can be set independently for all three applications.

The applications *P/t Norm. GMSK* and *Ext. Phase Err. GMSK* can be run in parallel, so the results for both applications are displayed simultaneously. Switchover between these two applications does not change the course of the measurement.

The GMSK applications and the *Overview 8PSK* suspend each other. The selected measurement status of each application is stored and will be put into effect as soon as the application is activated. In particular, an application in the status *RUN* is restarted each time it is activated.

Remote control
`INITiate:POWer[:NORMal][:GMSK]` etc.
`FETCh:POWer[:NORMal][:GMSK]:STATus?`
`INITiate:MODulation:XPERror[:GMSK]` etc.
`FETCh:MODulation:XPERror[:GMSK]:STATus?`
`INITiate:MODulation:OVERview:EPSK` etc.
`FETCh:MODulation:OVERview:EPSK:STATus?`

Measurement configuration

The configuration menus for all *Power* and *Modulation* measurements are directly accessible from the *Analyzer/Generator* menu:

- Pressing the *P/t Norm. GMSK* softkey twice opens the popup menu *Power Configuration* (see page 4.29 ff.).
- Pressing the *Ext. Phase Err. GMSK* or the *Overview 8PSK* softkey twice opens the popup menu *Modulation Configuration* (see page 4.57 ff.).

Selecting the Application

Appli-cation

The *Application* softkey selects the measurement application. The measurement control softkey (second softkey below *Connect. Control)* indicates the current application. Some of the hotkeys associated to the different softkeys, the *Setup* table, and the results in the *Analyzer/Generator* menu also vary as a function of the application. The corresponding measurement results are explained in section *Measurement Results* on page 4.6 ff.

P/t Normal GMSK

The *P/t Normal GMSK* hotkey selects the power versus time measurement for normal burst signals. See section *Power Measurements* on p. 4.8.

Remote control
The *P/t Normal GMSK* application is selected by the keywords `[:NORMal] [:GMSK]` in the 3rd and 4th level of the `POWer` commands, e.g.
`CONFigure:POWer [:NORMal][:GMSK]...`

Ext. Phase Err. GMSK

The *Ext. Phase Error GMSK* hotkey selects the measurement of the modulation accuracy of GMSK modulated signals. See section *Measurement Menu (Modulation – GMSK)* on p. 4.42.

Remote control
The *Phase Error GMSK* application is selected by the keywords `XPERror[:GMSK]` in the 3rd and 4th level of the `MODulation` commands, e.g.
`CONFigure:MODulation:XPERror[:GMSK]...`

Overview 8PSK

The *Overview 8PSK* hotkey selects the measurement of the power and modulation accuracy of 8PSK modulated signals. See section *Measurement Menu (Modulation – 8PSK)* on page 4.46.

Remote control
The *Overview 8PSK* application is selected by the keywords `OVERview:EPSK` in the 3rd and 4th level of the `MODulation` commands, e.g.
`CONFigure:MODulation:OVERview:EPSK...`

Application-Specific Settings

As outlined in section *Analyzer/Generator Menu* on p. 4.2, some of the hotkey/softkey combinations in the *Analyzer/Generator* menu vary as a function of the application. However, all *Analyzer/Generator* settings are always identical to the corresponding settings in the *Power* and *Modulation* menus. Changes made in the *Analyzer/Generator* menu overwrite the *Power* and *Modulation* settings and vice versa.

Description of settings

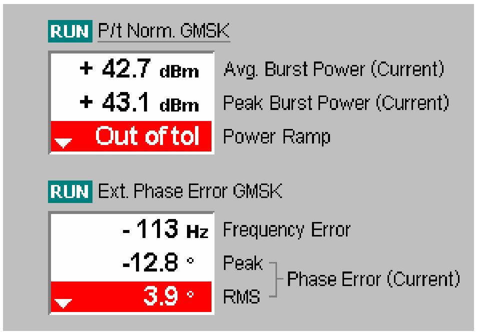
- The settings to be made in the *P/t Normal GMSK* application are described in section *P/t Normal GMSK* on p. 4.11 ff.
- The settings to be made in the *Ext. Phase Error GMSK* application are described in section *Test Settings* on p. 4.43 ff.
- The settings to be made in the *Overview 8PSK* application are described in section *Test Settings* on p. 4.49 ff.

Setup table

The *Setup* table in the right half of the *Analyzer/Generator* menu gives an overview of the measurement settings belonging to the current application. It changes when a different application is selected. The roll-key scrolls and expands the *Setup* table.

Measurement Results

The results displayed in the *Analyzer/Generator* menu depend on the selected application:



The results for the *P/t Norm. GMSK* and *Ext. Phase Error GMSK* applications are displayed simultaneously because both applications can be run in parallel. The results appear in two output fields, each containing three entries. A header line indicates the name of the application and its measurement status. The current application is underscored.

All results refer to the current burst. No comparison is made between different bursts, so the result does not depend on the statistical settings (e.g. single shot or continuous measurement).

P/t Norm. GMSK

The *P/t Norm. GMSK* output field indicates the average and peak burst power as well as the result of the limit check:

Avg. Burst Power (Current)	Average power of the current burst in dBm.
Peak Burst Power (Current)	Peak power of the current burst in dBm.
Power Ramp	Matching of the tolerances by the current burst. The messages that may appear in the list field are self-explanatory.

The *P/t Norm. GMSK* results are also indicated in the info box in the graphical measurement menu *Power* (see section *P/t Normal GMSK* on p. 4.20 ff.).

Remote control
```
READ[:SCALar]:POWer[:NORMal][:GMSK]?
FETCh[:SCALar]:POWer[:NORMal][:GMSK]?
SAMPle[:SCALar]:POWer[:NORMal][:GMSK]?
```

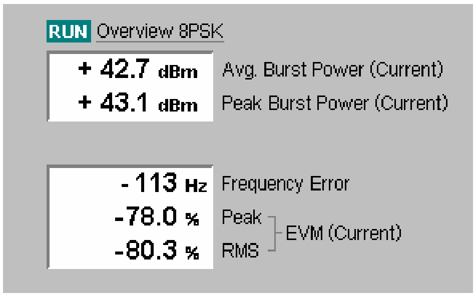
Ext. Phase Error GMSK

The *Ext. Phase Error GMSK* output field indicates the average (RMS) and peak phase error and the frequency error:

Frequency Error	Frequency error of the current burst in Hz.
Peak Phase Error (Current)	Extreme value of the phase error (minimum or maximum, whichever has the larger absolute value) of the current burst in degrees. The result can be positive or negative.
RMS Phase Error (Current)	RMS phase error of the current burst in degrees.

The *Ext. Phase Err. GMSK* results are also indicated in the graphical measurement menu *Modulation* (see section *Measurement Results* on p. 4.45 ff.). For a detailed explanation of the quantities characterizing the GMSK modulation accuracy see section *Measurement Menu (Modulation – GMSK)* on p. 4.42 f.

Remote control
```
READ[:SCALar]:MODulation:XPERror[:GMSK]?
FETCh[:SCALar]:MODulation:XPERror[:GMSK]?
SAMPle[:SCALar]:MODulation:XPERror[:GMSK]?
```



The results for the *Overview 8PSK* application appear in two output fields with two and three rows, respectively. A header line indicates the name of the application and its measurement status.

All results refer to the current burst. No comparison is made between different bursts, so the result does not depend on the statistical settings (e.g. single shot or continuous measurement).

Overview 8PSK

The *Overview 8PSK* output fields indicate the average and peak burst power, the average (RMS) and peak Error Vector Magnitude (EVM) and the frequency error:

Avg. Burst Power (Current) Average power of the current burst in dBm.

Peak Burst Power (Current) Peak power of the current burst in dBm.

Frequency Error Frequency error of the current burst in Hz.

Peak EVM (Current) Extreme value of the Error Vector Magnitude (minimum or maximum, whichever has the larger absolute value) of the current burst in degrees. The result can be positive or negative.

RMS EVM (Current) RMS-averaged EVM of the current burst in degrees. Quadratic averaging complies with the GSM standard.

The *Overview 8PSK* results are also indicated in the measurement menu *Modulation* (see section *Scalar Results (Overview)* on p. 4.51). For a detailed explanation of the quantities characterizing the 8PSK modulation accuracy see section *Measurement Menu (Modulation – 8PSK)* on p. 4.47 f.

Remote control
```
READ[:SCALar]:MODulation:OVERview:EPSK?
FETCh[:SCALar]:MODulation:OVERview:EPSK?
SAMPle[:SCALar]:MODulation:OVERview:EPSK?
```

Power Measurements

The menu group *Power* is designed to measure the RF output power of the MS transmitter. The power can be analyzed as a function of time in a single timeslot or in up to 4 consecutive timeslots. Furthermore, the CMU evaluates the average power and its evolution over several consecutive slots or frames. The different measurements are treated as different applications which can be selected with the *Application* softkey; the results are displayed in separate *Power* measurement menus. The popup menu *Power Configuration* provides configuration settings for all applications.

P/t Normal

The *P/t Normal ...* (burst power versus time) application measures the output power of the DUT over one burst period. The measurement curve obtained can be further processed to determine an average, minimum, or maximum result and calculate the average over the whole burst. *P/t* measurements are provided for normal bursts at GMSK or 8MSK modulation.

In addition to the burst power measurement, a limit check with tolerances depending on the RF output power of the DUT and the modulation scheme is performed; see section *Limit lines (Power Configuration – Limit Lines)* on p. 4.35 ff.

P/t Multislot

The *P/t Multislot* application measures the output power of the DUT over up to 653 symbol periods, corresponding to 4 timeslots plus an appropriate display margin. This measurement is particularly suited to GSM multislot solutions like GPRS or circuit-switched HSCSD where several timeslots can be allocated to a single connection.

The multislot measurement curve can be further processed to determine an average, minimum, or maximum result and calculate the average power over each burst measured. *P/t Multislot* measurements are provided both in *Non Signalling* and in *Signalling* test mode and for normal bursts at GMSK and 8PSK modulation. In addition to the burst power measurement, a limit check with tolerances depending on the RF output power of the DUT and the modulation scheme is performed; see section *Limit lines (Power Configuration – Limit Lines)* on p. 4.35 ff.

P/Slot

The *P/Slot* applications measure the average burst power in a series of consecutive timeslots. The average is taken over a section of the useful part of the burst; it is not correlated to the training sequence. The result is displayed either in a bar graph (all eight timeslots of a single TDMA frame, *P/Slot Graph* application) or in a table (up to 512 timeslots, corresponding to a total test time of approx. 0.3 s, *P/Slot Table* application).

P/Frame

The *P/Frame* measurement represents a fast and convenient method of monitoring the behavior of the average burst power in a particular timeslot over a whole range of consecutive TDMA frames. The measurement extends over a range of up to 256 frames, corresponding to test times of less than 1.2 s. The average is obtained like in the case of *P/Slot* measurements.

The *P/Slot* and the *P/Frame* measurement complement the *P/t* measurement where a large number of bursts can be measured but the output of the average burst power is restricted to current, average, minimum or maximum values within a statistics cycle (see *Display Mode* setting below). *P/Slot and P/Frame* returns **all** values; the applications are suitable whenever the behavior or the stability of the average burst power in particular timeslots are to be monitored over an extended time range in R&D.

RF Level

In all applications, the CMU measures at arbitrary RF input levels provided that they are within the allowed range of the RF input connectors.

Signalling mode

Note: *In Signalling mode, where the CMU is able to test a broad range of signalling issues, two further measurement applications are available (see section* Power Measurements *on page 4.112 ff):*

The average burst power can be measured as a function of the PCL of the mobile phone (application P/PCL*).*

Access bursts from the mobile station can be measured (see also section Limit lines (Power Configuration – Limit Lines) on page 4.35 ff.

Note: *An additional application,* TX Calibration, *is available with option R&S CMU-K47,* Smart Alignment @ GSM-MS. *For a description refer to Chapter 8 of this manual.*

Measurement Menu (Power)

The graphical measurement menu *Power* shows the results of the burst analysis (power measurement).

- The measurement control softkey *P/t Norm. GMSK,* which changes to *P/t Norm. 8PSK, P/Frame* etc., depending on the power measurement application and on the modulation scheme selected) controls the power measurement, indicates its status *(RUN* | *HLT* | *OFF)* and opens the configuration menu *Power Configuration*. The hotkeys associated to the measurement control softkey define the scope of the *Power* measurement.
- The other softkeys to the right of the test diagram are combined with various hotkeys (e.g. the hotkeys *Template PCL, Frequency, Channel, Frequency Offset,* and *Training Sequence* belong to the softkey *Analyzer Settings).* The softkey/hotkey combinations provide test settings and switch over between different measurements.

The measurement menu *Power* is opened from the main menu *Menu Select* (with the associated key at the front of the instrument) or using the *Menus* softkey and the *Power* hotkey.

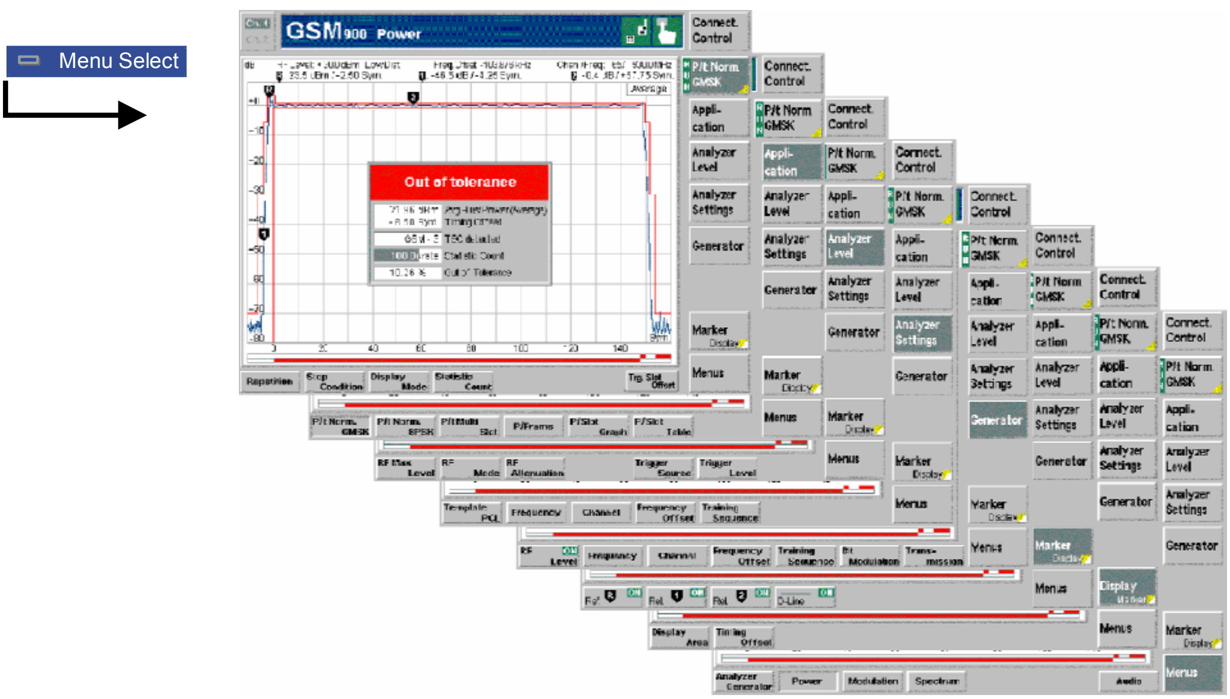


Fig. 4-2 Measurement menu Power – P/t Norm. GMSK

Test Settings

The basic settings for the *Power* measurement are directly accessible from the measurement menu via softkey/hotkey combinations. The entry of values is described in section *Test Settings* on page 4.3.

Many of the basic settings are also accessible from the *Power Configuration* popup menu. They are explained in more detail in section *Measurement Configurations (Power Configuration)* on page 4.29 ff.

a) Measurement Control

Each *Power* application is controlled by means of the measurement control softkey below the *Connect. Control* softkey and the associated hotkeys.

P/t Norm. GMSK

The *P/t Norm. GMSK* measurement control softkey (which changes to *P/t Norm. 8PSK* etc., depending on the application selected) controls the power measurement application and indicates its status *(RUN | HLT | OFF)*. This status can be changed after softkey selection (pressing once) by means of the *ON/OFF* key or the *CONT/HALT* key. The status can be set independently for all *Power* applications.

The active *Power* application generally suspends the other applications. On switchover between different applications, the selected measurement status of each application is stored and will be put into effect as soon as the application is activated. In particular, an application in the status *RUN* is restarted each time it is activated.

Remote control
```
INITiate:<Application>
ABORt:<Application>
STOP:<Application>
CONTinue:<Application>
FETCh:<Application>:STATus?
<Application> = POWer:NORMal[:GMSK]
```
etc.

Measurement configuration

Pressing the *P/t Norm. GMSK* softkey twice opens the popup menu *Power Configuration* (see page 4.29). Besides, the measurement control softkey provides hotkeys to define the scope of the measurement. All these settings are described in more detail in section *Measurement Control (Power Configuration – Control)* on page 4.29 ff.

b) Selecting the Measurement Application

Appli-cation

The Application softkey selects the power measurement application.

The applications *P/t Normal <Mod_Type>* depend on the modulation scheme of the analyzed signal. In the *P/t Multislot* application, the modulation in each measured slot can be defined separately. The *P/Frame, P/Slot Graph,* and *P/Slot Table* menus and settings do not depend on the modulation scheme.

The *Power* measurement menu and the measurement control softkey change with the application selected; the results are explained in section *Measurement Results* on page 4.20 ff.

P/t Normal GMSK

The *P/t Normal GMSK* hotkey selects the power versus time measurement for GMSK modulated normal burst signals (see explanation of GSM burst structure at the beginning of section *Limit lines (Power Configuration – Limit Lines)* on page 4.35).

Remote control:

The *P/t Normal GMSK* application is selected by the keywords [:NORMal] [:GMSK] in the 3rd and 4th level of the POWer commands, e.g. CONFigure:POWer [:NORMal][:GMSK]...

P/t Normal 8PSK

The *P/t Normal 8PSK* hotkey selects the power versus time measurement for 8PSK modulated normal burst signals (see explanation of GSM burst structure at the beginning of section *Limit lines (Power Configuration – Limit Lines)* on page 4.35).

Remote control:
The *P/t Normal 8PSK* application is selected by the keywords `[:NORMal]:EPSK` in the 3rd and 4th level of the POWer commands, e.g. `CONFigure:POWer[:NORMal]:EPSK...`

P/t Multislot

The *P/t Multislot* hotkey selects the power versus time measurement for multislot configurations (see explanation of GSM burst structure at the beginning of section *Limit lines (Power Configuration – Limit Lines)* on page 4.35).

Remote control:
The *P/t Multislot* application is selected by the 3rd level keyword `:MSLot` in the POWer commands, e.g. `CONFigure:POWer:MSLot...`

P/Frame

The *P/Frame* hotkey selects the power versus frame measurement. In this application, the average burst power in a particular timeslot is measured over a range of consecutive TDMA frames and displayed in tabular form.

Remote control:
The *P/Frame* application is selected by the keyword `:FRAMe` in the 3rd level of the `POWer` commands, e.g. `CONFigure:POWer:FRAMe...`

P/Slot Graph

The *P/Slot Graph* hotkey selects the power versus slot measurement with graphical display. In this application, the average burst power in all eight timeslots of a TDMA frame is measured and displayed in a bar graph.

Remote control:
The *P/Slot Graph* application is selected by the keyword `:SLOT` in the 3rd level of the `POWer` commands, e.g. `CONFigure:POWer:SLOT...`

P/Slot Table

The *P/Slot Table* hotkey selects the power versus slot measurement with tabular display. In this application, the average burst power in all eight timeslots of several consecutive TDMA frames is measured and displayed in a table.

Remote control:
The *P/Slot Table* application is selected by the keyword `:XSLot` in the 3rd level of the `POWer` commands, e.g. `CONFigure:POWer:XSLot...`

Some of the following test settings depend on the selected application.

c) P/t Normal GMSK

All softkeys and hotkeys in the *P/t Normal GMSK* application are shown in *Fig. 4-2* on page 4.9.

P/t Norm. GMSK

The *P/t Norm. GMSK* measurement control softkey controls the *P/t Norm. GMSK* measurement; see detailed explanation in section *Measurement Control* on p. 4.10. Besides, the measurement control softkey provides hotkeys to define the scope of the measurement. All these settings are described in more detail in section *Measurement Control (Power Configuration – Control)* on page 4.29 ff.

Repetition

The hotkey *Repetition* determines the repetition mode of the measurement *(Single Shot* or *Continuous* measurement).

Remote control

```
CONFigure:POWer[:NORMal][:GMSK]:CONTrol:REPetition
   <Repetition>,<StopCond>,<Stepmode>
```

Stop Condition

The *Stop Condition* hotkey sets a stop condition for the measurement *(None* or *On Limit Failure)*.

Remote control
```
CONFigure:POWer[:NORMal][:GMSK]:CONTrol:REPetition
             <Repetition>,<StopCond>,<Stepmode>
```

Display Mode

The hotkey *Display Mode* determines the display mode of the measurement curve.

Remote control
no display mode set, the four measurement curves are accessible via
```
FETCh:ARRAy:POWer[:NORMal][:GMSK][:CURRent]?
FETCh:ARRAy:POWer[:NORMal][:GMSK]:MINimum?
FETCh:ARRAy:POWer[:NORMal][:GMSK]:MAXimum?
FETCh:ARRAy:POWer[:NORMal][:GMSK]:AVERage?
```
etc.

Statistic Count

The *Statistic Count* hotkey defines the number of bursts per statistic cycle.

Remote control
```
CONFigure:POWer[:NORMal][:GMSK]:CONTrol
  <Mode>,1 ... 1000 | NONE
```

Trig. Slot Offset

The *Trig. Slot Offset* hotkey defines a delay time (integer number of GSM timeslots) between the trigger time and the measured timeslot (see *Fig. 4-3* on p. 4.18). In the default setting *(Trig. Slot Offset = 0)* the measured timeslot is determined by the trigger time. By varying the *Trig. Slot Offset,* an unknown GSM signal can be analyzed timeslot by timeslot at constant trigger settings.

Remote control
```
CONFigure:RFANalyzer:MCONTrol:TSOFfset 0 to 7
```

Analyzer Level Trg.

The *Analyzer Level/Trg.* softkey controls the level in the RF input signal path. The second level *(Trigger/Ana. Lvl.)* provides the trigger settings for the measurements.

The input level and trigger settings are also provided in the *Analyzer* and the *Trigger* tabs of the *Connection Control* menu. For a detailed description see sections *Table-Oriented Version* on p. 4.86 ff. and Trigger (Connection Control – Trigger) on p. 4.100 ff.

RF Max. Level

The *RF Max. Level* hotkey sets the maximum expected input level in dBm.

Remote control
```
[SENSE:]LEVel:MAXimum  <Level>
```

RF Mode

The *RF Mode* hotkey determines how the input level is defined.

Manual Manual input via *RF Max. Level* hotkey

Auto Automatic setting according to the average burst power of the applied signal.

Remote control
```
[SENSE:]LEVel:MODE  MANual | AUTomatic
```

RF Attenuation

The *RF Attenuation* hotkey selects a strategy for tuning the RF analyzer.

Normal	Input signal is kept unchanged
Low Noise	Enhanced mixer level. This setting ensures the full dynamic range of the CMU and is therefore recommended for *Power* and *Spectrum* measurements.
Low Distortion	Decreased mixer level. This setting ensures a high transmission reserve and is therefore recommended for *Modulation* measurements.

Remote control
```
[SENSE:]LEVel:ATTenuation  NORMal | LNOIse | LDIStortion
```

Trigger Source

The *Trigger Source* hotkey determines the trigger condition.

Free Run	Trigger by TDMA timing of the incoming burst
RF Power	Trigger on power (rising edge) of incoming burst, wideband trigger at the Front End
IF Power	Narrow-band trigger
Extern	External trigger signal fed in via connector AUX3 (pin 8)

Note: *The Free Run trigger generally slows down the measurements. It must not be used in the P/t Multislot, P/Frame, P/Slot Graph, and P/Slot Table applications.*

Remote control
```
TRIGger[:SEQuence]:SOURce
          FRUN | RFPOWer | IFPOWer | EXTern
```

Trigger Level

The *Trigger Level* hotkey determines the trigger level. This softkey is enabled for trigger source *RF Power* or *IF Power* only.

Remote control
```
TRIGger[:SEQuence]:THReshold LOW | MEDium | HIGH
```

Analyzer Settings

The *Analyzer Settings* softkey determines the template PCL, frequency and training sequence of the RF signal analyzed.

Template PCL

The *Template PCL* hotkey sets a power control level to correct the limit lines.

The template PCL merely serves to define a dynamic correction to the limit lines and the limits of the average burst power in analogy to the correction in the *Signalling* mode. It is not related to the transmit power of the mobile station under test.

Template PCLs between 0 and 31 may be selected; see tables in section *Limit Values for Average Burst Power* on page 4.127 ff.

Remote control
```
CONFigure:RFANalyzer:TPCL <PCL>
```

The following analyzer settings are described in more detail in section *RF Analyzer Settings (Connection Control – Analyzer)* on p. 4.82.

Frequency

The *Frequency* hotkey defines the frequency of the analyzed signal in MHz.

Remote control
`[SENSe:]RFANalyzer:CHANnel <Number>`

Channel

The *Channel* hotkey defines the GSM channel number of the analyzed signal.

Remote control
`[SENSe:]RFANalyzer:CHANnel <Number>`

Frequency Offset

The *Frequency Offset* hotkey defines a frequency offset relative to the signal frequency or GSM channel frequency defined with the *Frequency* or *Channel* hotkeys.
Remote control
`[SENSe:]RFANalyzer:FREQuency:OFFSet <Offset>`

Training Sequence

The *Training Sequence* hotkey defines a training sequence for the analyzed signal.

Remote control
`[SENSe:]RFANalyzer:TSEQuence <TSC>`

Generator Settings

The *Generator Settings* softkey configures the RF signal generated.

The following generator settings are described in more detail in section *Generator Settings (Connection Control – Generator)* on p. 4.88.

RF Level

The *RF Level* hotkey defines the generator level in the used timeslot in dBm.

Remote control
`SOURce:RFGenerator:LEVel:UTIMeslot <Level>`

Frequency

The *Frequency* hotkey defines the frequency of the RF generator signal in MHz.

Remote control
`SOURce:RFGenerator:FREQuency[:CHANnel] <Frequency>`

Channel

The *Channel* hotkey defines the GSM channel number of the generator signal.

Remote control
`SOURce:RFGenerator:FREQuency[:CHANnel] <ChannelCH>`

Frequency Offset

The *Frequency Offset* hotkey defines a frequency offset relative to the signal frequency or GSM channel frequency defined with the *Frequency* or *Channel* hotkeys.

Remote control
`SOURce:RFGenerator:FM:DEViation <Offset>`

Training Sequence

The *Training Sequence* hotkey selects a training sequence for the generator signal.

Remote control
`CONFigure:RFGenerator:MODulation:TSEQuence:SELection <TSC>`

Bit Modulation

The *Bit Modulation* hotkey selects a bit sequence to be modulated onto the generator signal.

Remote control
`CONFigure:RFGenerator:MODulation:BIT:SELection <Sequence>`

Trans- mission

The *Transmission* hotkey determines the shape of the generator signal (burst signal or continuous wave with constant level). An 8PSK-modulated signal is always bursted.

Remote control
`CONFigure:RFGenerator:MODulation:TRANsmission <Mode>`

Marker Display

The *Marker/Display* softkey positions up to 3 markers and a D-line in the test diagram and displays their values.

If pressed once again, the selected *Marker/Display* softkey changes to the *Display/Marker* softkey, see below.

Markers — are graphical tools for marking points on the measurement curve and for numerical output of measured values. The measurement menu Power provides a reference marker and two further markers which permit to measure differences (delta marker 1 and 2).
The coordinates of the three markers are indicated in the format Ordinate value (level)/abscissa value (time) in a parameter line above the test diagram. The position of the reference marker is expressed in absolute units (level in dBm and time in symbol periods), the delta marker by absolute or relative values (relative level in dB or time differences from the reference marker).

D-line — The D-line (display line) is a horizontal line that can be positioned on the test diagram at will to mark and read out level values.

Ref R

The hotkey *Ref. R* switches the reference marker on or off (use the *ON/OFF* key).

The reference marker is represented by the symbol R in the test diagram. The marker position (abscissa) is defined in the input field *Ref. Marker R*. The marker can be positioned to arbitrary time values. It is switched off in the default setting *(Off).* The marker level is given by the measurement curve at the marker position.

The position of all markers can be varied using the rollkey.

Remote control
No command, screen configuration only.

Rel 1

The *Rel. 1* hotkey switches the delta marker 1 on or off (use the *ON/OFF* key).

The delta marker 1 is represented by the symbol 1 in the test diagram. The marker position (abscissa) is defined in the input field *Rel. Marker 1*. The marker can be positioned to arbitrary time values. If its position is outside the diagram area it will be invisible and its coordinates will be “<abscissa_value> / - - -“. The marker is switched off in the default setting *(Off).* The marker level is given by the measurement curve at the marker position.

The toggle switch *Rel 1 Config* pops up when the hotkey is pressed for the second time. It defines whether the position of delta marker 1 is measured and indicated in absolute units (dBm) or relative to the reference marker.

Remote control
No command, screen configuration only.

Rel 2

The *Rel. 2* hotkey switches the delta marker 2 on or off (use the *ON/OFF* key). Functions and remote control are analogous to delta marker 1.

D-Line

The *D-Line* hotkey switches the D-line in the test diagram on or off.

The D-line is a horizontal, colored auxiliary line in the test diagram and is used for marking a level value and for measuring level differences. The level (ordinate) is determined in the input field *D-Line* and indicated on the D-line. The permissible value range is the diagram area, the default setting is Off.

The switch *D-Line Config.* is opened by pressing *D-Line* twice and determines whether the D-line level is expressed in absolute units (in dBm, setting absolute) or relative to the Max. Level (in dB, setting relative).

Remote control
No command, screen configuration only.

Display Marker

The *Display/Marker* softkey zooms or shifts the graphical display. It is selected by pressing the *Marker/Display* softkey twice. If pressed once again, the selected *Display/Marker* softkey changes back to the *Marker/Display* softkey, see above.

Display Area

The *Display Area* hotkey selects the displayed screen area.

It is possible to select either the complete burst (see Fig. 4-12), or zoom in to a particular area:

Full Range	Display of complete burst in the time range –10 symbols to 157 symbols and levels between –80 dBc and 10 dBc
Useful Part	Full time range, measurement curve magnified around the reference level
Left Upper Corner	Measurement curve magnified around the left upper corner
Rising Edge	Full level range, time axis from –10 symbols to 10 symbols
Right Upper Corner	Measurement curve magnified around the right upper corner
Falling Edge	Full level range, time axis from 139 symbols to 157 symbols

The screen setting and the measurement do not affect each other.

Remote control
No command, screen configuration only.

Timing Offset

The *Timing Offset* hotkey shifts the burst by the entered number of symbols.

The burst is shifted relative to the time axis and the tolerance template for the burst analysis, see section *Limit lines (Power Configuration – Limit Lines)* on page 4.35. Therefore, the value of *Timing Bit Offset* affects the result of the tolerance check.

Remote control

```
CONFigure:POWer[:NORMal][:GMSK]:TOFFset <Offset>
CONFigure:POWer[:NORMal]:EPSK:TOFFset <Offset>
```

Menus

The *Menus* softkey displays the hotkey bar for changing to the other measurement groups. The main measurement menu within each group is directly opened by pressing the associated hotkey.

d) P/t Normal 8PSK

The *P/t Normal 8PSK* test settings differ from the *P/t Normal GMSK* settings (see p. 4.11 ff.) in two softkeys.

P/t Norm. 8PSK

The *P/t Norm. 8PSK* measurement control softkey controls the *P/t Norm. 8PSK* measurement; see detailed explanation in section *Measurement Control* on p. 4.10. Besides, the measurement control softkey provides hotkeys to define the scope of the measurement. All these settings are described in more detail in section *Measurement Control (Power Configuration – Control)* on page 4.29 ff. The *Repetition, Stop Condition, Display Mode,* and *Statistic Count* softkeys behave as described in section *P/t Normal GMSK* on page 4.11 ff. In the *P/t Norm. 8PSK* application, there is one additional hotkey:

Ref Power Mode

The *Ref. Power Mode* hotkey defines whether the reference power (0-dB line) in the measurement diagram is derived from the average power of the current measurement curve *(Current),* the average power of the average curve *(Average),* or the average power of the current curve with an additional correction for the deviation due to the data modulated onto the RF signal *(Data Compens.).* See section *Measurement Control (Power Configuration – Control)* on page 4.29.

Remote control

```
CONFigure:POWer[:NORMal]:EPSK:CONTrol:RPMode
  CURRent | AVERage | DCOMpens
```

8PSK and GMSK symbol periods are of equal length, see explanation of GSM burst structure at the beginning of section *Limit lines (Power Configuration – Limit Lines)* on page 4.35.

e) P/t Multislot

The *P/t Multislot* test settings differ from the *P/t Normal GMSK* settings (see p. 4.11 ff.) in several respects. Most of the differences are related to the configuration of the measurement and display range.

Note: *No Free Run trigger must be used in the P/t Multislot, P/Frame, P/Slot Graph, and P/Slot Table applications.*

Multislot

The *Multislot* measurement control softkey controls the *P/t Multislot* measurement; see detailed explanation in section *Measurement Control* on p. 4.10. Besides, the measurement control softkey provides hotkeys to define the scope of the measurement. Most of these settings are described in more detail in section *Measurement Control (Power Configuration – Control)* on page 4.29 ff. The *Repetition, Stop Condition, Display Mode,* and *Statistic Count* softkeys behave as described in section *P/t Normal GMSK* on page 4.11 ff. In the *P/t Multislot* application, there are two additional hotkeys:

Slot Count

The hotkey *Slot Count* defines an integer number of timeslots to be measured. The actual measured time range is larger than the integer number of slots because it comprises an additional display margin; for details see remote control command description. The relation between the measured time range and the trigger time is given by the *Trig. Slot Offset;* see *Fig. 4-3* on p. 4.18.

The display range is adapted to the *Slot Count* settings by default but can be modified by means of the *Display Marker – Time Scale* and *Display Marker – Default Scale* hotkeys. Changing the *Slot Count* overrides the *Time Scale* settings and restores the default display range.

Remote control
`CONFigure:POWer:MSLot:SCOunt`

Trig. Slot Offset

The hotkey *Trig. Slot Offset* defines a delay time (integer number of GSM timeslots) between the trigger time and the timeslot that is measured in all *Multislot* configurations. In the graphical display, this measured timeslot is marked by *Trg. Slot Offs. 0*.

- If *Slot Count* is equal to 1, then the measurement extends over the measured timeslot plus an appropriate display margin.
- If *Slot Count* is equal to 2, then the timeslot preceding the measured timeslot *(Trg. Slot Offs. –1)* and the measured slot *(Trg. Slot Offs. 0)* are measured.
- If *Slot Count* is equal to 3 (4), then *Trg. Slot Offs – 1, Trg. Slot Offs. 0* and the next timeslot (the two next timeslots, *Trg. Slot Offs. + 1* and *Trg. Slot Offs. + 2)* are measured.

The beginning of the measured timeslot defines the origin (symbol no. 0) of the time axis. The measured timeslot is also the reference for the *Timing* measurement; it must be active to obtain valid measurement results.

The relation between the *Trig. Slot Offset*, the *Slot Count* and the measured time range for a signal with three active timeslots is shown in *Fig. 4-3 below*.

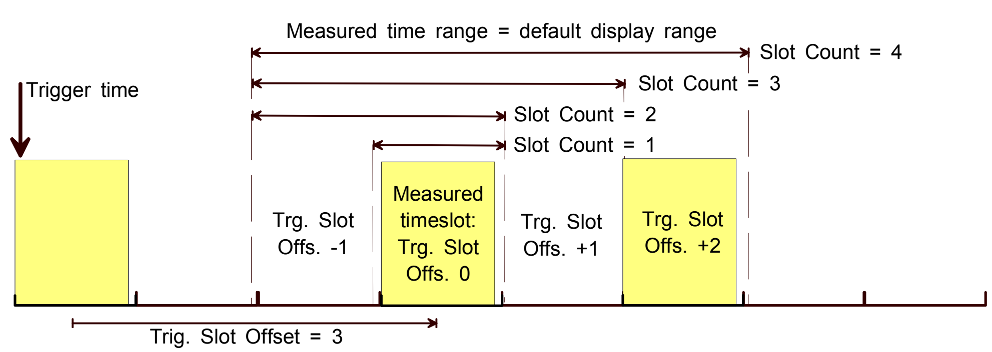


Fig. 4-3 Trigger slot offset and slot count (for Trig. Slot Offset = 3)

The display range is adapted to the *Slot Count* and *Trig. Slot Offset* settings by default but can be modified by means of the *Display Marker – Time Scale* and *Display Marker – Default Scale* hotkeys.

Remote control
`CONFigure:RFANalyzer:MCONtrol:TSOFfset 0 to 7`

Display Marker

The *Display/Marker* softkey, which is activated by pressing the selected *Marker/Display* softkey again, configures the graphical display.

Info Box

The hotkey *Info Box* switches the info boxes for all displayed timeslots on or off. For a description of the info boxes see section *P/t Multislot* on p. 4.23 ff.

Remote control
No command, display configuration only

Timing Offset

The *Timing Offset* hotkey shifts the burst by the entered number of symbol periods, e.g. to compensate for a known, constant timing error of the MS. See section *Measurement Control (Power Configuration – Control)* on p. 4.29 ff.

Remote control
`CONFigure:POWer:MSLot:TOFFset`

Modulation View

The hotkey *Modulation View* defines the expected modulation scheme and burst type in all four timeslots that can be measured and adjusts the power/time template. To obtain a valid measurement result, the actual modulation scheme and burst type in all measured slots (see *Fig. 4-3* on p. 4.18) must be compatible with the *Modulation View* settings. See section *Measurement Control (Power Configuration – Control)* on p. 4.29 ff.

Remote control
`CONFigure:POWer:MSLot:MVIew`

Level Scale

The *Level Scale* hotkey defines a maximum RF level in dBm *(Max)* and a level range in dB *(Span)* that will be displayed in the graphical diagram and thus determines the scale of the y axis.

Remote control
No command, display configuration only

Time Scale

The *Time Scale* hotkey defines the start time *(Start)* and the total time interval *(Span)* that will be displayed in the graphical diagram and thus determines the scale of the x axis.

Both values are expressed in symbol periods. 1 symbol corresponds to approx. 3.69 µs so that 1 timeslot comprises 156 ¼ symbols. *Start* is expressed relative to symbol 0 of the measured timeslot (see *Fig. 4-3* on p. 4.18). *Time Scale* only configures the diagram; it does not affect the number of timeslots actually measured but is modified as this number is changed (see *Slot Count* hotkey on p. 4.73).

Remote control
No command, display configuration only

Default Scale

The *Default Scale* hotkey sets a default *Level Scale* and a default *Time Scale*, the latter corresponding to the number of timeslots measured (see *Slot Count* hotkey on p. 4.73) plus an appropriate display margin.

Remote control
No command, display configuration only

f) P/Frame, P/Slot Graph, P/Slot Table

The *P/Frame, P/Slot Graph, P/Slot Table,* and *TX Calibration* test settings differ from the *P/t Normal GMSK* settings (see p. 4.11 ff.) in several respects:

- The measurement statistics is simplified; only the repetition mode can be set.
- Everything related to the measurement curve *(Display Mode, Markers, Display settings)* is omitted.
- In the *P/Slot Table* and *P/Frame* applications, the number of slots to be measured *(Slot Count, Frame Count)* can be set.
- The *P/Slot Table* application provides a special *Retriggered* measurement mode where a series of possibly non-equidistant bursts with decreasing levels is measured. The test settings for the retriggered measurement are associated with the measurement control softkey and also accessible from the *Control* tab of the *Power Configuration* menu; see section *Measurement Control (Power Configuration – Control)* on page 4.29 ff.

The remaining settings are identical with those of the *P/t Normal GMSK* application; see page 4.11 ff.

Note: *No Free Run trigger must be used in the P/t Multislot, P/Frame, P/Slot Graph, and P/Slot Table applications.*

Measurement Results

The measurement results depend on the selected application.

a) P/t Normal GMSK

The values shown in the measurement menu *Power*, application *P/t Normal GMSK,* can be divided into three groups:

- Settings
- Scalar measurement results (single values)
- Arrays (the measurement curve plotted as a function of time)

These values are indicated in two parameter lines, the test diagram and an info box:

Parameter line 1, 2

Test diagram

Info box

Limit Check

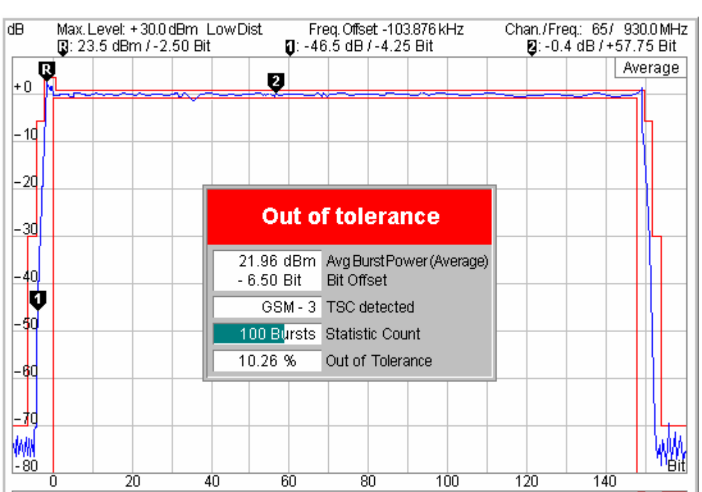


Fig. 4-4 Display of results (Power – P/t Norm. GMSK)

Settings/ scalar measurement results

Settings and scalar measurement results are indicated in the two parameter lines above the test diagram and in the info box, a popup window in the middle of the graphical screen *Power*.

1st parameter line

The first parameter line contains the following settings:

Max. Level Maximum expected input level as set in the *Analyzer* tab of the *Connection Control* menu (see section *Table-Oriented Version* on p. 4.86 ff.)

Attenuation Input path attenuation *(Normal, Low Noise, Low Distortion)* as set in the *Analyzer* tab of the *Connection Control* menu (see section *Table-Oriented Version* on p. 4.86 ff.)

Freq. Offset Frequency offset compared to the nominal channel frequency

Chan./Trig. Slot Offs. RF channel and trigger slot offset (see *Trig. Slot Offset* hotkey on p. 4.18)

2nd parameter line

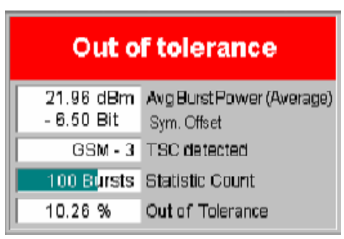
The second parameter line contains the following marker values:


Level and time of reference marker


Level and time of delta marker 1 (setting *absolute*) or difference from reference marker (setting *relative*)


Level and time of delta marker 2 (setting absolute) or difference from reference marker (setting relative)

Info box



The info box contains the following settings:

Sym. Offset *Time Delay* set by means of the *Display/Marker* softkey: Number of symbols that the burst is shifted with respect to the time axis and the tolerance template. In *Signalling* mode, the measured timing advance error is displayed instead.

Statistic Count Number of bursts per statistics cycle, as set in the *Control* tab of the *Power Configuration* menu.

In addition, the following scalar results are indicated:

Avg Burst Power Average burst power, depending on the display mode set (see upper right corner of the diagram).

TSC detected Training sequence of the measured RF burst *(GSM – 0 to 7 | Dummy* | ---.

Out of Tolerance Relative number of bursts that are out of the tolerances defined by the limit lines.

Burst Matching Error message if the displayed curve is out of tolerance.

Remote control
Settings are retrieved using the query corresponding to the setting command (setting command with appended question mark).

For scalar measurement results:

```
READ[:SCALar]:POWer[:NORMal][:GMSK]?
CALCulate[:SCALar]:POWer[:NORMal][:GMSK]
```

```
   :LIMit:MATChing?
FETCh[:SCALar]:POWer[:NORMal][:GMSK]?
SAMPle[:SCALar]:POWer[:NORMal][:GMSK]?
```

Measurement curves (arrays)

The measurement result is displayed as a continuous measurement curve in the test diagram together with the limit lines, markers and the D-line, if defined. The curve is derived from 668 equidistant measurement points with a ¼ symbol spacing covering a time range between –10 symbols and 156 ¾ symbols.

The measurement curve in the *Power* measurement menu shows the measured burst power (in dB) as a function of time (in symbol periods). The displayed result depends on various test settings. The display mode for the measurement curve *(Minimum, Maximum, Average, Current)* is indicated in the upper right corner of the diagram.

The scale of both axes can be adjusted via the *Display Area* hotkey (see section *P/t Normal GMSK* on p. 4.20).

Remote control

```
READ:ARRay:POWer[:NORMal][:GMSK]...?
FETCh:ARRay:POWer[:NORMal][:GMSK]...?
SAMPle:ARRay:POWer[:NORMal][:GMSK]...?
```

Limit Check

The result of the limit check is visualized in two colored bars below the diagram. In each area of the burst, the upper (lower) bar turns red if the result exceeds (falls below) the power/time template defined in the *Limit Lines* tab of the *Power Configuration* menu.

Remote control

```
CALCulate[:SCALar]:POWer[:NORMal][:GMSK]:LIMit:MATChing...?
```

b) P/t Normal 8PSK

As shown in *Fig. 4-5* below, the *P/t Normal 8PSK* measurement results are similar to the *P/t Normal GMSK* results. The x-axis scale of both diagrams is equal because 8PSK and GMSK symbol periods are of equal length. The following differences occur:

- The default limit lines differ from the GMSK limit lines.

See explanation of GSM burst structure and power/time templates in section *Limit lines (Power Configuration – Limit Lines)* on page 4.35 ff.

Parameter line 1, 2

Test diagram

Info box

Limit Check

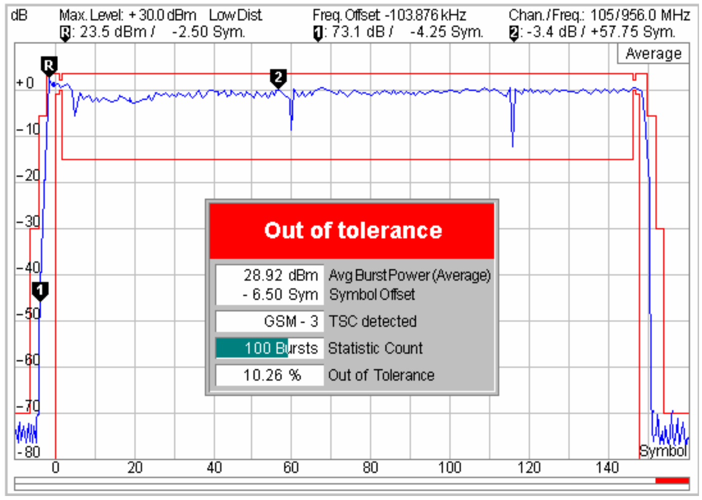


Fig. 4-5 Display of results (Power – P/t Norm. 8PSK)

c) P/t Multislot

As shown in *Fig. 4-6* below, the *P/t Multislot* measurement results are similar to the *P/t Normal GMSK* results. The following differences occur:

- The first parameter line shows the selected *Trig. Slot Offset*, see p. 4.18.
- The info boxes, the diagram and the limit lines differ from the single-slot configuration, see below.

Parameter line 1, 2

Test diagram

Info boxes

Limit Check

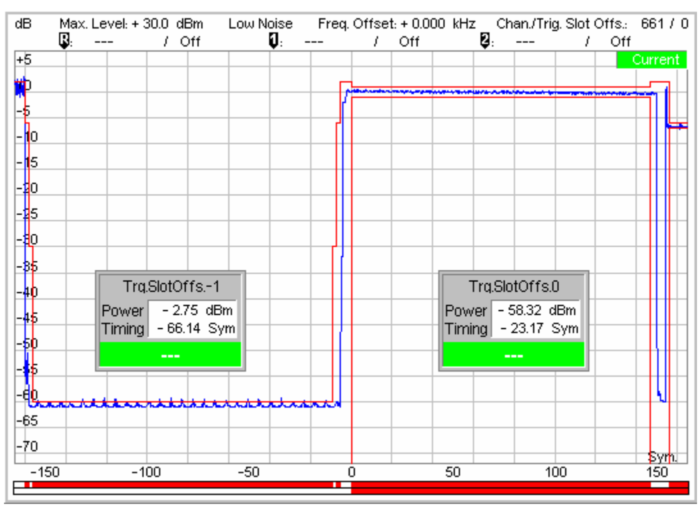
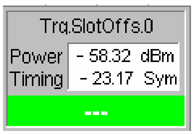


Fig. 4-6 Display of results (Power – P/t Multislot)

Info boxes



The info boxes show the following properties of the individual timeslots:

Power Average burst power in dBm. The *Power* result depends on the display mode as indicated in the upper right corner of the diagram.

Timing Timing error of the burst in symbol periods (actual timing minus the slot offset times the nominal slot duration). The actual timing of the burst is given by the training sequence and measured relative to the measured timeslot *(Trigger Slot Offset 0;* see *Fig. 4-3* on page 4.18).

Below the two measurement results, an error message is displayed if the burst is out of tolerance. An info box is provided for each timeslot displayed (1 to 4; see *Slot Count* hotkey on p. 4.73). The boxes can be suppressed altogether by means of the *Display/Marker – Info Box* hotkey.

Remote control
Settings are retrieved using the query corresponding to the setting command (setting command with appended question mark).

For scalar measurement results:

```
READ[:SCALar]:POWer:MSLot?
CALCulate[:SCALar]:POWer:MSLot
  :LIMit:MATChing?
FETCh[:SCALar]:POWer:MSLot?
SAMPle[:SCALar]:POWer:MSLot?
```

Measurement curves (arrays) The measurement result is displayed together with the limit lines, markers and the D-line (if defined) as a continuous measurement curve in the test diagram. The curve is derived from equidistant measurement points with a ¼ symbol spacing the number of which depends on the number of timeslots measured (see *Slot Count* hotkey on p. 4.73, for details see remote control command description).

The measurement curve in the *Power* measurement menu shows the measured burst power (in dB) as a function of time (in symbol periods). The displayed result depends on various test settings. The display mode for the measurement curve *(Minimum, Maximum, Average, Current)* is indicated in the upper right corner of the diagram. If a two stage multislot measuremet is active, a right black triangle at the right edge of the diagram marks the *2 Shot Assembly Level* (see p. 4.32).

The scale of both axes can be adjusted via the hotkeys associated to the *Display/Marker* softkey (see section *P/t Multislot* on p. 4.17 f.).

Remote control
`READ:ARRay:POWer:MSLot...?` etc.

Limit Check The result of the limit check is visualized in two colored bars below the diagram. In each area of the burst, the upper (lower) bar turns red if the result exceeds (falls below) the power/time template defined in the *Limit Lines* tab of the *Power Configuration* menu.

Remote control

```
CALCulate[:SCALar]:POWer:MSLot:LIMit:MATChing?
CALCulate:ARRay:POWer:MSLot:LIMit:MATChing[:CURRent]?
CALCulate:ARRay:POWer:MSLot:AREA:LIMit:MATChing[:CURRent]?
```

Tolerance template

The multislot template is calculated after each single shot measurement from the single slot templates of all measured bursts (depending on the modulation scheme), the measured timing of all bursts and the multislot guard level. The measured average burst powers and timing references may vary in time, causing the multislot template to be shifted after each measurement cycle. In contrast to the single slot template, the position of the multislot template is not pinned down by the *Limit Lines* settings.

Due to the variation of the template, a multislot limit check for statistical (Min., Max, Avg.) results doesn't make sense: Template and limit check are omitted. The exact position of the template and the measurement curve at any time and the results of the current limit check can be queried with the command group quoted below.

Remote control
`[SENSe:]ARRay:POWer:MSLot:AREA:LIMit...?`

d) P/Frame

The results displayed in the measurement menu *Power*, application *P/Frame,* can be divided into two groups:

- Settings
- Measurement results, i.e. the average burst power in up to 256 consecutive TDMA frames.

The measurement results are indicated in a parameter line and a frame table:

Parameter line

Max. Level: +30.0 dBm LowDist Freq. Offset -103.876 kHz Chan./Freq.: 65/ 930.0 MHz

Frame table

Frame								
0... 7	- 49.0	- 48.7	- 47.3	+ 26.8	- 46.3	+ 27.1	+ 26.7	- 47.1
8... 15	- 46.6	- 43.4	- 48.1	+ 27.2	- 46.8	+ 27.3	+ 27.3	- 46.4
16... 23	- 49.0	- 48.7	- 47.3	+ 26.8	- 46.3	+ 27.1	+ 26.7	- 47.1
24... 31	- 46.6	- 43.4	- 48.1	+ 27.2	- 46.8	+ 27.3	+ 27.3	- 46.4
32... 39	- 49.0	- 48.7	- 47.3	+ 26.8	- 46.3	+ 27.1	+ 26.7	- 47.1
40... 47	- 46.6	- 43.4	- 48.1	+ 27.2	- 46.8	+ 27.3	+ 27.3	- 46.4
48... 55	- 49.0	- 48.7	- 47.3	+ 26.8	- 46.3	+ 27.1	+ 26.7	- 47.1
56... 63	- 46.6	- 43.4	- 48.1	+ 27.2	- 46.8	+ 27.3	+ 27.3	- 46.4
64... 71	- 49.0	- 48.7	- 47.3	+ 26.8	- 46.3	+ 27.1	+ 26.7	- 47.1
72... 79	- 46.6	- 43.4	- 48.1	+ 27.2	- 46.8	+ 27.3	+ 27.3	- 46.4
80... 87	- 49.0	- 48.7	- 47.3	+ 26.8	- 46.3	+ 27.1	+ 26.7	- 47.1
88... 95	- 46.6	- 43.4	- 48.1	+ 27.2	- 46.8	+ 27.3	+ 27.3	- 46.4
96...103	- 49.0	- 48.7	- 47.3	+ 26.8	- 46.3	+ 27.1	+ 26.7	- 47.1
104...111	- 46.6	- 43.4	- 48.1	+ 27.2	- 46.8	+ 27.3	+ 27.3	- 46.4
112...119	- 49.0	- 48.7	- 47.3	+ 26.8	- 46.3	+ 27.1	+ 26.7	- 47.1
120...127	- 46.6	- 43.4	- 48.1	+ 27.2	- 46.8	+ 27.3	+ 27.3	- 46.4

all results in dBm

Fig. 4-7 Display of results (Power – P/Frame)

Settings

The essential settings are indicated in a parameter line above the test diagram. The line is identical to the first parameter line of the test diagram in the *P/t Normal GMSK* application.

Results

The *P/Frame* application measures the average burst power in a particular timeslot and over up to 256 consecutive TDMA frames. The average is taken over a section of the useful part of the burst; it is not correlated to the training sequence. The time slot number within the TDMA frame depends on the trigger time for the first measurement. The number of frames measured is selected in the configuration menu; see *Frame Count* parameter on p. 4.35.

A particular timeslot can be selected with an appropriate trigger condition. E.g., if the power in the timeslot to be measured is clearly higher than the power in the remaining seven timeslots, a power trigger (trigger settings *RF Power* or *IF Power)* can be used. Otherwise, use an appropriate external trigger signal.

The results are shown in a tabular overview. To be consistent with the numbering of the timeslots within a TDMA frame, the measured slots are numbered starting from 0. For more than 128 measured slots, the table can be scrolled using the cursor keys. No limit check is performed.

Note: *In* Continuous *measurements* (Repetition = Continuous)*, the results in the table are updated row by row. After the end of each measurement cycle the update re-starts in the first table row. To clearly distinguish the current from the previous cycle, 4 strokes are inserted after the most recent measurement result.*

Remote control

```
READ:ARRay:POWer:FRAMe[:CURRent]?
READ[:SCALar]:POWer:FRAMe:FPOWer<nr>[:CURRent]?
FETCh:ARRay:POWer:FRAMe[:CURRent]?
SAMPle:ARRay:POWer:FRAMe[:CURRent]?
```

e) P/Slot Graph

The results displayed in the measurement menu *Power*, application *P/Slot Graph,* can be divided into two groups:

- Settings
- Measurement results, i.e. the average burst power in all eight slots of a TDMA frame

The measurement results are indicated in a parameter line, the test diagram and a slot table:

Parameter line

Test diagram

Slot table

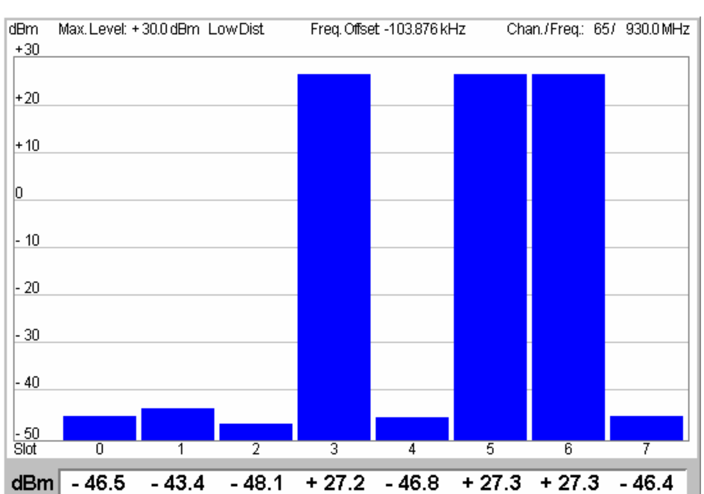


Fig. 4-8 Display of results (Power – P/Slot menu)

Settings

The essential settings are indicated in a parameter line above the test diagram. The line is identical to the first parameter line of the test diagram in the *P/t Normal GMSK* application.

Results The *P/Slot* application measures the average burst power in eight consecutive time slots. The average is taken over a section of the useful part of the burst; it is not correlated to the training sequence. The time slots are numbered 0 to 7; however, this does not mean that they all belong to the same TDMA frame (slot 0 to 7).

A particular timeslot can be selected as timeslot 0 with an appropriate trigger condition. E.g., if the power in one timeslot is clearly higher than the power in the remaining seven timeslots, a power trigger (trigger settings *RF Power* or *IF Power)* can be used. Otherwise, use an appropriate external trigger signal.

The eight values are shown in a bar graph and in a tabular overview below. No limit check is performed.

Remote control
```
READ:ARRay:POWer:SLOT[:CURRent]?
FETCh:ARRay:POWer:SLOT[:CURRent]?
SAMPle:ARRay:POWer:SLOT[:CURRent]?
```

f) P/Slot Table

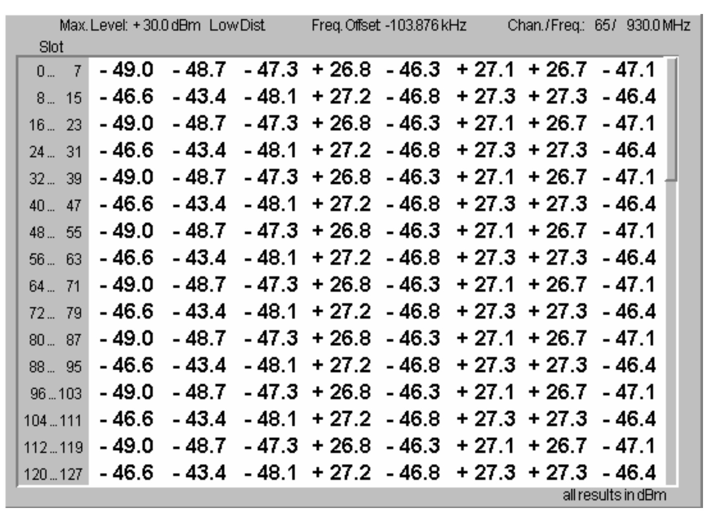
The results displayed in the measurement menu *Power*, application *P/Slot Table,* can be divided into two groups:

- Settings
- Measurement results, i.e. the average burst power in up to 512 consecutive TDMA timeslots.

The measurement results are indicated in a parameter line and a slot table:

Parameter line

Slot table



Max. Level: +30.0 dBm Low Dist Freq. Offset -103.876 kHz Chan./Freq.: 65/ 930.0 MHz

Slot								
0... 7	- 49.0	- 48.7	- 47.3	+ 26.8	- 46.3	+ 27.1	+ 26.7	- 47.1
8... 15	- 46.6	- 43.4	- 48.1	+ 27.2	- 46.8	+ 27.3	+ 27.3	- 46.4
16... 23	- 49.0	- 48.7	- 47.3	+ 26.8	- 46.3	+ 27.1	+ 26.7	- 47.1
24... 31	- 46.6	- 43.4	- 48.1	+ 27.2	- 46.8	+ 27.3	+ 27.3	- 46.4
32... 39	- 49.0	- 48.7	- 47.3	+ 26.8	- 46.3	+ 27.1	+ 26.7	- 47.1
40... 47	- 46.6	- 43.4	- 48.1	+ 27.2	- 46.8	+ 27.3	+ 27.3	- 46.4
48... 55	- 49.0	- 48.7	- 47.3	+ 26.8	- 46.3	+ 27.1	+ 26.7	- 47.1
56... 63	- 46.6	- 43.4	- 48.1	+ 27.2	- 46.8	+ 27.3	+ 27.3	- 46.4
64... 71	- 49.0	- 48.7	- 47.3	+ 26.8	- 46.3	+ 27.1	+ 26.7	- 47.1
72... 79	- 46.6	- 43.4	- 48.1	+ 27.2	- 46.8	+ 27.3	+ 27.3	- 46.4
80... 87	- 49.0	- 48.7	- 47.3	+ 26.8	- 46.3	+ 27.1	+ 26.7	- 47.1
88... 95	- 46.6	- 43.4	- 48.1	+ 27.2	- 46.8	+ 27.3	+ 27.3	- 46.4
96...103	- 49.0	- 48.7	- 47.3	+ 26.8	- 46.3	+ 27.1	+ 26.7	- 47.1
104...111	- 46.6	- 43.4	- 48.1	+ 27.2	- 46.8	+ 27.3	+ 27.3	- 46.4
112...119	- 49.0	- 48.7	- 47.3	+ 26.8	- 46.3	+ 27.1	+ 26.7	- 47.1
120...127	- 46.6	- 43.4	- 48.1	+ 27.2	- 46.8	+ 27.3	+ 27.3	- 46.4

all results in dBm

Fig. 4-9 Display of results (Power – P/Slot Table)

Settings The essential settings are indicated in a parameter line above the test diagram. The line is identical to the first parameter line of the test diagram in the *P/t Normal GMSK* application.

The remaining *P/Slot Table* settings are related to the retriggered measurement mode (in *Non Signalling* mode only).

P/Slot Table – Measure Mode

Activates either the normal *P/Slot Table* measurement or the retriggered mode described on p. 4.28. The retriggered measurement settings are defined in the *Retriggered* section below.

Remote control
`CONFigure:POWer:XSLot:MMODe NORM | RETRiggered`

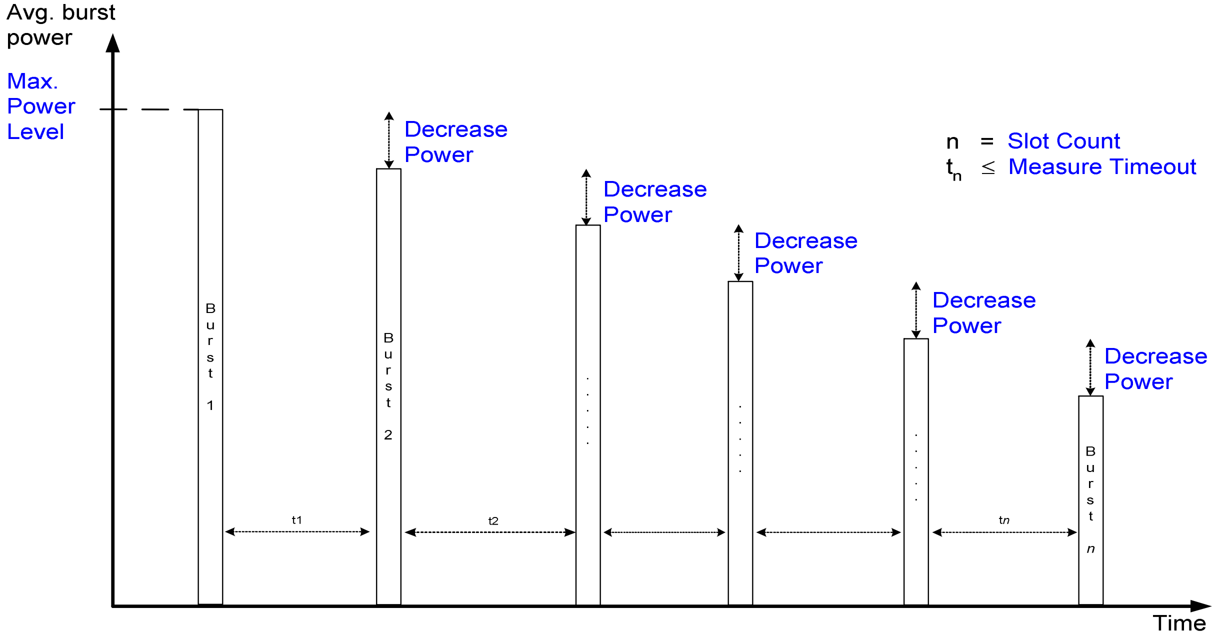


Fig. 4-11 Retriggered measurement settings

Retriggered – Max. Power Level

(Approximate) start value of the received signal power.

NOTE

The received burst powers must be approximately equal to the values calculated from the Max. Power Level *and the* Decrease Power. *Much higher burst powers can overdrive the analyzer. Much lower burst powers can cause the IF trigger mechanism to fail, especially at high trigger thresholds.*

Remote control
`CONFigure:POWer:XSLot:RETRiggered:PLEVel`

Retriggered – Decrease Power

Power steps between any two consecutive bursts. The power steps must be approximately equal.

Remote control
`CONFigure:POWer:XSLot:RETRiggered:DPOWer`

Measurement Configurations (Power Configuration)

The popup menu *Power Configuration* contains three tabs to determine the parameters controlling the power measurement including the error tolerances.

The popup menu *Power Configuration* is activated by pressing the measurement control softkey at the top right in the graphical measurement menu *Power* twice. It is possible to change between the tabs by pressing the associated hotkeys.

Measurement Control (Power Configuration – Control)

The *Control* tab controls the power measurement by determining

- The time after which a measurement with invalid results is stopped *(Inv. Res. Det. Timeout,* for *Power vs. Time* applications)
- The *Repetition* mode
- The *Stop Condition* for the measurement (for burst power vs. time measurements only)
- The type of measurement curve displayed *(Display Mode,* for burst power vs. time measurements only)
- The number of bursts/evaluation periods forming a statistics cycle *(Statistic Count,* for burst power vs. time measurements only)
- The measurement *Filter* for *P/t Normal GMSK, P/t Normal 8PSK* and *P/t Multislot* measurements
- The averaging rule to obtain the reference power *(Ref. Power Mode*, for *8PSK* measurements only)
- The *Timing Offset*, the expected modulation *(Modulation View)*, the number of slots measured *(Slot Count)* and the *Info Box* in the *P/t Multislot* application
- The number of timeslots measured *(Slot Count)* in the *P/Slot Table* application
- The number of frames measured *(Frame Count)* in the *P/Frame* application

Besides, it configures the graphical diagrams by adding or removing the *Grid*.

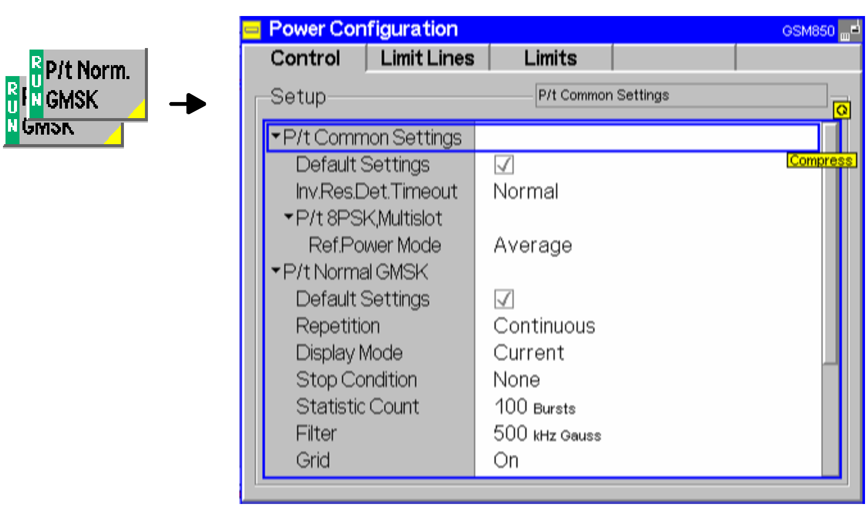


Fig. 4-10 Power Configuration – Control

The settings can be defined independently for the different applications of the *Power* measurement group. The following settings are available in several applications:

Default Settings

The *Default All Settings* switch assigns default values to all settings in the *Control* tab (the default values are quoted in the command description in chapter 6 of this manual). In addition, default switches for the individual modulation schemes are provided.

Remote control
```
CONFigure:POWer[:NORMal][:GMSK]:CONTrol:DEFault  ON | OFF
etc.
```

Inv. Res. Det. Timeout

Period of time after which a *Power vs. Time* measurement with invalid results is stopped and a new measurement can be started. The *Medium* and *Short* timeouts are considerably shorter than the *Normal* timeout.

Short timeouts are suitable in particular for reducing test times in remote control, e.g. for transmitter adjustments over several steps, each with a definite, stable output signal configuration.

Remote control
```
CONFigure:POWer:PVT:IRDTimeout  NORMal | MEDium | SHORt
```

Repetition

The *Repetition* parameter defines how often the measurement is repeated:

Single Shot — Single-shot measurement: The measurement is stopped after a statistics cycle (or after a stop condition is met, see below). A stopped measurement is indicated by the status display *HLT* in the *Power* softkey.

Unless otherwise stated, a statistics cycle corresponds to the number of bursts/evaluation periods set under *Statistic Count*.

Continuous — Continuous measurement: The CMU continues the measurement until it is terminated explicitly (or until the stop condition for the measurement is met, see below). The measurement results are valid after one statistics cycle; however, the measurement is continued, and the output is continuously updated. An ongoing measurement is indicated by the status display *RUN* in the softkey *Power*.

Single shot should be selected if only a single measurement result is required under fixed conditions. The continuous measurement is suitable for monitoring the evolution of a measured quantity in time, for example for adjustments.

Note: *In remote mode, the counting measurement (counting mode) is available as a further measurement mode with a defined number of measurement cycles to be performed, see chapter 6 of this manual.*

Remote control
```
CONFigure:POWer[:NORMal][:GMSK]:CONTrol:REPetition
       CONTinuous | SINGleshot | 1 ... 10000,<StopCondition>,
                                  <Stepmode> etc.
```

Stop Condition

The *Stop Condition* field defines a stop condition for the measurement:

NONE — Continue measurement irrespective of the results of the limit check

On Limit Failure — Stop measurement as soon as the limit check fails (one of the tolerances is exceeded)

Remote control
```
CONFigure:POWer[:NORMal][:GMSK]:CONTrol:REPetition
        <Repetition>,SONerror | NONE, <Stepmode> etc.
```

Display Mode

The *Display Mode* field defines which of the four measured and calculated measurement curves is displayed. The measurement curves differ in the way the burst power *p(t)* at a fixed point in time *t* is calculated if the measurement extends over several bursts:

Current	Measured value for current burst
Minimum	Minimum over all measured bursts
Maximum	Maximum over all measured bursts
Average	Average value over a number of bursts

The number of bursts for calculation of the statistical values *Minimum, Maximum* and *Average* – and thus the result – depends on the repetition mode set. In detail, this implies:

Single shot	Display of minimum, maximum and average value from the performed statistics cycle.
Continuous	Display of minimum and maximum from all bursts already measured. The **average value**, however, is calculated according to the rule in Chapter 3, section *General Settings*.

Remote control
no display mode set explicitly, the four measurement curves are accessible via

```
FETCh:ARRAy:POWer[:NORMal][:GMSK][:CURRent]?
FETCh:ARRAy:POWer[:NORMal][:GMSK]:MINimum?
FETCh:ARRAy:POWer[:NORMal][:GMSK]:MAXimum?
FETCh:ARRAy:POWer[:NORMal][:GMSK]:AVERage?
```
etc.

Statistic Count

The input field *Statistic Count* defines the length of the statistics cycles in bursts.

The settings *1* and *OFF* (press *ON/OFF* key) are equivalent. A statistics cycle determines the duration of single-shot measurements.

Remote control

```
CONFigure:POWer[:NORMal][:GMSK]:CONTrol
  <MODE>,1 ... 1000 | NONE
```

Filter

The input fields *Filter* determine which type of measurement filter is used for the P/t measurements:

500 kHz Gauss	Gauss filter with a 3-dB bandwidth of 500 kHz, recommended for GMSK modulation
600 kHz Band	Bandpass filter with a bandwidth of 600 kHz and steep edges, recommended for 8PSK modulation

Both filters are in accordance with the conformance specification GSM 11.10.

Remote control

```
CONFigure:POWer[:NORMal][:GMSK]:FILTer G500 | B600
CONFigure:POWer[:NORMal]:EPSK:FILTer G500 | B600
CONFigure:POWer:MSLot:FILTer G500 | B600
```

Grid

The *Grid* button switches the grid on or off in the graphical test diagram. By default, the grid is switched on.

Remote control

```
CONFigure:POWer[:NORMal][:GMSK]:CONTrol:GRID  ON | OFF
```

The following settings are application-specific:

P/t Normal 8PSK, P/t 8PSK, Multislot – Ref. Power Mode

The *Ref. Power Mode* determines how the reference power, i.e. the 0-dB line in the measurement diagram, is calculated. The setting is valid for **both** single-slot and multislot measurements on 8PSK modulated signals.

Current The reference power depends on the *Display Mode* set. It is equal to the average power of the *Current* measurement curve (display mode *Current)* or to the average power of the *Average* measurement curve (display mode *Average, Maximum, or Minimum)*.

Average The reference power is equal to the average power of the average measurement curve.

Data Compens. The reference power depends on the *Display Mode* set. It is equal to the data-compensated average power of the *Current* measurement curve (display mode *Current)* or to the data-compensated average power of the *Average* measurement curve (display mode *Average, Maximum, or Minimum)*.

Average power denotes the RF carrier power averaged over the useful part of the measured burst (application *P/t Normal 8PSK)* or of the measured timeslot (application *P/t Multislot* with 8PSK modulation, see Slot *Count* softkey on p. 4.73).

Owing to the characteristics of 8PSK modulation, the amplitude of the RF signal varies with the transmitted data. As a consequence, only the long term average of the power when taken over the useful part of the burst for random data represents a correct measure for the output power of the mobile phone. This long time average (rather than the average power of the current burst) is also the correct reference power (0-dB line) for the *P/t Norm. 8PSK* measurement.

The *Average* setting ensures that a correct reference power is used, however, averaging results in a longer measurement time. In the *Data Compensated* mode, a known data sequence is used to correct the measured average power of the current burst and estimate the correct reference power. Delays due to averaging are avoided.

Remote control
```
CONFigure:POWer[:NORMal]:EPSK:CONTrol:RPMode
   CURRent | AVERage | DCOMpens
```

P/t Multislot – 2 Shot Assembly Level

2 Shot Assembly Level defines a signal level relative to the *Max. Level* where the two results obtained in a two stage measurement are joined together: All trace points above the assembly level are obtained with a large *Max. Level,* the ones below are measured with lower *Max. Level*.

This parameter takes effect as long as the two stage measurement is active; see *Two stage measurement for high dynamic range* on p. 4.41. A black triangle on the right edge of the screen marks the assembly level.

Remote control
```
CONFigure:POWer:MSLot:TSALevel <Level>
```

P/t Multislot – Timing Offset

The *Timing Offset* shifts the burst by the entered number of symbol periods, e.g. to compensate for a known, constant timing error of the MS. The burst is shifted relative to the time axis and the tolerance template for the multislot burst analysis. Therefore, the value of *Timing Offset* affects the result of the tolerance check.

Remote control
```
CONFigure:POWer:MSLot:TOFFset
```

P/t Multislot – Modulation View

The *Modulation View* section defines the expected modulation scheme and burst type in all four timeslots that can be measured and adjusts the power/time template. To obtain a valid measurement result, the actual modulation scheme and burst type in all measured slots must be compatible with the *Modulation View* settings. Otherwise, the CMU displays a warning: *"Signal does not match configuration!"*

The following settings are provided for all slots:

GMSK	GMSK modulation and normal bursts expected; the GMSK power/time template is used
8PSK	8PSK modulation and normal bursts expected; the 8PSK power/time template is used
Access B.	Access bursts expected; the power/time template for access bursts is used
ANY	Arbitrary modulation scheme and burst type; the CMU determines the modulation of the measured burst and uses the appropriate template. Valid results are obtained with both GMSK and 8PSK modulation.
OFF	No signal expected: timeslot must be inactive to obtain a valid result

The *Modulation View* settings are ignored for all slots that are not measured.

Note: *In an EGPRS test mode connection (Signalling mode), it is possible to measure and display GMSK and 8PSK modulated bursts simultaneously. A measurement example is reported in Chapter 2; see section* Multislot Measurements with Mixed Modulation Schemes*.*

In a packet data connection (with option R&S CMU_K42/-K43), the P/t Multislot *measurement can be used to analyze access bursts that the MS transmits periodically while a connection is established; see Chapter 2; section* Continuous Access Burst Measurement.

Remote control
`CONFigure:POWer:MSLot:MVIew`

P/t Multislot – Slot Count

The *Slot Count* defines an integer number of timeslots to be measured in the P/t Multislot application. The actual time range measured is larger than the integer number of slots because it comprises an additional display margin; for details see remote control command description.

Remote control
`CONFigure:POWer:MSLot:SCOunt`

P/t Multislot – Info Box

The *Info Box* parameter switches the info boxes for all displayed timeslots on or off.

Remote control
No command, display configuration only

P/Slot Table – Slot Count

The input field *Slot Count* defines the total number of slots measured in the *P/Slot Table* application.

Remote control
`CONFigure:POWer:XSLot:SCOunt`

The remaining *P/Slot Table* settings are related to the retriggered measurement mode (in *Non Signalling* mode only).

P/Slot Table – Measure Mode

Activates either the normal *P/Slot Table* measurement or the retriggered mode described on p. 4.28. The retriggered measurement settings are defined in the *Retriggered* section below.

Remote control
`CONFigure:POWer:XSLot:MMODe NORM | RETRiggered`

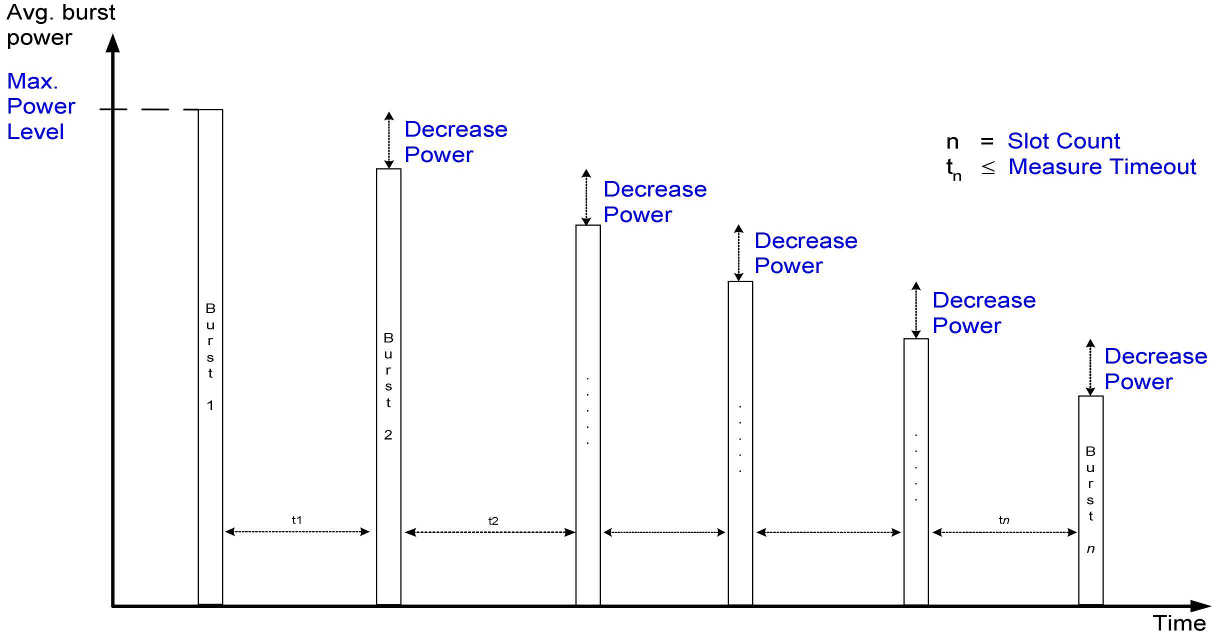


Fig. 4-11 Retriggered measurement settings

Retriggered – Max. Power Level

(Approximate) start value of the received signal power.

Remote control
`CONFigure:POWer:XSLot:RETRiggered:PLEVel`

Retriggered – Decrease Power

Power steps between any two consecutive bursts. The power steps must be approximately equal.

Remote control
`CONFigure:POWer:XSLot:RETRiggered:DPOWer`

Retriggered – Measurement Timeout

Maximum time (in s) between any two consecutive bursts. The measurement is aborted if the time between two consecutive triggered bursts exceeds the timeout, otherwise it extends over the *Slot Count* specified for the *P/Slot Table* measurement.

If a timeout is met the remaining measurement results are invalid.

Remote control
`CONFigure:POWer:XSLot:RETRiggered:TIMeout`

P/Frame – Frame Count

The input field *Frame Count* defines the total number of consecutive TDMA frames measured in the *P/Frame Table* application. One timeslot is measured in each frame. One TDMA frame has a duration of approx. 4.6 ms. A smaller number of frames reduces the measurement time.

Remote control
`CONFigure:POWer:FRAMe:FCOunt`

Limit lines (Power Configuration – Limit Lines)

The *Limit Lines* tab defines the limit lines for the burst power vs. time measurements (applications *P/t Norm. GMSK*, *P/t Norm. 8PSK,* and *P/t Multislot*).

Burst structure in the GSM mobile radio network:

GMSK modulation

In the GSM mobile radio network, all radio channels are divided into frames with 8 timeslots, each with a duration of 15/26 ms ≈ 577 µs. In this time mask, bursts with various types of bit patterns are transferred:

Normal burst	Used for data transmission on the traffic channel and on the control channels except RACH.
Access burst	Used by the mobile (MS) for initial random access to the nework and for handover.
Other burst types	Dummy burst, frequency correction burst, synchronization burst, are only used by the BTS.

The basic GSM modulation scheme is GMSK modulation. With this modulation scheme, the transmission rate is 270.833 ksymbols/s (where each symbol codes one data bit), resulting in a bit duration/symbol duration of 3.69 µs/symbol. The structure of the GSM bursts is shown in *Fig. 4-37*. Compared to a normal burst, the access burst has a longer guard period (68.25 symbols instead of 8.25 symbols) whereas the length of the useful part of the burst (useful duration) is shortened by 60 symbols. The extended guard period is needed since timing advance is not known at initial random access and handover.

The tolerance template for normal (NB) and access bursts (AB) can be divided into different areas. These areas are used as a basis for the definition of the limit lines and are shown in the following diagram (*Fig. 4-12*).

Note that in upper areas 2 and 7, the limit lines depend on the PCL of the mobile phone. In the CMU, this can be taken into account by defining a PCL-dependent, dynamic correction to the static limit lines, which is explained in the *Limit Lines* section of the *Signalling* mode (see p. *4.126*).

Note: *In* Non Signalling *mode, only normal bursts can be measured. The access bursts transmitted by the mobile phone to initiate a location update can be analyzed in Signalling mode; see section* Power Measurements *on page 4.112 ff. The reference level (0 dB line) is equal to the received transmitter carrier power, i.e. the average value of the transmitter carrier power over the useful part of the burstduration of the burst as received by the CMU. The burst is fitted into the tolerance template such that the transition between bit 13/14 of the training sequence corresponds to the center of the useful part of the burst. This timing reference can be modified via the* Time *softkey, see section* Test Settings *on page* 4.9.

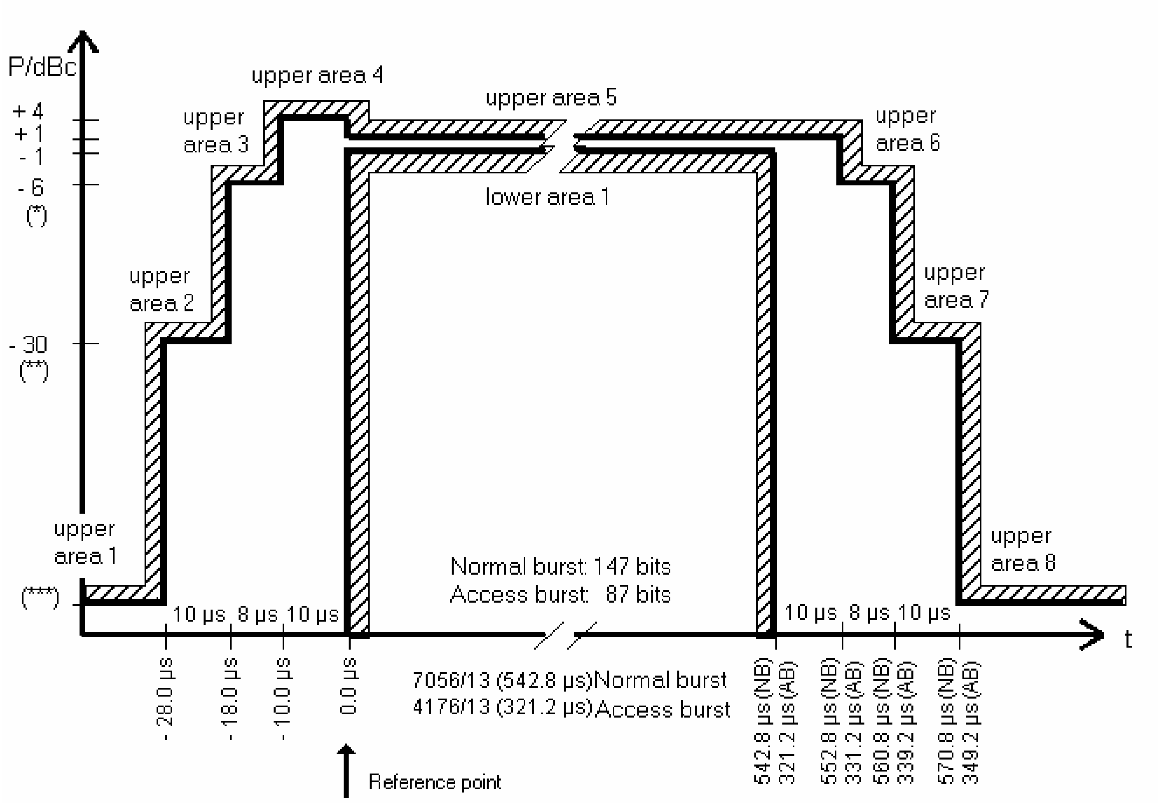


Fig. 4-12 GSM power/time template for normal and access bursts with GMSK modulation

The two edges of the tolerance templates are defined as a function of the power control level of the mobile phone. The following specifications apply to both modulation schemes (*Fig. 4-12* and *Fig. 4-13*):

	GSM400/GT800/850/900-MS	GSM1800/1900-MS
(*)	–4.0 dBc for power control level (PCL) 16; –2.0 dBc for PCL 17; –1.0 dBc for PCL 18 and 19.	–4.0 dBc for PCL 11 –2.0 dBc for PCL 12 –1.0 dBc for PCL 13, 14, and 15.
(**)	–30.0 dBc or –17.0 dBm (higher value)	–30.0 dBc or –20.0 dBm (higher value)
(***)	–59.0 dBc or –36.0 dBm (higher value)	–48 dBc or -48 dBm (higher value)

The limit lines for GMSK and 8PSK modulation are set in separate table sections but in an analogous way:

8PSK modulation

8PSK modulation was introduced to GSM with release 1999 (GSM 05.05 version 7.1.0). 8PSK channels (the so-called EDGE channels) are used for data transmission; only normal bursts are transmitted. The modulating symbol rate is the same as in GMSK modulation (270.833 ksymb/s), which corresponds to a bit rate of 3 x 270.833 kbit/s. The CMU uses the same time scale for both modulation schemes; a symbol duration in GMSK modulation is equal to a symbol duration in 8PSK modulation.

The power template for 8PSK burst differs from the GMSK power template; see *Fig. 4-13* below. In analogy to GMSK modulation, the limit lines at the edges of the burst depend on the PCL of the mobile phone.

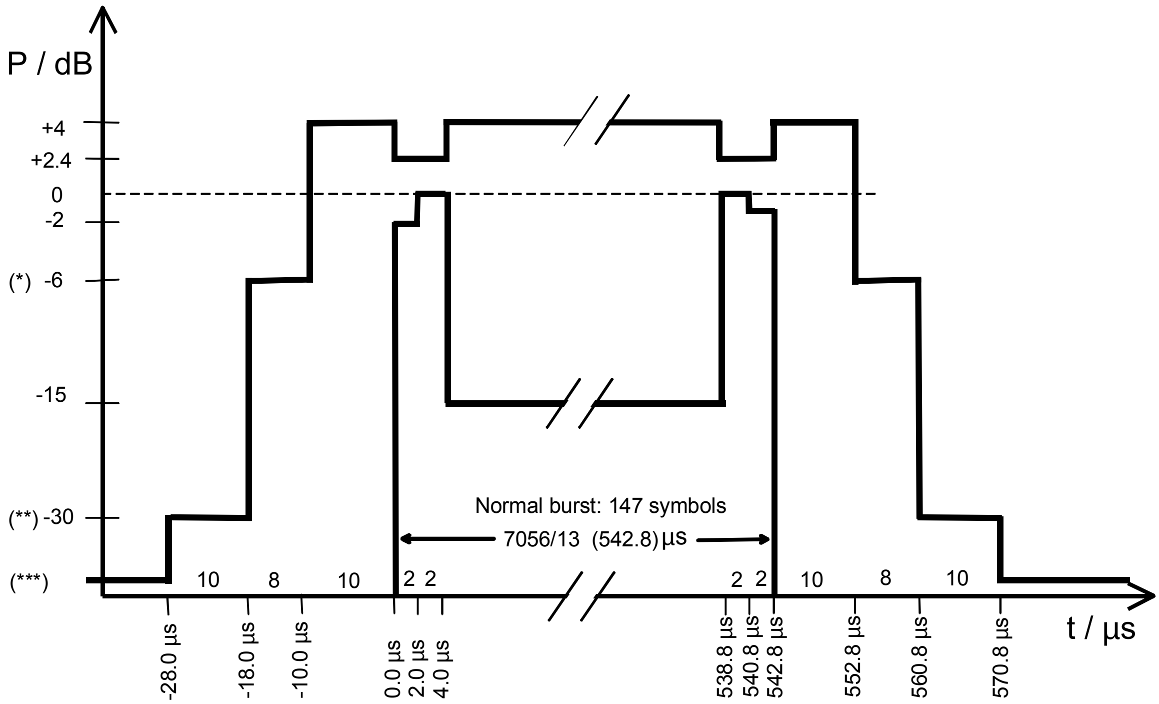


Fig. 4-13 GSM power/time template for normal bursts with 8PSK modulation (according to GSM05.05 version 8.5.0; see explanation after previous figure)

The limit lines for multislot configurations are based on the single-slot limit lines:

Multislot configurations

According to GSM 11.10, the power/time template for multislot configurations coincides with the template for a single GSM burst except in the guard period between every two consecutive active timeslots, where the output power shall not exceed the level allowed for the useful part of the first timeslot or the level allowed for the useful part of the second timeslot plus a multislot guard level of 3 dB, whichever is the highest. The template for two consecutive 8PSK modulated timeslots with the same output power is shown in *Fig. 4-14 below*.

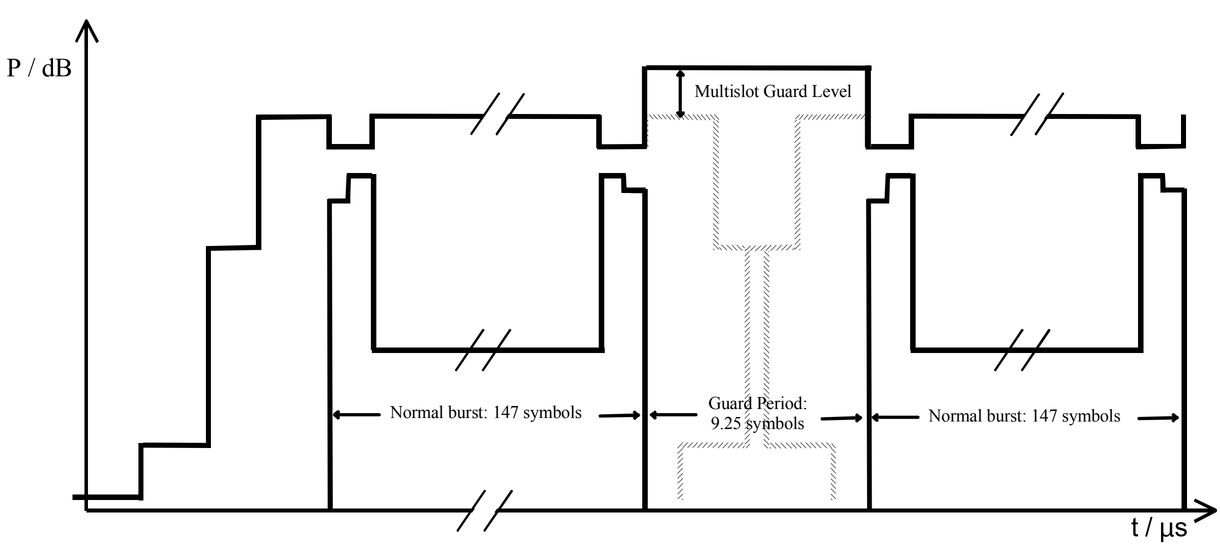


Fig. 4-14 GSM power/time template for multislot configurations

Note: *The CMU treats the areas where the* **lower** *limit lines are switched on as the useful part of the burst; the remaining areas form the guard period. The tester calculates the multislot tolerance template from the single-slot limit lines and the* Multislot Guard *level (see below) and normalizes it to the average RF carrier power in the useful part of the* Meas. Timeslot. *This implies that the tolerance template is changed if the useful part of the burst is extended by enabling an additional lower limit area.*

In remote control the exact current position of the multislot template can be queried with the `[SENSe:]ARRay:POWer:MSLot:AREA:LIMit...?` *commands.*

The *Limit Lines* tab provides:

- A preview of the default limit lines showing the different areas *(Area Info)*
- Definition of the limit lines for the normal burst area by area *(Upper Limit Line, Lower Limit Line)*

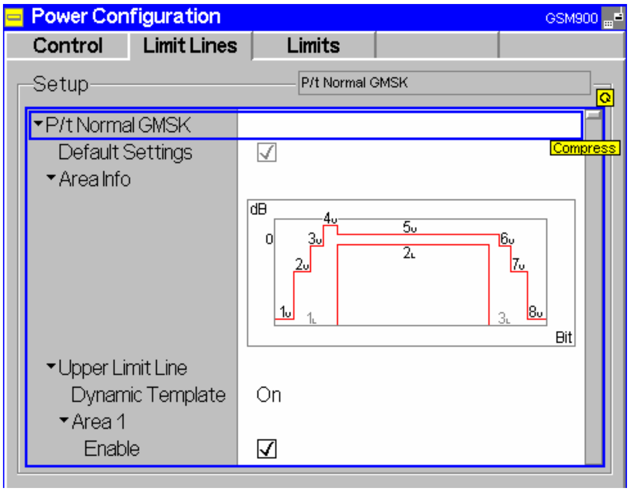


Fig. 4-15 Power Configuration – Limit Lines

Default Settings The *Default All Settings* switch assigns default values to all settings in the *Limits* tab (the default values are quoted in the command description in chapter 6 of this manual). In addition, default switches for the individual modulation schemes are provided.

Remote control
`CONFigure:POWer[:NORMal][:GMSK]:LIMit:LINE:DEFault ON | OFF`

Area Info The *Area Info* diagram represents a simplified preview of the defined tolerance template.

Remote control
–

Upper Limit Line The table *Upper Limit Line* defines the upper limit lines for normal bursts. The normal burst can be divided into up to 16 areas *(Area 1 to Area 16)*; within an area, the limit line represents a line section with arbitrary (even infinite) slope. In all areas, the static limit lines can be corrected (shifted) by adding an (optional) dynamic (i.e. template PCL-dependent) correction. The CMU's power template is thus far more flexible than the GSM template shown above.
Dynamic Template Enable *(On)* or disable *(Off)* the dynamic limit line correction for the entire upper limit line. With disabled dynamic limit line correction the upper limit line is equal to the upper *Static* limit line.

Remote control
`CONFigure:POWer[:NORMal][:GMSK]:LIMit:LINE:UPPer:ALL:DYNamic:ENABle`
`CONFigure:POWer[:NORMal]:EPSK:LIMit:LINE:UPPer:ALL:DYNamic:ENABle`

Static limit lines

The *Static* limit lines are defined as follows:

Area 1 to 16	Area number
Enable	Enabled (switch on) or disabled (and invisible) limit line. A disabled limit line implies that the limit check for the area is switched off as well.
Time	Start and (below) stop time of the area in symbols
Level rel.	Start and (below) stop level of the area in units relative to the carrier. The reference level (0-dB line) is the carrier power averaged over the useful part of the burst.
Level abs.	Start and (below) stop level of the section in absolute units (dBm).

The input of relative and absolute limit values is optional; both can be switched off for valid areas (setting *Off)*. If both absolute and relative limit values are specified in an area, the tolerance template and the results of the limit check refer to the **looser** criterion.

The permissible ranges for the upper and lower limit lines, i.e. of the quantities *Time, Level rel.,* and *Level abs*. vary according to the area numbers, see command description in chapter 6.

Remote control

```
CONFigure:POWer[:NORMal][:GMSK]:LIMit:LINE:UPPer<nr>
         [:STATic]:ENABle  ON | OFF
CONFigure:POWer[:NORMal][:GMSK]:LIMit:LINE:UPPer<nr>[:STATic]
         <StartTime>,<EndTime>,<StartRelLevel>,<EndRelLevel>,
         <StartAbsLevel>,<EndAbsLevel>,<Visibility>
```

Dynamic limit line correction

The *Dynamic* limit line section, serves to correct the limit lines depending on the *Template PCL*. It is defined as follows:

Range 1 to 10	Continuous range of power control levels defined by start PCL and stop PCL
PCL from	Lowest template power control level in the range
PCL to	Highest template power control level in the range
Correction	Correction value in dB to be applied to the whole range
Enable	Enabled (switch on) or disabled dynamic correction

The dynamic limit line correction can be switched off entirely; see *Dynamic Limit Line Correction* parameter above.

Remote control

```
CONFigure:POWer[:NORMal][:GMSK]:LIMit:LINE:UPPer<nr>:DYNamic:
ENABle ON | OFF
CONFigure:POWer[:NORMal][:GMSK]:LIMit:LINE:UPPer:ALL:DYNamic:
ENABle ON | OFF
CONFigure:POWer[:NORMal][:GMSK]:LIMit:LINE:UPPer<AreaNr>
         :DYNamic<RangeNr>
         <fromPCL>,<toPCL>,<Correction>,<Enable> etc.
```

Lower Limit Line The table *Lower Limit Line* defines the lower limit lines for normal bursts. All settings are analogous to the upper limit lines.

Remote control

```
CONFigure:POWer[:NORMal][:GMSK]:LIMit:LINE:LOWer<nr>
         [:STATic]:ENABle  ON | OFF
CONFigure:POWer[:NORMal][:GMSK]:LIMit:LINE:LOWer<nr>[:STATic]
         <StartTime>,<EndTime>,<StartRelLevel>,<EndRelLevel>,
         <StartAbsLevel>,<EndAbsLevel>,<Visibility>
```

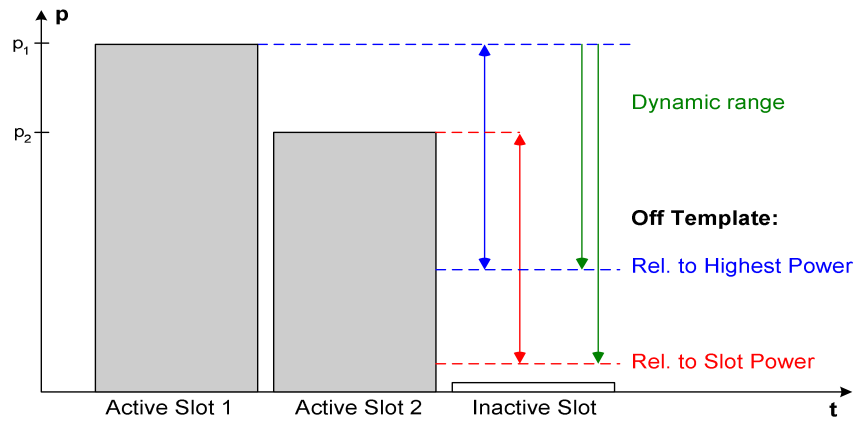
P/t Multislot – Multislot Guard The *Multislot Guard* parameter defines the level in dB by which the upper limit line in the guard period between two consecutive bursts is raised (see *Fig. 4-14* on p. 4.37): The upper limit line in the guard period equals the upper limit line in the useful part of the first timeslot or the upper limit line in the useful part of the second timeslot plus *Multislot Guard*, whichever is the highest. No lower limit line is defined during the guard period.

Remote control

```
CONFigure:POWer:MSLot:LIMit:LINE:GLEVel <Level>
```

P/t Multislot – Off Template The *Off Template* parameter defines the reference for the upper limit line in inactive slots. This setting is valid at high MS output levels, where the limit line is defined relative to the burst power and the alternative absolute limit does not apply.

The off template can be defined either relative to the highest power in all measured slots *(Rel. to Highest Power))* or relative to the active slot preceding/following the inactive slot (*Rel. to Slot Power)*. If two slots 1 and 2 with powers $p_1 > p_2$ are active and if slot 2 is next to the inactive slot, then the off template *Rel. to Slot Power* is lower; the difference between the two templates is equal to $p_1 – p_2$.



The figure above shows that the dynamic range required for testing the off template *Rel. to Slot Power* is also increased by the factor $p_1 – p_2$. To ensure a sufficient dynamic range, the R&S CMU automatically switches to a two stage measurement if the the off template is measured *Rel. to Slot Power*; see below.

Remote control

```
CONFigure:POWer:MSLot:LIMit:LINE:OTEMplate RMAX | RSL
```

Two stage measurement for high dynamic range

In the two stage measurement the multislot range is measured in two frames using two different input level settings *(Max. Level)* of the R&S CMU. The results of the two stages are combined and displayed together in the *P/t Multislot* menu. The two maximum levels differ by 30 dB, which means that – depending on the level range of the MS under test and the external test setup – a gain in dynamic range up to 30 dB can be achieved.

The two stage measurement ensures a sufficient dynamic range for arbitrary slot powers but increases the measurement time by a factor of 2 (the time can further increase in *Signalling* mode). The measurement can be configured by means of the *2 Shot Assembly Level* in the *Control* tab of the *Connection Control* menu (see p. 4.32).

Limit Values for Average Burst Power (Power Configuration – Limits)

The tab *Limits* defines tolerance limits for the average burst power depending on the *Template PCL* defined via the *Analyzer Settings – Template PCL* hotkey. The limits apply to all applications of the *Power* menu providing a limit check (not to *P/Frame, P/Slot Graph* and *P/Slot Table)*.

The limits are defined in analogy to the *Signalling* mode where they depend on the actual PCL of the mobile phone; see section *Limit Values for Average Burst Power* on page 4.127 ff.

Modulation Measurements

The menu group *Modulation* comprises the functions for measurement of the modulation parameters of the RF signal transmitted by the mobile phone. The measurement results are displayed in the graphical measurement menu *Modulation,* the popup menu *Modulation Configuration* is used for configuration of the measurements.

The characteristics of the modulation measurement, the measured quantities and the measurement menus depend largely on the modulation scheme *(GMSK* or *8PSK* modulation). For the sake of clarity, the two modulation schemes are explained separately throughout the remainder of this section.

Measurement Menu (Modulation – GMSK)

If the GMSK modulation scheme is selected (see *Application* softkey in section *Test Settings* on page 4.43 ff.), the graphical measurement menu *Modulation* displays the results of the extended phase and frequency error analysis.

- The measurement control softkey *Ext. Phase Err. GMSK* controls the measurement, indicates its status *(RUN* | *HLT* | *OFF)* and opens the configuration menu *Modulation Configuration* (press twice). The hotkeys associated to the measurement control softkey define the scope of the *Modulation* measurement.
- The other softkeys to the right of the test diagram are combined with various hotkeys. The softkey/hotkey combinations provide test settings and switch over between different measurements. The entry of values is described in section *Test Settings* on page 4.3.

The measurement menu *Modulation* can be accessed from any other measurement menu of function group *GSMxxxx-MS Non Signalling* using the *Modulation* hotkey. It can be opened also from the *Menu Select* main menu (with the associated key at the front of the instrument).

Frequency and phase errors are determined as follows:

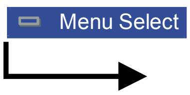
The actual phase of the signal received from the mobile station is recorded during the entire burst and stored. The transferred data is demodulated and the training sequence searched for. The middle of the training sequence is used for time synchronization (transition between bit 13/14).

The complete data content of the burst is then mathematically modulated using an ideal modulator. The resulting ideal phase is compared with the measured phase. From the difference between the two quantities (the phase difference trajectory), a regression line is calculated using the Mean Square Error method. The *phase error* is the difference between the phase difference trajectory and the regression line; it is calculated and plotted over the whole useful part of the burst (147 symbols). The average *frequency error* in the burst is equal to the derivative of the regression line with respect to time.

The **Origin Offset** and the **I/Q Imbalance** characterize the accuracy of the I/Q modulation. They are defined and measured in analogy to the 8PSK modulation scheme; see (see *Fig. 4-19* on page 4.48 and *Equation 4-1*).

For the **tolerance check** the phase error trajectory is fitted into the tolerance template and checked for tolerance violations. According to GSM specifications, a maximum peak phase error of $\pm 20^0$, a maximum RMS phase error of $\pm 5^0$, and a frequency error of 0.05 ppm referred to the carrier frequency is allowed.

The CMU evaluates the phase error with a resolution of 4 measured values per modulating symbol. This corresponds to a sampling rate of approx. 1 MHz.



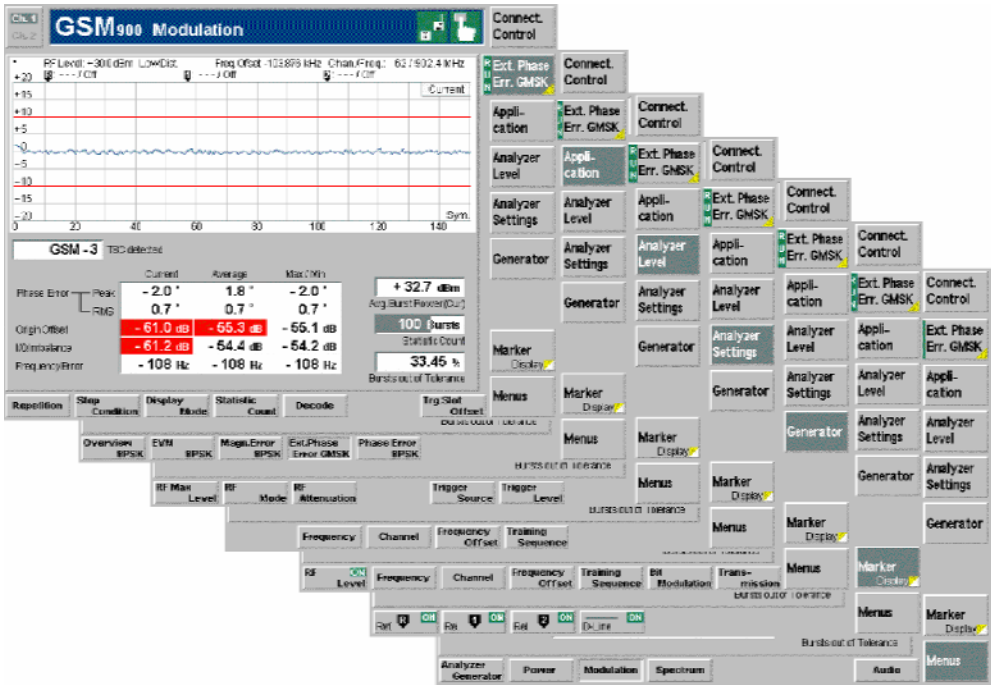


Fig. 4-16 Measurement menu Modulation – Ext. Phase Err. GMSK

Test Settings

The *Analyzer Level, Analyzer Settings, Generator, Marker,* and *Menus* test settings are identical with those in the *Power* menu (see section *Test Settings* on page 4.9). The following softkeys and hotkeys differ from the *Power* measurement:

Ext. Phase Err. GMSK

The *Ext. Phase Err. GMSK* softkey controls the GMSK modulation measurement and indicates its status *(RUN | HLT | OFF).*

This status can be changed after softkey selection (pressing once) by means of the *ON/OFF* key or the *CONT/HALT* key. It can be set independently for all *Modulation* applications.

The active application generally suspends the other applications. On switchover between different applications, the selected measurement status of each application is stored and will be put into effect as soon as the application is activated. In particular, an application in the status *RUN* is restarted each time it is activated.

Note: *The abbreviation "Ext." in* Ext. Phase Err. GMSK *denotes an "Extended" modulation measurement including the quantities* I/Q Origin Offset *and* I/Q Imbalance*. In remote control, the phase and frequency error can be determined separately to speed up the measurement; see test object* `MODulation[:PERRor]`.

Remote control

```
INITiate:MODulation:XPERror[:GMSK]
ABORt:MODulation:XPERror[:GMSK]
STOP:MODulation:XPERror[:GMSK]
CONTinue:MODulation:XPERror[:GMSK]
```

Measurement configuration

Pressing the *Ext. Phase Err. GMSK* softkey twice opens the popup menu *Modulation Configuration* (see page 4.57 ff.). Besides, the hotkeys *Repetition, Stop Condition,* and *Statistic Count* defining the scope of the measurement and the *Trig. Slot Offset* hotkey are associated to the *Ext. Phase Err. GMSK* softkey. The function of these hotkeys is explained in the *Power* menu section (see section *P/t Normal GMSK* on page 4.11 f.); they are identical with the parameters set in the *Control* tab of the *Modulation Configuration* menu (see page 4.57 ff.).

The *Ext. Phase Err. GMSK* hotkey bar contains two additional hotkeys:

Disp. Mode

The *Disp. Mode* hotkey selects one of the following display modes:

Current	Measured value for current burst
Minimum/Maximum	Extreme value of a number of bursts
Average	Average value of a number of bursts

See section *Measurement Control (Modulation Configuration – Control)* on page 4.57 ff.

Remote control
No display mode set explicitly, the three measurement curves are accessible via
`FETCh:ARRay:MODulation:XPERror[:GMSK][:BURSt][:CURRent]?`
`FETCh:ARRay:MODulation:XPERror[:GMSK][:BURSt]:MMAX?`
`FETCh:ARRay:MODulation:XPERror[:GMSK][:BURSt]:AVERage?` etc.

Decode

The *Decode* hotkey defines whether or not guard or tail bits are decoded.

See section *Measurement Control (Modulation Configuration – Control)* on page 4.57 ff.

Remote control
`CONFigure:MODulation:XPERror[:GMSK]:TIME:DECode STANdard | GTBits`

Application

The *Application* softkey selects the modulation scheme. Only one application of the *Modulation* menu is related to GMSK modulated signals. The 8PSK applications are described in section *Test Settings* on p. 4.49 f.

Phase Err. GMSK

The *Phase Error GMSK* hotkey selects the extended phase error measurement on GMSK modulated signals.

Remote control
The *Phase Error GMSK* application is selected by the keywords `XPERror[:GMSK]` in the 3rd and 4th level of the `MODulation` commands, e.g.
`CONFigure:MODulation:XPERror[:GMSK]...`

Measurement Results (Ext. Phase Err. GMSK)

The values shown in the *Modulation* measurement menus can be divided into three groups:

- Setting values
- Scalar measurement results (single values)
- Arrays (traces plotted as a function of time)

The results are indicated in two parameter lines, the test diagram, and a tabular overview below:

Parameter line 1, 2

Test diagram

Output fields and table

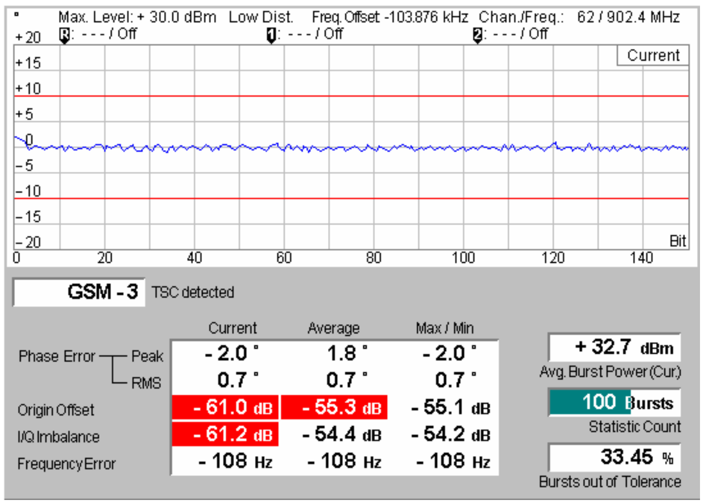


Fig. 4-17 Display of results (Modulation – Ext. Phase Err. GMSK)

Settings/ Scalar results Scalar measurement results and settings are indicated in the two parameter lines above the test diagram and in the output table below.

1st parameter line The first parameter line contains the following settings:

Max. Level Maximum input level set as in the *Analyzer* tab of the *Connection Control* menu (see section *Table-Oriented Version* on p. 4.86 ff.)

Attenuation Setting for the external attenuation of the input level *(Normal, Low Noise, Low Distortion)*

Freq. Offset Frequency offset compared to the nominal channel frequency

Chan./Trig. Slot Offs. RF channel and trigger slot offset (see *Trig. Slot Offset* hotkey on p. 4.18)

2nd parameter line The second parameter line contains the following marker values:

 Level and time of reference marker

 Level and time of delta marker 1 (setting *absolute*) or difference from reference marker (setting *relative*)

 Level and time of delta marker 2 (setting *absolute*) or difference from reference marker (setting *relative*)

Remote control
The settings are retrieved using the query corresponding to the setting command (setting command with appended question mark).

Output fields and table

The output fields display the following scalar values:

TSC detected	Detected training sequence of the current burst received from the mobile station *(GSM 0 to 7* or *Dummy* or *"---"),* see *Analyzer* tab, section *Table-Oriented Version* on p. 4.86 ff.
Avg. Burst Power	Average power of current burst (irrespective of the display mode selected and of the current measurement curve),
Statistic Count	Number of bursts per statistics cycle. The colored bar indicates the relative measurement progress in the statistics cycle.
Bursts out of Tolerance	Percentage of bursts that violate the tolerance limits.

The following scalar values are calculated for the current burst first. From the current results the average referenced to a statistics cycle (*Average;* see averaging rules in Chapter 3) and the extreme value over all bursts measured so far *(Max/Min)* is calculated:

Phase Error Peak	Maximum phase error
Phase Error RMS	Effective phase error (RMS-averaged over the burst)
Origin Offset	Origin offset in the I/Q constellation diagram; calculated in analogy to 8PSK modulation (see *Fig. 4-19* on page 4.48 and *Equation 4-1*)
I/Q Imbalance	Amplitude difference between the I and Q components of the measured signal see (see *Fig. 4-19* on page 4.48 and *Equation 4-2*)
Frequency Error	Frequency error

Remote control

```
READ[:SCALar]:MODulation:XPERror[:GMSK]?
FETCh[:SCALar]:MODulation:XPERror[:GMSK]?
SAMPle[:SCALar]:MODulation:XPERror[:GMSK]?

CALCulate:MODulation:XPERror[:GMSK]:LIMit:MATChing?
```

Measurement curves (arrays)

The continuous measurement curve in the test diagram shows the phase error in the burst (in degrees) as a function of time (in symbols). The display mode *(Current, Max./Min., Average)* for the measurement curve is indicated in the upper right corner of the diagram.

The scale of both axes is fixed. The measurement curve comprises the whole useful part of the normal burst (symbol 0 to 146 ¾). The curve is derived from 588 equidistant measurement points with a ¼ symbol spacing. The y-axis ranges from –20° to +20°.

Due to the definition of the phase error (see shaded section on page 4.42), the phase error oscillates around the center of the diagram: The 0° line is equal to the regression line of the phase error trajectory calculated using the Mean Square Error method.

The two colored, horizontal lines in the test diagram mark the selected tolerance range of the phase error.

Remote control

```
READ:ARRay:MODulation:XPERror[:GMSK][:BURSt]...?
FETCh:ARRay:MODulation:XPERror[:GMSK][:BURSt]...?
SAMPle:ARRay:MODulation:XPERror[:GMSK][:BURSt]...?
```

Measurement Menu (Modulation – 8PSK)

If the 8PSK modulation scheme is selected (see *Application* softkey in section *Test Settings* on page 4.43 ff.), the graphical measurement menu *Modulation* displays quantities characterizing the 8PSK modulation accuracy.

- The measurement control softkey *Overview 8PSK* (which changes to *EVM 8PSK, Magn. Error 8PSK,* or *Phase Error 8PSK* if the corresponding application is selected) indicates the measurement status *(RUN | HLT | OFF)* and opens the configuration menu *Modulation Configuration* (press twice). The hotkeys associated to the measurement control softkey define the scope of the *Power* measurement.
- The other softkeys to the right of the test diagram are combined with various hotkeys. The softkey/hotkey combinations provide test settings and switch over between different measurements. The entry of values is described in section Measurement Menu (Power) on page 4.8.

The measurement menu *Modulation* can be accessed from any other measurement menu of function group *GSMxxxx-MS Non Signalling* using the *Modulation* hotkey. It can be opened also from the *Menu Select* main menu (with the associated key at the front of the instrument).

Quantities characterizing the 8PSK modulation accuracy are determined as follows:

The actual modulation vector of the received signal from the mobile station is measured over the complete burst and stored. From a comparison of this measured modulation vector with the (computed) ideal signal vector, three non-redundant quantities are calculated (see *Fig. 4-18*):

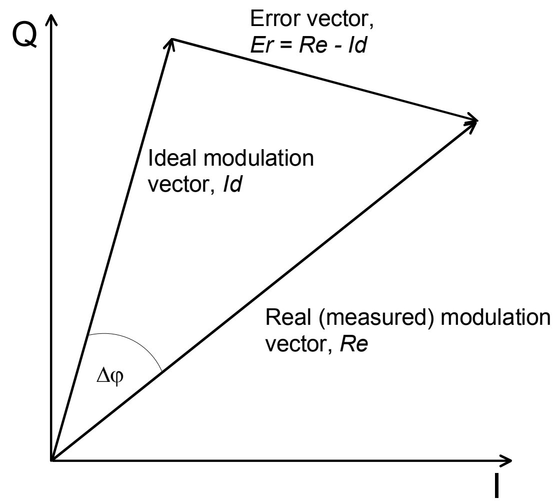
Phase error	Difference in phase between the measured and the ideal signal vector.
Magnitude error	Difference between the magnitudes of the measured and the ideal signal vector.
Error vector magnitude	Magnitude of the vector connecting the measured and the ideal signal vector. In contrast to the previous quantities, the error vector magnitude cannot be negative.

These three quantities are calculated as a function of time and displayed over the whole useful part of the burst (symbol 6 to symbol 162), each of them in a separate graphical measurement menu. In addition, the peak and RMS values of all three quantities are calculated (over the whole display range or over the first ten symbols only) and displayed.

Finally, the *Modulation* measurement provides the following scalar quantities:

95th percentile	Limit value below which 95% of the values of a measurement curve are located. The 95th percentile of a measured quantity has the same unit as the quantity itself. In the 8PSK modulation measurement, the CMU determines 95th percentiles of the Error Vector Magnitude, the Magnitude Error, and the Phase Error.
Origin offset	Origin offset in the I/Q constellation diagram reflecting a DC offset in the baseband signal (see *Fig. 4-19* on page 4.48 and *Equation 4-1*). The origin offset corresponds to an RF carrier feedthrough.
I/Q imbalance	Amplitude difference between the in-phase (I) to the quadrature (Q) components of the measured signal, normalized and logarithmized (see *Fig. 4-19* on page 4.48 and *Equation 4-2*). The I/Q imbalance corresponds to an unwanted signal in the opposite sideband.
Frequency error	Difference of the measured frequency from the expected frequency.

For the **tolerance check** all three phase error curves can be fitted into a tolerance template and checked.



The I/Q vector diagram shows the following quantities measured in the *Modulation* menu:

$\vert Er \vert = \vert Re - Id \vert$	Error vector magnitude (EVM)
$\Delta\varphi$	Phase error
$\vert Re \vert - \vert Id \vert$	Magnitude error

The measurement diagrams show the relative magnitude error and the relative EVM, i.e. the quantities defined above divided by the magnitude of the ideal modulation vector | *Id* |.

Note: *The test functionality of the CMU is beyond the requirements of the standard where nothing regarding the phase error and magnitude error is specified.*

Fig. 4-18 Modulation errors in the I/Q vector diagram

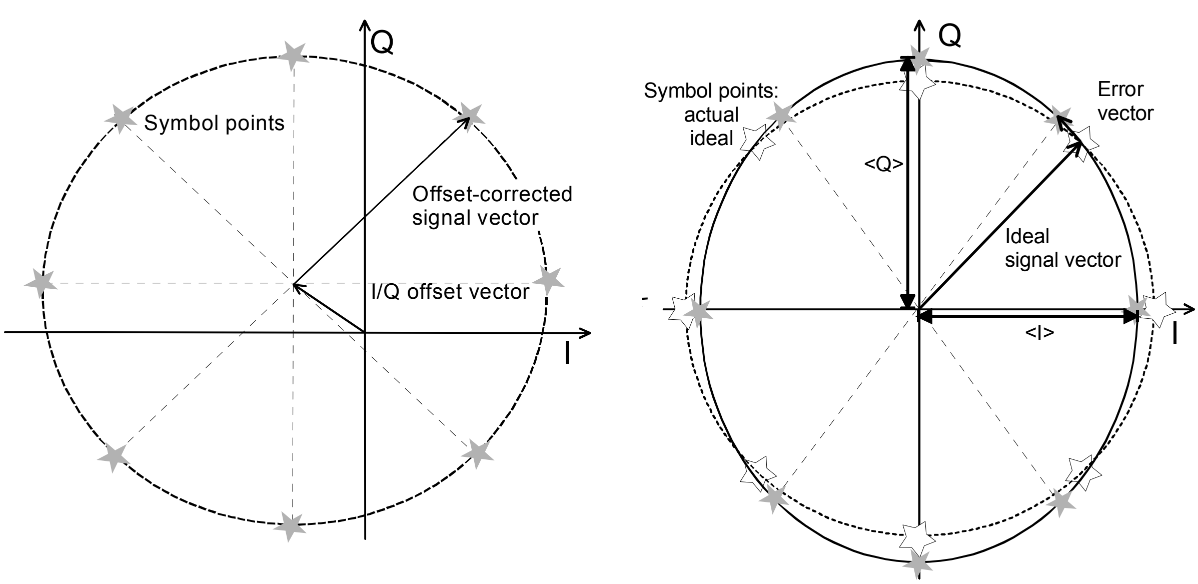


Fig. 4-19 Modulation errors in the I/Q constellation diagram

Fig. 4-19 is an idealized representation of the modulation errors where the effect of a pure origin offset (left diagram) and of a pure I/Q imbalance (right diagram) are completely disentangled. The I/Q offset in dB is the logarithmic ratio of the I/Q offset vector (i.e. the estimated DC-offset of the measured signal) to the average offset-corrected signal vector:

$$\text{Origin Offset} = 20\log\frac{|\text{I/Q offset vector}|}{|\text{Offset-corrected signal vector}|} \qquad \text{(Equation 4-1)}$$

In *Equation 4-1*, |Offset-corrected signal vector| denotes the magnitude of the offset-corrected signal vector averaged over all constellation points. The average is evaluated according to the rule given in the annex of standard GSM 05.05.

The I/Q imbalance in dB is equal to the difference between the estimated I and Q amplitudes of the measured signals, which are normalized and logarithmized as follows:

$$\text{I/Q Imbalance} = 20\log\frac{|<I> - <Q>|}{|<I> + <Q>|} \qquad \text{(Equation 4-2)}$$

The I/Q imbalance is measured for GMSK-modulated signals only.

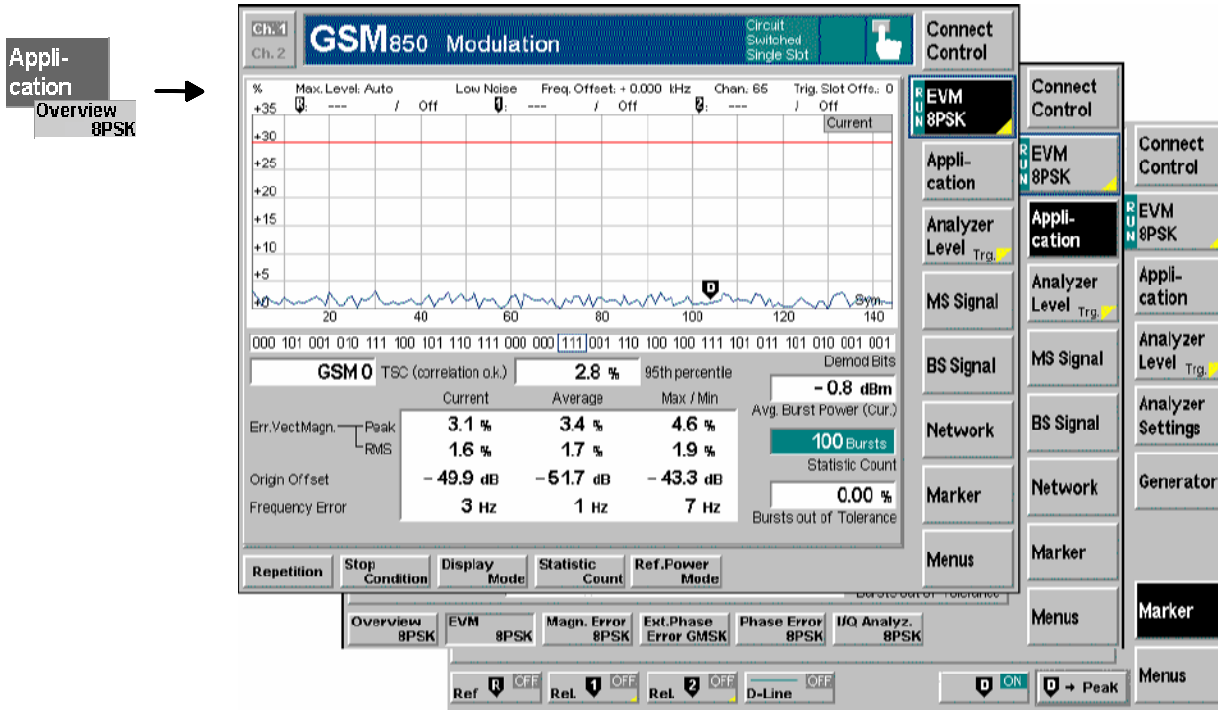


Fig. 4-20 Measurement menu Modulation – EVM 8PSK

Test Settings

The *Analyzer Level, Analyzer Settings, Generator,* and *Menus* test settings are identical with those in the *Power* menu (see section *Test settings* on page 4.9). The *Overview 8PSK* measurement control softkey (which changes to *EVM 8PSK, Magn. Error 8PSK,* or *Phase Error 8PSK* if the corresponding application is selected) is analogous to the *Ext. Phase Err. GMSK* softkey described in section *Test Settings* on page 4.43 The *Ref. Power Mode* is analogous to the *Power* menu and affects the *Avg. Burst Power* result. With 8PSK modulation, the *Application* softkey provides the following applications:

Application

The *Application* softkey selects the measurement application and the modulation scheme. Several applications of the *Modulation* menu are related to 8PSK modulated signals. The GMSK application is described in section *Test Settings* on p. 4.43 f.

Overview 8PSK

The *Overview 8PSK* hotkey selects all scalar modulation results to be displayed. For an explanation of the measured quantities see section *Measurement Menu (Modulation – 8PSK)* on page 4.46.

Remote control
No explicit switchover command. All *Overview 8PSK* measurements are identified by the 3rd/4th level keywords `...OVERview:EPSK...`

EVM 8PSK

The *EVM 8PSK* hotkey selects the magnitude of the error vector to be displayed. The error vector connects the measured signal from the mobile station and the ideal signal vector at the symbol points, see explanation in section *Measurement Menu (Modulation – 8PSK)* on page 4.46. The diagram shows the relative magnitude (in percent), i.e. the ratio of the magnitude of the error vector to the magnitude of the ideal signal vector.

Remote control
No explicit switchover command. All *EVM 8PSK* measurements are identified by the

$3^{rd}/4^{th}$ level keywords ...EVMagnitude:EPSK...

Phase Err. 8PSK

The *Phase Error 8PSK* hotkey selects the phase error of the modulation vector to be displayed.

The phase error is the difference in phase between the measured signal from the mobile station and an ideal signal waveform at the symbol points, see explanation in section *Measurement Menu (Modulation – 8PSK)* on page 4.46.

Remote control
No explicit switchover command. All *Phase Error 8PSK* measurements are identified by the $3^{rd}/4^{th}$ level keywords ...PERRor:EPSK...

Magn. Err. 8PSK

The *Magnitude Error 8PSK* hotkey selects the magnitude error of the modulation vector to be displayed.

The magnitude error is the difference in magnitude between the measured signal from the mobile station and an ideal signal waveform at the symbol points, see explanation in section *Measurement Menu (Modulation – 8PSK)*. The diagram shows the relative magnitude error (in percent), i.e. the ratio of the absolute magnitude error to the magnitude of the ideal signal vector.

Remote control
No explicit switchover command. All *Magn. Error 8PSK* measurements are identified by the $3^{rd}/4^{th}$ level keywords ...MERRor:EPSK...

I/Q Analyz. 8PSK

The *I/Q Analyz. 8PSK* hotkey selects the diagrams to display the modulation vector in the I/Q plane (constellation diagram, vector diagram) and the I and Q amplitude vs. time *(I Phase, Q Phase, I Phase & Q Phase).*

The diagram type is selected via *Display – Waveform* or in the configuration menu; see section *Measurement Control (Modulation Configuration – Control)* on page 4.57 ff. This application is available in *Non Signalling* mode only.

Remote control
No explicit switchover command. All *I/Q Analyz 8PSK* measurements are identified by the $3^{rd}/4^{th}$ level keywords ...IQANalyzer:EPSK...

Marker

The hotkeys associated with the *Marker* softkey control the markers and the display line.

In addition to the reference markers and the relative markers described on p. 4.15, an additional marker controls the readout of the demodulated bits in the 8PSK-diagrams (application *EVM 8PSK, Phase Error 8PSK, Magnitude Error 8PSK)*.

On /OFF

Switches the demodulated bit marker on or off and defines its position as an integer symbol value within the displayed useful part of the burst (symbols no. 3 to 144). The symbol at the marker position is displayed in the center of the demodulated bits bar below the diagram, framed with a blue rectangle.

110 001 101 010 010 010 110 010 011 010 110 100 100 101 110 011 011 110 010 010 000 001 101

Remote control
CONFigure:MODulation:<Application>:EPSK:DBITs
where <Application> = EVMagnitude | PERRor | MERRor

–> Peak

Sets the demodulated bit marker to the symbol with the largest of all EVM values across the burst (application *EVM 8PSK)* or to the symbol where the absolute value of the phase error (application *Phase Err. 8PSK)* or magnitude error (application *Magn. Err. 8PSK)* reaches its maximum.

This function is suitable for analyzing the correlation between large modulation errors and the transferred bit pattern.

Remote control
`READ[:SCALar]:MODulation:<Application>:EPSK:DBITs:PEAK?`
where `<Application> = EVMagnitude | PERRor | MERRor`

Measurement Results

The values shown in the *Modulation* measurement menus can be divided into three groups:

- Setting values
- Scalar measurement results (single values)
- Arrays (traces plotted as a function of time)

The measurement menu for the *Overview* application shows all scalar results but no trace. The measurement menus for the remaining three applications are analogous to each other and show the phase error, the (relative) magnitude error or the (relative) error vector magnitude as a function of time and the corresponding peak and effective values. The range and unit of the y-axis is adjusted to the measured quantity. The *I/Q Analyzer* application provides a graphical analysis of the modulation vector in the I/Q plane.

a) Scalar Results (Overview)

The measurement menu for the application *Overview 8PSK* shows all scalar results. Most of the values are indicated in tabular form:

Parameter line

Output fields

Output table
and additional fields

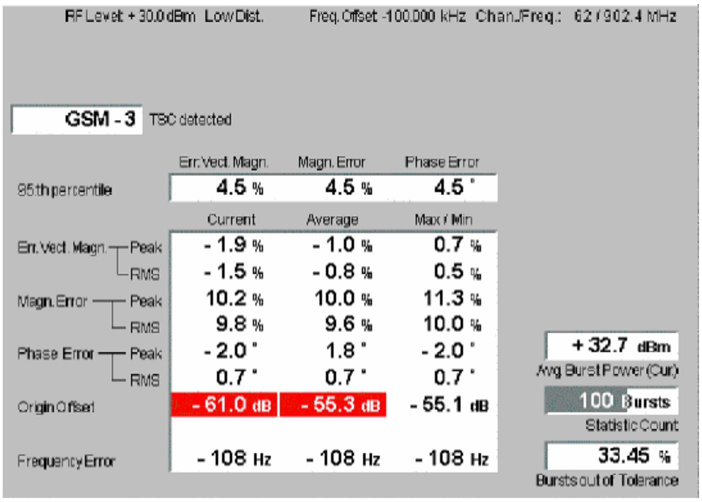


Fig. 4-21 Display of results (Modulation – Overview)

Parameter line The parameter line contains the following settings:

Max. Level Maximum expected input level set as in the *Analyzer* tab of the *Connection Control* menu (see section Table-Oriented

		Version on p. 4.86 ff.),
	Attenuation	Setting for the external attenuation of the input level *(Normal, Low Noise, Low Distortion)*,
	Freq. Offset	Frequency offset compared to the nominal channel frequency,
	Chan./Trig. Slot Offs.	RF channel and trigger slot offset (see *Trig. Slot Offset* hotkey on p. 4.18)

Remote control — The settings are retrieved using the query corresponding to the setting command (setting command with appended question mark).

Output fields — In the output fields in the center of the menu, the following results are displayed:

TSC detected — Detected training sequence of the current burst received from the mobile station *(GSM 0 to 7* or *Dummy* or *"---"),* see *Analyzer* tab, section *Table-Oriented Version* on p. 4.86 ff.

95th percentile — Limit values below which 95% of the measured *Error Vector Magnitudes, Magnitude Errors,* and *Phase Errors* in the current burst are located. Owing to this definition, the 95th percentile of a measured quantity has the same unit as the quantity itself.

Output table — The scalar values in the output table are explained at the beginning of this section on page 4.47. They are first calculated for the current burst. From the current results the average referenced to a statistics cycle (*Average,* see averaging rule in Chapter 3, section *General Settings)* and the extreme value over all bursts measured during the ongoing measurement *(Max/Min)* is calculated. Peak and RMS[1] values are taken over the whole useful part of the burst.

Error Vect. Magn. — Peak and effective (RMS averaged) value of the relative error vector magnitude

Magn. Error — Peak and RMS (relative) magnitude error

Phase Error — Peak and RMS phase error

Origin Offset — Origin offset in the I/Q constellation diagram

Frequency Error — Difference between measured and expected signal frequency

Additional fields — Three output fields to the right of output table indicate the following results and settings:

Avg. Burst Power — Average power of current burst (irrespective of the display mode selected and of the trace in the other 8PSK applications).

Statistic Count — Length of bursts per statistics cycle. The colored bar indicates the relative measurement progress in the statistics cycle.

Bursts out of Tolerance — Percentage of bursts that violate the tolerance limits.

Limit Check — A red output field and an arrow pointing upwards or downwards indicates that the measurement result exceeds the upper or lower limit set in the *Limits* tab of the *Modulation* configuration menu, see p. 4.61.

Remote control — The settings are retrieved using the query corresponding to the setting command (setting command with appended question mark).

```
READ[:SCALar]:MODulation:OVERview:EPSK? etc.
CALCulate[:SCALar]:MODulation:OVERview:EPSK:
  LIMit:MATChing?
```

[1] To keep the results comparable, RMS averaging was chosen for both positive quantities and quantities with alternating sign. The RMS-averaged EVM is calculated according to the rule of GSM 05.05.

b) Test Diagrams (EVM, Phase Error, Magn. Error)

The graphical measurement menus for the three applications *EVM 8PSK*, *Magn. Error 8PSK*, and *Phase Error 8PSK* are analogous. The results are indicated in two parameter lines, the test diagram, and a tabular overview below:

Parameter lines

Test diagram

Demod. bits

Output fields

and table

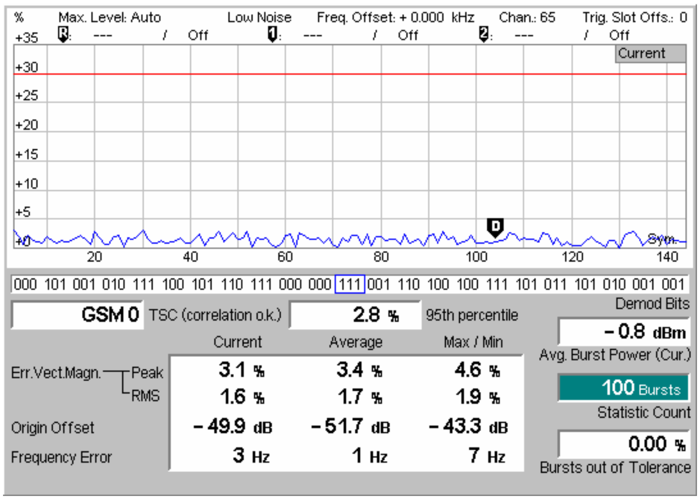


Fig. 4-22 Display of results (Modulation – EVM / Phase Error / Magn. Error)

Settings/ Scalar results Scalar measurement results and settings are indicated in the two parameter lines above the test diagram and in the output table below.

Parameter line The first parameter line contains the following settings:

Max. Level	Maximum input level set as in the *Analyzer* tab of the *Connection Control* menu (see section *Table-Oriented Version* on p. 4.86 ff.)
Attenuation	Setting for the external attenuation of the input level *(Normal, Low Noise, Low Distortion)*
Freq. Offset	Frequency offset compared to the nominal channel frequency
Chan./Trig. Slot Offs.	RF channel and trigger slot offset (see *Trig. Slot Offset* hotkey on p. 4.18)

Remote control The settings are retrieved using the query corresponding to the setting command (setting command with appended question mark).

Output fields Below the diagram, the following results are displayed:

TSC detected	Detected training sequence of the current burst received from the mobile station *(GSM 0 to 7* or *Dummy* or *"---"),* see *Analyzer* tab, section *Table-Oriented Version* on p. 4.86 ff.
95th percentile	Limit values below which 95% of the measured *Error Vector Magnitudes, Magnitude Errors,* and *Phase Errors* in the current burst are located. Owing to this definition, the 95th percentile of a measured quantity has the same unit as the quantity itself.

Output table The output table contains the following scalar values:

Avg. Burst Power	Average power of current burst (irrespective of the display mode selected and of the current trace),
Statistic Count	Number of sweeps per statistics cycle. The colored bar indicates the relative measurement progress in the statistics cycle,
Bursts out of Tolerance	Percentage of bursts that violate the tolerance limits.

The following scalar values are calculated for the current burst first. From the current results the average referenced to a statistics cycle (*Average,* see averaging rule in Chapter 3, section *General Settings)* and the extreme value over all bursts measured so far *(Max/Min)* is calculated:

Err. Vect. Magn. (Peak)	Maximum EVM (application *EVM 8PSK* only)
Err. Vect. Magn. (RMS)	Effective EVM (RMS-averaged over the burst)
Magn. Error (Peak)	Maximum magnitude error (application *Magn. Err. 8PSK* only)
Magn. Error (RMS)	Effective magnitude error (RMS-averaged over the burst)
Phase Error (Peak)	Maximum phase error (application *Phase Err. 8PSK* only)
Phase Error (RMS)	Effective phase error (RMS-averaged over the burst)
Origin Offset	Origin offset in the I/Q constellation diagram
Frequency Error	Difference between measured and expected signal frequency

Peak and RMS values are specific to the current application *(Phase Error, Magnitude Error* or *Error Vector Magnitude)*. For an explanation of all quantities measured refer to the beginning of this section on page 4.47.

Limit Check

A red output field and an arrow pointing upwards or downwards indicates that the measurement result exceeds the upper or lower limit set in the *Limits* tab of the *TX Tests* configuration menu, see p. 4.61.

Remote control

`READ[:SCALar]:MODulation:EVMagnitude:EPSK` etc.

```
CALCulate[:SCALar]:MODulation:EVMagnitude:EPSK
   :LIMit:MATChing?
```

Test diagram

The continuous trace in the test diagram shows the measured quantity as a function of time (in symbols). The display mode *(Current, Max./Min., Average)* for the trace is indicated in the upper right corner of the diagram.

The measurement curve comprises the useful part of the normal burst excluding tail symbols (symbol 3 to 144). The curve is derived from 142 equidistant measurement points. The y-axis range is fixed for any of the three measured quantities (applications):

0 % to +20 %	for the error vector magnitude
–20 % to +20 %	for the magnitude error
–20 deg to +20 deg	for the phase error

The red, horizontal lines in the test diagram mark the tolerance range of the measured quantities as set in the *Limits* tab of the *Modulation Configuration* menu (see p. 4.61 ff).

Remote control

`READ:ARRay:MODulation:EVMagnitude:EPSK:CURRent?` etc.

Demod. Bits

It the demodulated bit marker is switched on (see marker functions on p. 4.50), then the demodulated bits in a 23-symbol range are displayed below the test diagram.

110 001 101 010 010 010 110 010 011 010 110 100 100 101 110 011 011 110 010 010 000 001 101

Each 8PSK symbol corresponds to 3 bits. The symbol at the marker position is displayed in the center of the bar, framed with a blue rectangle. Towards the edges of the burst, the bar contains invalid results (symbol numbers <3 and >144).

The result is suitable for analyzing the correlation between modulation errors and the transferred bit pattern.

Remote control
```
READ[:SCALar]:MODulation:<Application>:EPSK:DBITs
READ:ARRay:MODulation:<Application>:EPSK:DBITs?
READ[:SCALar]:MODulation:<Application>:EPSK:DBITs:PEAK?
```
etc., where <Application> = EVMagnitude | PERRor | MERRor

c) Display of the Modulation Vector (I/Q Analyzer)

The *I/Q Analyz. 8PSK* application provides five different graphical menus to display and analyze the modulation vector of the received 8PSK-modulated signal. The diagram type is selected via *Display – Waveform* or in the configuration menu; see section *Measurement Control (Modulation Configuration – Control)* on page 4.57 ff.

Representation in the I/Q Plane

The *Constellation* and the *Vector* diagram both show the basic properties of the 8PSK modulation vector in the I/Q plane. The menus display the actual test diagram and several output fields for the output power and the essential modulation parameters.

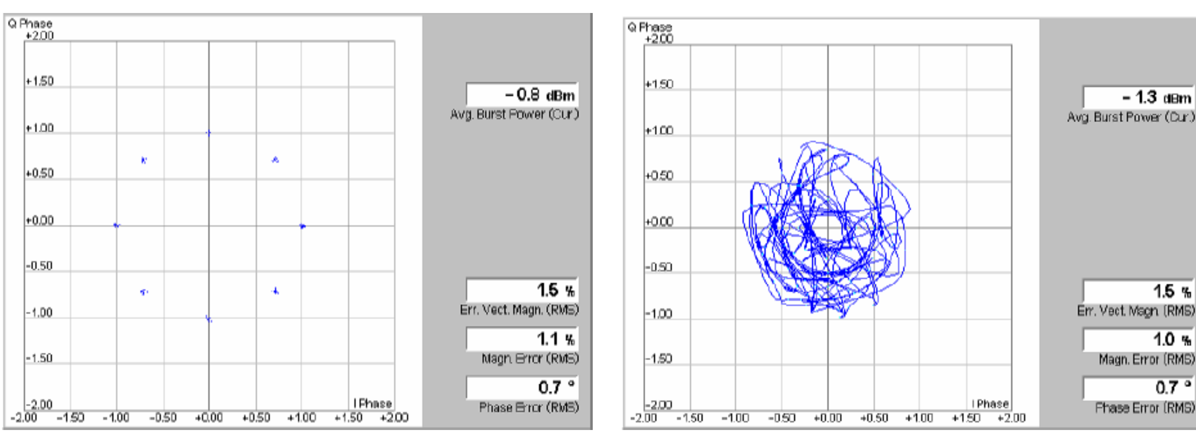


Fig. 4-23 Display of results (Modulation – I/Q Analyzer – Constellation/Vector)

Settings/ Scalar results

The scalar modulation parameters indicated in the output fields on the right side are also shown in the other *Modulation* applications; see e.g. section *Scalar Results (Overview)* on p. 4.51 ff.

Remote control
```
READ[:SCALar]:MODulation:IQANalyzer:EPSK?
```
etc.

Diagrams

The constellation and vector diagrams trace the 8PSK modulation vector in the normalized I/Q plane over a definite time interval. The normalized I amplitude <I> scales the horizontal axis, the normalized Q amplitude <Q> scales the vertical axis. The phase angle is given by

$$\varphi = \arctan(<Q> / <I>),$$

and the normalization is chosen so that the signal amplitude at the constellation points averaged over the measurement length is equal to 1.

The two diagrams differ in the way the result is displayed.

Constellation diagram

In the *Constellation* diagram the modulation vector is only traced at the constellation points; the diagram shows a dot for each symbol. If the inter-symbol interference is removed by means of an appropriate I/Q filter (see p. 4.60), then the constellation diagram of an ideal 8PSK-modulated signal contains 8 constellation points with distance 1 from the origin and relative angles of $\pi/4$. Large variations of the symbol point positions in the constellation diagram indicate a poor signal quality.

Vector diagram

In the *Vector* diagram the modulation vector is traced with an oversampling factor of 4; the diagram shows a continuous curve. The vector diagram shows that the 8PSK modulation scheme allows transitions between each pair of constellation points.

A single shot measurement extends over 142 symbols within the useful part of a normal GSM burst (symbol 3 to symbol 144). The vector diagram is based on 4*142 = 568 measurement points.

Settings

To customize the graphical representation it is possible to zoom the diagrams, keeping the origin at fixed position, and to display or remove the grid *(Display* softkey). The appearance of the diagram is also influenced by the parameters *Rotation* (see p. 4.60) and I/Q filter (see p. 4.60).

Remote control

```
READ:ARRay:MODulation:IQANalyzer:EPSK:IPHASe?
READ:ARRay:MODulation:IQANalyzer:EPSK:QPHASe?
```
etc.

Representation of the Amplitudes vs. Time

The *I Phase,* the *Q Phase,* and the *I Phase & Q Phase* diagrams show the normalized amplitudes of the I and Q components of the modulation vector as a function of time (eye diagrams). All diagrams are Cartesian diagrams, the time forming the x-axis.

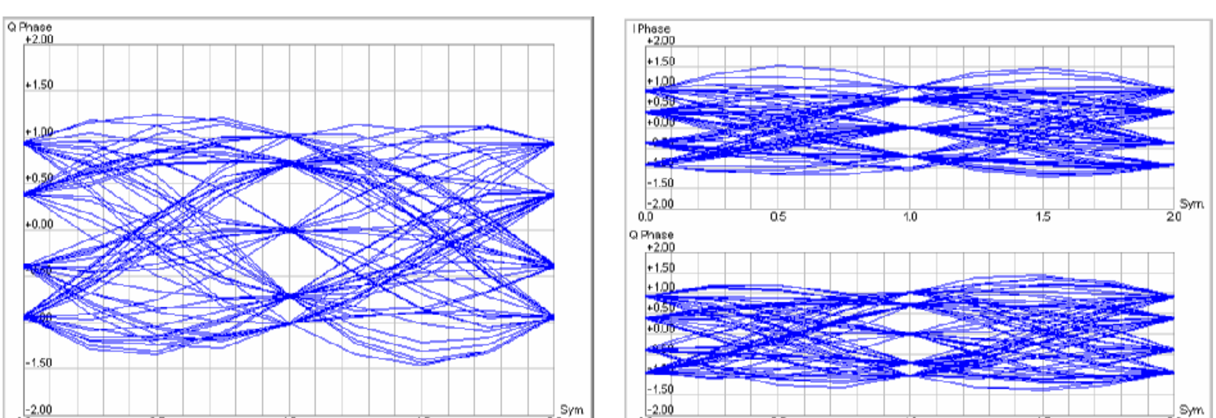


Fig. 4-24 Display of results (Modulation – I/Q Analyzer – I Phase / Q Phase)

Diagram

The *I Phase,* the *Q Phase,* and the *I Phase & Q Phase* diagrams trace the normalized I and Q amplitudes as a function of time. Diagrams of this type are often referred to as eye diagrams. The horizontal axis covers a fixed 2-symbol time interval, starting at the time of a constellation point, whereas the total duration of a single shot measurement is 142 symbols (symbols no. 3 to 144). The measurement curve restarts at the left diagram edge after each 2-symbol period so that the complete diagram contains 71 superimposed curves.

The number of nodes on the vertical axis of the I or Q eye diagram is equal to the number of different I or Q amplitudes in the constellation diagram (=5). The number of eyes is equal to the number of nodes minus one. Smeared-out nodes and small eye apertures indicate a poor signal quality.

The *I Phase* and *Q Phase* diagrams are analogous; the combined *I Phase & Q Phase* diagram displays the *I Phase* diagram on top of the *Q Phase* diagram.

Settings

To customize the graphical representation it is possible to zoom the diagrams in vertical direction, keeping the zero-amplitude reference at fixed position, and to display or remove the grid *(Display* softkey). The appearance of the diagram is also influenced by the parameters *Rotation* (see p. 4.60) and I/Q filter (see p. 4.60).

Remote control
`READ:ARRay:MODulation:IQANalyzer:EPSK:IPHASe?`
`READ:ARRay:MODulation:IQANalyzer:EPSK:QPHASe?` etc.

Measurement Configurations (Modulation Configuration)

The popup menu *Modulation Configuration.* contains two tabs to determine the parameters of the phase and frequency error measurement including the error tolerances.

The popup menu *Modulation Configuration* is activated by pressing the measurement control softkey (labeled *Ext. Phase Err. GMSK, Overview 8PPSK, ...* depending on the modulation scheme and application selected) in the top right of the graphical measurement menu *Modulation* twice. By pressing the associated hotkeys, it is possible to change between the tabs.

Measurement Control (Modulation Configuration – Control)

The *Control* tab controls the *Modulation* measurement by defining

- The time after which a measurement with invalid results is stopped *(Inv. Res. Det. Timeout)*
- The *Repetition* mode
- The *Stop Condition* for the measurement
- The measurement curve displayed *(Display Mode*, not for application *Overview 8PSK)*
- The number of bursts/evaluation periods forming a statistics cycle *(Statistic Count)*,
- The decoding rule for guard and tail bits *(Decode*, for GMSK modulation only)
- The averaging rule to obtain the reference power *(Ref. Power Mode*, for *8PSK* measurements only)
- The display configuration for the *I/Q Analyzer* diagrams

Besides, it influences the graphical measurement menus by adding or removing the *Grid*.

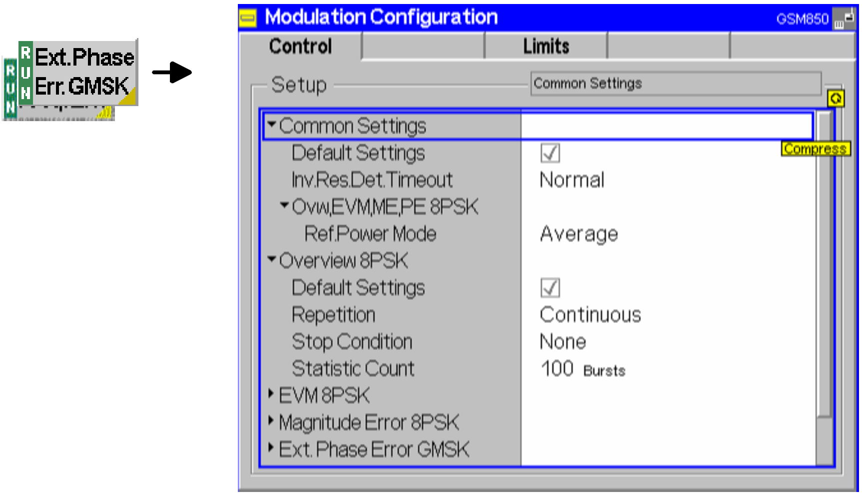


Fig. 4-25 Modulation Configuration – Control

The settings can be defined separately for the different applications of the *Modulation* measurement group. Most functions are analogous to those of the menu *Control* in the menu group *Power* (see page 4.29). In the remote-control commands, the keyword `POWer` is to be replaced by `MODulation`. The following parameters are specific to the *Modulation* measurement:

Default Settings The *Default Settings* switches assign default values to all settings in the *Control* tab belonging to an individual application (the default values are quoted in the command description in chapter 6 of this manual).

Remote control
`CONFigure:MODulation:XPERror[:GMSK]:CONTrol:DEFault ON | OFF`
`etc.`

Display Mode The *Display Mode* defines which of the measured and calculated measurement curves is displayed. The measurement curves differ in the way the measured quantity at a fixed point in time *t* is calculated if the measurement extends over several bursts

Current	Measured value for the current burst
Max./Min.	Extreme value over a number of bursts
Average	Average value over a number of bursts

The number of bursts for the calculation of the statistic values *Minimum/Maximum* and *Average* – and thus the result – depends on the repetition mode set (see section *Measurement Control (Power Configuration – Control)* on page 4.29). In detail, this implies:

Single shot	Display of minimum, maximum and average value from the performed statistics cycle
Continuous	Display of minimum and maximum from all bursts already measured. The **average value**, however, is calculated according to the averaging rule in Chapter 3, section *General Settings*.

In a power measurement absolute values are determined, whereas the measured phase error can have both positive or negative sign. To assess the phase error only the magnitude (and not the sign) is of importance so that extreme values are output in the menu *Modulation* instead of maxima and minima.

Remote control
no display mode set, the four measurement curves are accessible via
`FETCh:ARRAy:MODulation:XPERror[:GMSK][:BURSt]`

```
  [:CURRent]?
FETCh:ARRAy:MODulation:XPERror[:GMSK][:BURSt]:MMAX?
FETCh:ARRAy:MODulation:XPERror[:GMSK][:BURSt]
  :AVERage?
```
etc.

Decode

Decode defines whether or not guard or tail bits are decoded (for GMSK modulation only).

Guard and tail bits are located at the beginning and the end of a normal burst (see *Fig. 4-37*), which is why they also affect the phase error at the beginning and the end of the useful information and therefore the frequency error. The CMU offers two settings:

Standard — Guard and tail bits are assumed to be in line with GSM. If the mobile station does actually not send these bits correctly, large phase errors will be measured at the beginning and end of the useful information.

Guard & Tailbits — Guard and tail bits are also decoded. This avoids excessive phase errors in the case of bursts that do not comply with the standard.

Remote control
```
CONFigure:MODulation:XPERror[:GMSK]:TIME:DECode
  STANdard | GTBits
```

Raw Symb. Timing Recovery

Raw Symb. Timing Recovery specifies how the R&S CMU determines the raw symbol timing required for demodulating the signal (for application *Ext. Phase Error GMSK* only).

Non Data Aided — The raw symbol timing is obtained by estimating the decision points of the received bit pattern, irrespective of the data content in the burst. After demodulating the signal, the R&S CMU refines the symbol timing estimate to calculate the modulation results.

Data Aided — To improve the raw symbol timing estimate, the R&S CMU correlates to the training sequence and exploits the information about the known bit pattern in the sequence. After demodulation, the modulation results are calculated like in the *Non Data Aided* procedure.

The modulation results obtained with both procedures are equivalent, provided that the demodulation is successful. The *Non Data Aided* procedure is slightly faster and almost always sufficient. Very rarely, this procedure can fail due to a large group delay in the DUT, causing an incorrect demodulation and thus irregular modulation results. In those cases, *Data Aided* can be used to improve the raw symbol timing estimate.

Remote control
```
CONFigure:MODulation:XPERror[:GMSK]:RSTRecovery NON | TSC
```

The following parameters specify the values and appearance of the *I/Q Analyzer* diagrams.

Rotation

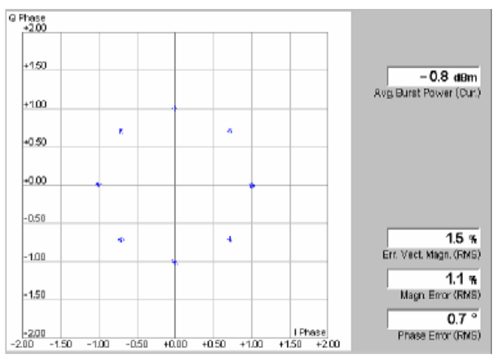
According to standard 3GPP TS 05.04 the 8PSK symbols are continuously rotated with 3π/8 radians per symbol before pulse shaping. Due to the rotation zero crossings in the vector diagram are avoided, however, the number of possible symbol point locations in the constellation diagram is doubled.

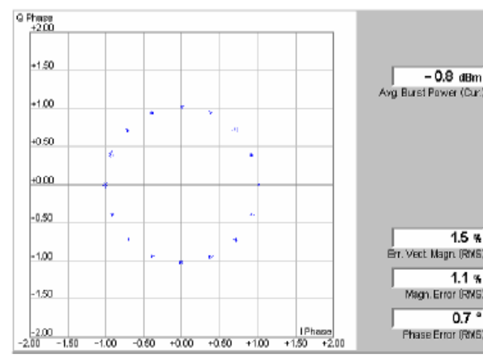
Rotation specifies whether or not the 3π/8 rotation is subtracted off before the symbols are displayed in the constellation diagram.

3π / 8 Removed The constellation points appear as if no phase rotation occurred; the constellation diagram contains 8 symbol point locations (left example below). The symbol mapping of the modulating bits into the 8 symbols is in accordance with specification 3GPP TS 05.04.

3π / 8 The phase-rotated constellation points are displayed; the constellation diagram contains 16 symbol point locations (right example below).

The *Rotation* setting is effective for the *Constellation* diagram only.





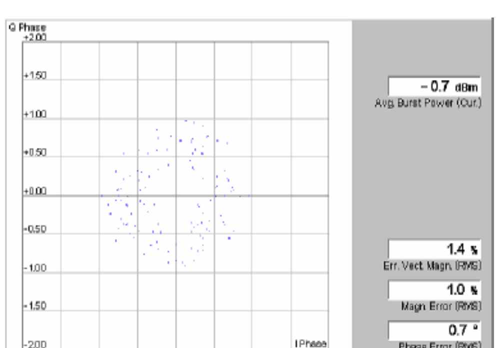
Remote control
```
CONFigure:MODulation:IQANalyzer:EPSK:ROTation
   P38 | P38Removed
```

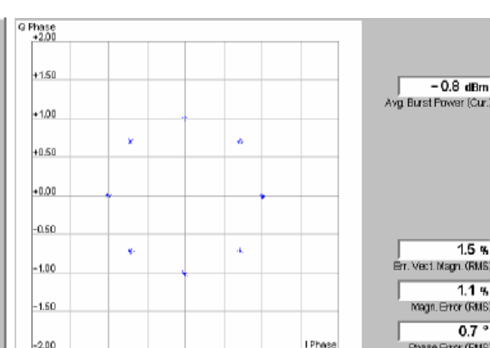
I/Q Filter

Specifies whether the I/Q data is filtered in order to eliminate the inter-symbol interference (ISI) at all constellation points.

Unfiltered No I/Q filter applied. The position of the constellation points is smeared out due to the ISI effects (left example below).

ISI Removed The constellation points appear at fixed locations (right example below).





Remote control
```
CONFigure:MODulation:IQANalyzer:EPSK:IQFilter
   ISIRemoved | UNFiltered
```

Zoom

Zoom magnifies the diagram with an equal factor in horizontal and vertical direction, leaving the center (i.e. the intersection between the I and Q axis) at fixed position:

Normal The normalized I and Q amplitudes range between –2 and +2.

Factor n The normalized I and Q amplitudes range between –2/n and +2/n, where n = 2, 5, 10, 20.

In addition to the zoom factor it is possible to shift the diagram in horizontal or vertical direction using the *Zoom* hotkey associated with the *Display* softkey.

Remote control
no command, display configuration only.

Waveform Type

Waveform Type selects the diagram type:

Correlation Correlation diagram; see section *Representation in the I/Q Plane* on p. 4.55 ff.

Vector Vector diagram; see section *Representation in the I/Q Plane* on p. 4.55 ff.

I Phase Eye diagram of the I amplitude; see section *Representation of the Amplitudes vs. Time* on p. 4.56 ff.

Q Phase Eye diagram of the Q amplitude; see section *Representation of the Amplitudes vs. Time* on p. 4.56 ff.

I Phase & Q Ph. Eye diagrams of the I and Q amplitude in a single diagram; see section *Representation of the Amplitudes vs. Time* on p. 4.56 ff.

Remote control
no command, display configuration only.

Tolerance Values (Modulation Configuration – Limits)

The *Limits* tab defines upper and lower error limits for the measured values of the *Modulation* measurement.

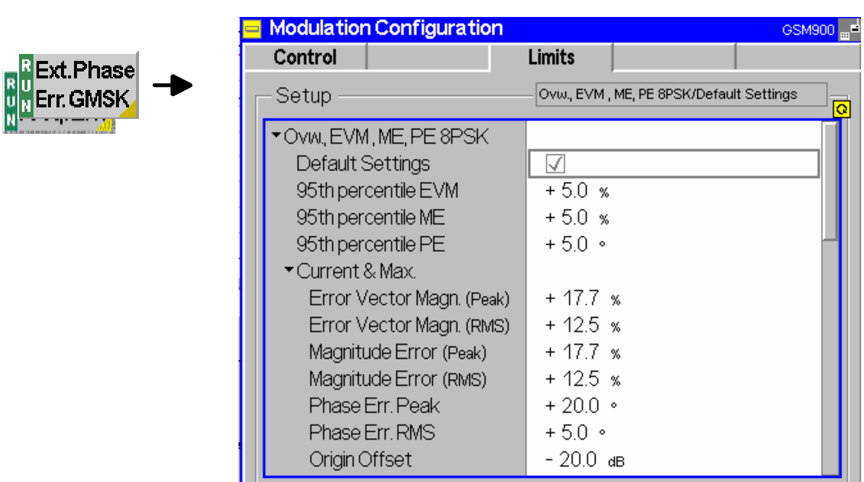


Fig. 4-26 Modulation Configuration – Limits

Default Settings

The *Default Settings* switches assign default values to all parameters of a particular application. The default values are quoted in the command description in chapter 6 of this manual.

Remote control
`CONFigure:MODulation:XPERror[:GMSK]:CONTrol:DEFault ON | OFF etc.`

Ovw., EVM, ME, PE 8PSK

The *Ovw., EVM, ME, PE 8PSK* table section defines all limits for 8PSK-modulated signals. The limits are set independently for the display modes *Current* and *Max./Min.* on one hand, *Average* on the other hand; see section *Measurement Control (Modulation Configuration – Control)* on page 4.57 ff.

95th percentile PE Upper limit for the phase error below which 95% of all measured phase error values are located

95th percentile ME Upper limit for the magnitude error below which 95% of all measured relative magnitude error values are located

95th percentile EVM Upper limit for the relative error vector magnitude below which 95% of all measured EVM values are located

Error Vector Magn. Upper limits for the (peak and RMS-averaged[2]) relative error vector magnitude (EVM). Both entries are positive.

Magnitude Error Upper limits for the absolute value of the (peak and RMS) relative magnitude error. Both entries are positive; the limits for the peak magnitude error define a tolerance mask symmetric to the origin.

Phase Error Upper limits for the absolute value of the (peak and RMS) phase error. Both entries are positive; the limits for the peak phase error define a tolerance mask symmetric to the origin.

Origin Offset Upper limit for the origin offset in the I/Q constellation diagram.

Frequency Error Upper limit for the difference between the measured and the expected frequency of the signal.

For an explanation of all measured quantities refer to the beginning of this section on page 4.47.

Remote control
```
CONFigure:MODulation:OEMP:EPSK:LIMit[:CURRent]  ...
CONFigure:MODulation:OEMP:EPSK:LIMit:AVERage  ...
```

Ext. Phase Error GMSK

The table section *Ext. Phase Error GMSK* defines upper limits for the different GMSK modulation parameters. The limits depend on the display mode of the measurement curve:

Current & Max. Common limits for the *Current* measurement curve and for the *Minimum/Maximum* curve (including the *Current* and the *Max./Min* scalar results)

Average Limits for the *Average* measurement curve (including the *Average* scalar results)

For setting of the display mode see section *Measurement Control (Modulation Configuration – Control)* on page 4.57.

The meaning of the error limits is the same for the *Current* or *Minimum/Maximum (Current & Max.)* and the *Average* results:

Phase Error Peak Maximum phase error

Phase Error RMS RMS phase error (RMS-averaged over the burst)

Origin Offset Upper limit for the origin offset in the I/Q constellation diagram.

---

[2] To keep the results comparable, RMS averaging was chosen for both positive quantities and quantities with alternating sign. The RMS-averaged EVM is calculated according to the rule of GSM 05.05.

I/Q Imbalance Upper limit for the amplitude difference between the in-phase and quadrature components of the signal.

Frequency Error Average frequency error in the burst

The *Phase Error Peak* and the *Frequency Error* are quantities with alternating sign; the corresponding limits are symmetric to the origin (i.e. the absolute value of both quantities must fall below the specified positive limit). In contrast to the *Power* measurement where individual limit lines can be switched off, the *Modulation* limit check is always active.

Remote control

```
CONFigure:MODulation:XPERror[:GMSK]:LIMit[:CURRent]
        <PhaseErrorPeak>,<PhaseErrorRMS>,<FrequencyError>
```

Spectrum Measurements

The menu group *Spectrum* measures the off-carrier power originating from the modulation process *(spectrum due to modulation)* and from the bursty nature of the RF signal, i.e. the power ramping up and down *(spectrum due to switching)*. The two spectra can be measured separately (applications *Modulation* and *Switching)* or together (application *Modulation & Switching).* Moreover, it is possible to analyze the power vs. time of the signal at off-carrier frequencies. The popup menu *Spectrum Configuration* provides measurement settings.

The *Spectrum* measurement serves to measure the amount of energy that spills outside the designated radio channel when the mobile station transmits at variable output power. The measurement is made in the time domain (zero frequency span mode), at a series of frequency points distributed around the nominal frequency of the designated channel (see section *Tolerance Values (Spectrum Configuration – Limit Lines)* on page 4.74 ff.).

In GSM 05.05 and GSM 11.10, the two *Spectrum* measurements are specified in detail:

- For the *spectrum due to modulation*, the power must be averaged over a portion of the useful part of the burst, excluding the training sequence, and then averaged again over a given minimum number of bursts.
- For the *spectrum due to switching*, the peak power over a minimum number of bursts must be determined.

Additional requirements concerning the measurement bandwidths are specified.

The *Spectrum* measurements for GMSK and 8PSK modulation are analogous, however, the tolerance values specified in the GSM standard depend on the modulation scheme. The CMU can automatically determine the modulation scheme of the received bursts and adjust the tolerance template.

A typical example of a burst measured at 400 kHz offset from the carrier (1st alternate channel) with a 30 kHz measurement filter is given below (Fig. 4-27). In the left example, the burst power at any time is averaged over several consecutive busts, the right example represents a peak hold measurement.

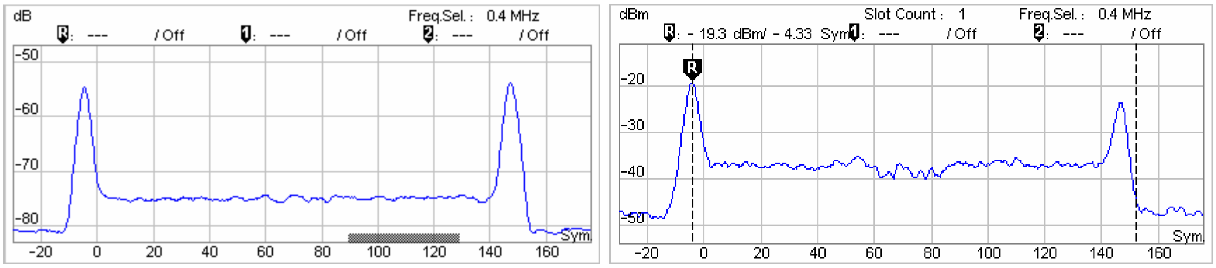


Fig. 4-27 Spectrum due to modulation and switching transients in time domain representation

Multislot Mode If the DUT operates in multislot mode, the spectrum due to *Switching* depends on the MS transmitter output power in all timeslots. The CMU provides a special multislot mode where the switching transients can be correctly measured for any multislot configuration and for any levels in the individual UL timeslots; see *Slot Count* softkey on p. 4.73.

The *Spectrum due to Modulation* measurement is performed on a slot by slot basis; the result is not influenced by multislot scenarios.

Trigger Settings In *Free Run* trigger mode (see section *Trigger (Connection Control – Trigger)* on p. 4.100 ff.), the CMU does not detect the burst edges of the measured RF signal. This mode is unsuitable for *Switching* measurements but can be used for *Modulation* measurements on continuous signals.

Measurement Menu (Spectrum)

The graphical measurement menu *Spectrum* displays the results of the adjacent channel power measurement.

- The measurement control softkey *Modulation* (which changes to *Switching* or *Modulation/Switching* when the corresponding application or modulation scheme is selected) controls the measurement, indicates its status *(RUN | HLT | OFF)* and opens the configuration menu *Spectrum Configuration* (press twice). The hotkeys associated to the measurement control softkey define the scope of the *Spectrum* measurement.
- The remaining softkeys to the right of the test diagram are combined with various hotkeys. When a softkey is selected and an associated hotkey pressed, a popup window appears which indicates a setting or enables an entry. The entry of values is described in section *Test Settings* on page 4.3.

The measurement menu *Modulation* can be accessed from any other measurement menu of function group *GSMxxxx-MS Non Signalling* using the *Spectrum* hotkey. It can be opened also from the *Menu Select* main menu (with the associated key at the front of the instrument).

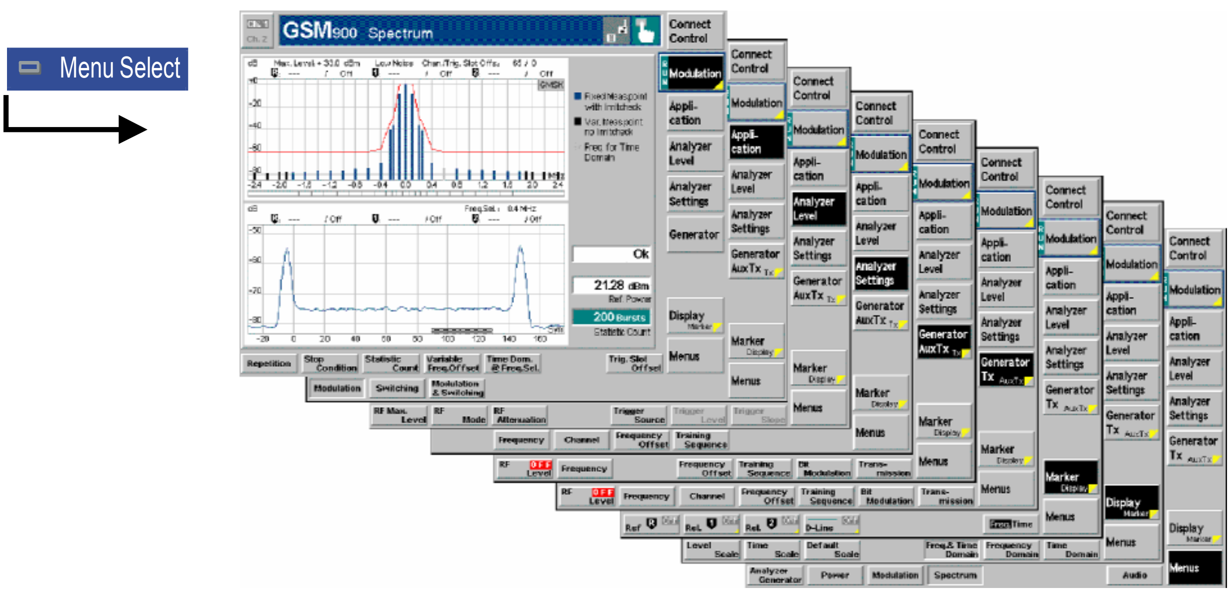


Fig. 4-28 Measurement menu Spectrum due to Modulation

Test Settings

The *Analyzer Level, Analyzer Settings, Generator,* and *Menus* test settings are identical with those in the *Power* menu (see section *Test settings* on page 4.9). The following softkeys and hotkeys differ from the *Power* measurement:

Modulation

The *Modulation* softkey controls the measurement and indicates its status *(RUN | HLT | OFF).* This status can be changed after softkey selection (pressing once) by means of the *ON/OFF* key or the *CONT/HALT* key. It can be set independently for all *Spectrum* applications.

The active application generally suspends the other applications. On switchover between different applications, the selected measurement status of each application is stored and will be put into effect as soon as the application is activated. In particular, an application in the status *RUN* is restarted each time it is activated.

Remote control
```
INITiate:SPECtrum:MODulation
ABORt:SPECtrum:MODulation
```

```
STOP:SPECtrum:MODulation
CONTinue:SPECtrum:MODulation
FETCh:SPECtrum:MODulation:STATus?
```

Measurement configuration

Pressing the *Modulation* softkey twice opens the popup menu *Spectrum Configuration* (see page 4.57 ff.). Besides, the hotkeys *Repetition, Stop Condition,* and *Statistic Count* defining the scope of the measurement and the *Trig. Slot Offset* hotkey are associated to the *Modulation* softkey. The function of these hotkeys is explained in the *Power* menu section (see section *Test settings* on page 4.9); they are identical with the parameters set in the *Control* tab of the *Spectrum Configuration* menu (see page 4.57 ff.).

The remaining parameters are specific to the *Spectrum* measurement and described in section *Measurement Control (Spectrum Configuration – Control)* on p. 4.71 ff.

Appli-cation

The *Application* softkey changes the type of spectrum to be measured. The two alternative spectra can be displayed in separate measurement menus or together in a common menu. When an application is selected, the corresponding measurement menu is called up and the labeling of the measurement control softkey is adapted. The configuration settings for both applications, however, are listed in a common popup menu (see p. 4.71 ff.).

Modulation

The *Modulation* hotkey selects the spectrum due to modulation measurement for GMSK or 8PSK modulated signals; see p. 4.67 ff. The application also provides an additional power vs. time diagram at a selectable frequency offset from the carrier.

Remote control
No explicit switchover command. All spectrum due to modulation measurements are identified by the 2nd to 4th level keywords `..SPECtrum:MODulation`

Switching

The *Switching* hotkey selects the spectrum due to switching for GMSK or 8PSK modulated signals; see p. 4.69 ff. The application also provides an additional power vs. time diagram at a selectable frequency offset from the carrier.

Remote control
No explicit switchover command. All spectrum due to modulation measurements are identified by the 2nd to 4th level keywords `...SPECtrum:SWITching`

Modulation Switching

The *Modulation/Switching* hotkey selects the simultaneous measurement of the spectrum due to modulation and the spectrum due to switching for GMSK or 8PSK modulated signals.

Remote control
No explicit switchover command. All combined spectrum measurements are identified by the 2nd to 4th level keywords `...SPECtrum:MSWitching`

Display Marker

The *Display/Marker* softkey is available in the *Modulation* and *Switching* applications. It provides hotkeys to change the diagram scales (for the time domain diagram) and display or hide the power vs. frequency bar graph and/or power vs. time diagram.

Remote control
No remote control commands, display configuration only.

Marker Display

The *Marker/Display* softkey is available in all applications. It provides hotkeys to position markers in the different diagrams. In the *Switching* application, a marker placed on a bar in the frequency domain diagram will also appear on the corresponding peak value of the curve in the time domain diagram; see Fig. 4-30 on p. 4.69.

Remote control
No remote control commands, display configuration only.

Measurement Results

The *Spectrum* measurement menu and the results depend on the type of spectrum (application) selected. The scaling of the x-axis is equal for the *Modulation* and *Switching* spectra. However, the spectrum due to modulation is expressed in relative units (dBc), the spectrum due to switching in absolute units (dBm).

a) Spectrum due to Modulation

In the *Spectrum due to Modulation* measurement, the average burst power at a series of fixed and variable frequency points around the selected RF frequency is displayed. The results and the test settings are indicated in two parameter lines, the test diagram (frequency domain bar graph), and some additional output fields.

The power vs. time at a particular offset frequency from the carrier can be displayed in an additional time domain diagram.

Parameter lines

Frequency domain: Bar graph with legend on the right side

Time domain: diagram

Additional output fields on the right side

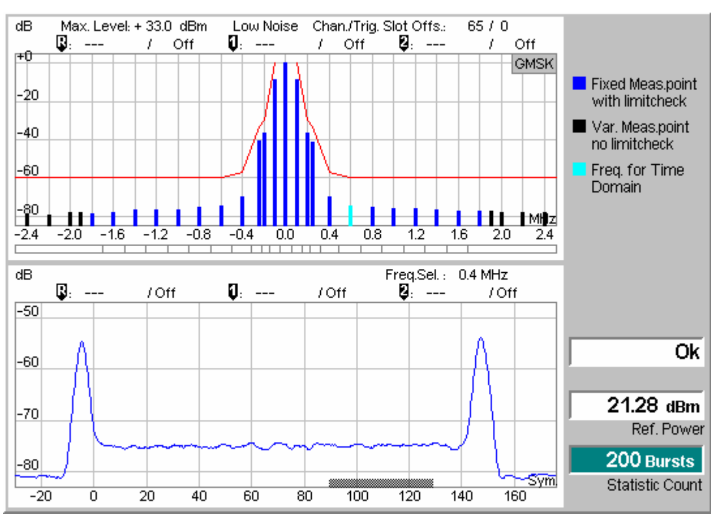


Fig. 4-29 Display of results (spectrum due to modulation)

Parameter lines The first parameter line contains the following settings:

Max. Level	Maximum input level set as in the *Analyzer* tab of the *Connection Control* menu (see section *Table-Oriented Version* on p. 4.86 ff.)
Attenuation	Setting for the external attenuation of the input level *(Normal, Low Noise, Low Distortion)*
Freq. Offset	Frequency offset compared to the nominal channel frequency
Chan./Trig. Slot Offs.	RF channel and trigger slot offset (see *Trig. Slot Offset* hotkey on p. 4.18)

2nd parameter line

The second parameter line contains the following marker values:

R	Absolute level (in dBm) and frequency offset from the carrier of reference marker
1	Level (in dBm) and frequency offset of delta marker 1 (setting *absolute*). With setting *relative,* the level difference from the carrier is indicated (same as the diagram units)
2	Level and time of delta marker 2, see delta marker 1

Output fields

The info box indicates the following settings and scalar results:

Burst Matching	Error message if the displayed burst is out of tolerance.
Ref. Power	Absolute value of the measured carrier output power of the MS. According to GSM specifications, the *Ref. Power* is measured with a filter bandwidth of 30 kHz so that it differs from the average burst power determined in the *Power vs. Time* menu.
Statistic Count	Number of bursts per statistics cycle.

Remote control
The settings are retrieved using the query corresponding to the setting command (setting command with appended question mark). The reference power and burst matching are retrieved with a single command:

```
READ[:SCALar]:SPECtrum:MODulation?
FETCh[:SCALar]:SPECtrum:MODulation?
SAMPle[:SCALar]:SPECtrum:MODulation?
```

Response: `<RefPow>,<Matching>`

Diagrams

The measurement application provides a power vs. frequency bar graph and a power vs. time diagram. Which of the diagrams are displayed depends on the display settings; see *Display/Marker* softkey on p. 4.66.

Frequency Domain: Bar graph

The bar graph shows the current carrier output power of the BTS and the measured spectrum due to modulation at up to 11 fixed but non-equidistant frequencies that are symmetrically distributed around the carrier frequency. The measurement at every single frequency point can be switched on and off in the *Meas X* tab (see p. 4.79). Moreover it is possible to define additional variable test frequencies.

The diagram is scaled such that the x-axis indicating the frequency offset from the carrier ranges from –2.5 MHz to +2.5 MHz (with R&S CMU-U65 Var04; with older versions the measurement range is restricted to –1.8 MHz to +1.8 MHz). The carrier output power *(Ref. Power)* defines the 0 dB reference level. The spectral tolerance mask defined in the *Limit Lines* tab (see p. 4.74 ff) is indicated in addition. The measurement result at particular frequencies can be retrieved by means of markers.

Color legend

The frequency domain diagram can show three types of bars:

- The dark blue bars correspond to the fixed spectrum due to modulation test frequencies defined in the conformance test specification. The result at the fixed frequencies is limit-checked.
- Black bars correspond to the additional variable test frequencies. The result is not limit-checked.
- The light blue bar in the diagram center indicates the frequency where the time-domain diagram is measured, i.e. the frequency set under *Modulation – Time Dom. @ Freq. Sel*.

Remote control

```
READ:ARRay:SPECtrum:MODulation[:FDOMain]?
FETCh:ARRay:SPECtrum:MODulation[:FDOMain]?
```

`SAMPle:ARRay:SPECtrum:MODulation[:FDOMain]?`

Limit Check

The upper limit lines defined in the *Limit Lines* tab of the configuration menu (see p. 4.74 ff) yield the red polygonal curve in the diagram. The limit line template used (GMSK or 8PSK) is indicated in the upper right corner of the diagram. If the limit check fails at a particular test point the corresponding section of the bar across the bottom of the diagram turns red.

Remote control
`CALCulate:ARRay:SPECtrum:MODulation:AREA:LIMit:MATChing?`

Time Domain Diagram

The time domain diagram shows the current MS output power at the frequency set under *Modulation – Time Dom. @ Freq. Sel.,* measured with a 30 kHz filter and averaged over consecutive bursts. The diagram is scaled such that the x-axis covers one burst length plus an appropriate margin; the carrier output power *(Ref. Power)* defines the 0 dB reference level. The diagram scale can be changed using the *Display/Marker* softkey.

The gray bars across the bottom of the diagram represent the *Averaging Areas* (A, B or both) selected in the *Control* tab of the configuration menu (see p. 4.72).

Remote control
```
READ:ARRay:SPECtrum:MODulation:TDOMain?
FETCh:ARRay:SPECtrum:MODulation:TDOMain?
SAMPle:ARRay:SPECtrum:MODulation:TDOMain?
```

b) Spectrum due to Switching

In the *Spectrum due to Switching* measurement, the maximum level measured at a series of fixed and variable frequency points around the selected RF frequency is displayed. The results and the test settings are indicated in two parameter lines, the test diagram (power vs. frequency bar graph), and some additional output fields.

The power vs. time at a particular offset frequency from the carrier can be displayed in an additional power vs. time diagram.

Parameter lines

Frequency domain: Bar graph with legend on the right side

Time domain: diagram

Additional output fields on the right side

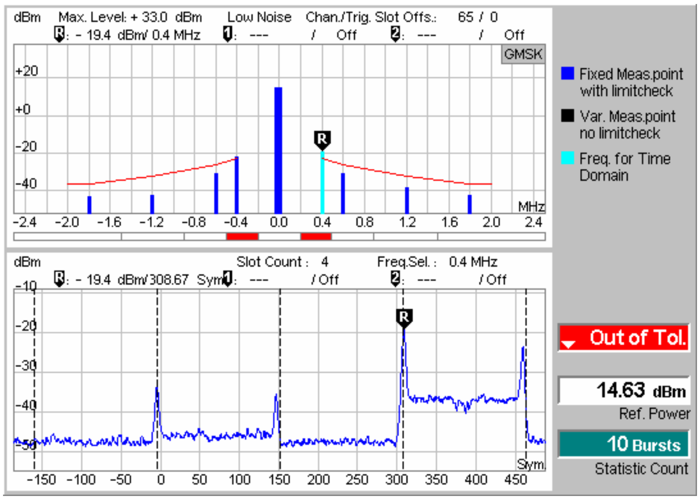


Fig. 4-30 Display of results (spectrum due to switching)

The two parameter lines, the output fields, the color legend and the time domain diagram are identical with the *due to Modulation* menu, see above. Note that, according to GSM specifications, the *Ref.*

Power is measured with a wide-band filter so that it slightly differs from the average burst power determined in the *Power* menu.

Frequency Domain: Bar graph

The bar graph shows the carrier output power of the mobile station in the *Measured Timeslot* and the measured spectrum due to switching at up to 4 non-equidistant frequencies that are symmetrically distributed around the carrier frequency. The switching transients are obtained in peak hold mode but can be updated after each measurement cycle (see *Cont. Stat. Mode* parameter in section *Measurement Control (Spectrum Configuration – Control)* on p. 4.71 ff.). The diagram is scaled such that the x-axis indicating the frequency offset from the carrier ranges from –2.5 MHz to +2.5 MHz (with R&S CMU-U65 Var04; with older versions the measurement range is restricted to –1.8 MHz to +1.8 MHz). The y-axis is in absolute power units (dBm).

The spectral tolerance mask defined in the *Limit Lines* tab (see p. 4.74 ff.) is indicated in addition. The measurement result at particular frequencies can be retrieved by means of markers. The measurement at every single frequency point can be switched on and off in the *Meas X* tab (see p. 4.79).

Remote control
```
READ:ARRay:SPECtrum:SWITching[:FDOMain]?
FETCh:ARRay:SPECtrum:SWITching[:FDOMain]?
SAMPle:ARRay:SPECtrum:SWITching[:FDOMain]?
```

Limit Check

The upper limit lines defined in the *Limit Lines* tab of the configuration menu (see p. 4.74 ff.) yield the red polygonal curve in the diagram. The limit line template used (GMSK or 8PSK) is indicated in the upper right corner of the diagram. If the limit check fails at a particular test point the corresponding section of the bar across the bottom of the diagram turns red.

Remote control
```
CALCulate:ARRay:SPECtrum:SWITching:AREA:LIMit:MATChing?
```

Time Domain Diagram

The time domain diagram shows the current MS output power at the frequency set under *Modulation – Time Dom. @ Freq. Sel.,* measured with a 30 kHz filter, a 100 kHz video filter and in peak hold mode.

The diagram is scaled such that the x-axis covers the number of burst lengths selected in the configuration menu *(Spectrum Configuration – Control – Switching – Slot Count)* plus an appropriate margin. The carrier output power *(Ref. Power)* defines the 0 dB reference level. The diagram scale can be changed using the *Display/Marker* softkey.

Remote control
```
READ:ARRay:SPECtrum:SWITching:TDOMain?
FETCh:ARRay:SPECtrum:SWITching:TDOMain?
SAMPle:ARRay:SPECtrum:SWITching:TDOMain?
```

c) Application Modulation & Switching

In the *Modulation & Switching* application, both spectra are measured in a single measurement shot. The measurement menu contains two diagrams corresponding to the frequency domain bar graphs in the *Modulation* and *Switching* applications. *Modulation & Switching* can be used if both spectra but no power vs. time results are needed.

In remote control, *Modulation & Switching* is identified by the 2nd to 4th level keywords `...SPECtrum:MSWitching...` The combined `MSWitching` measurement takes longer than a single `MODulation` or `SWITching` measurement, however, all results can be retrieved with a single command.

Measurement Configurations (Spectrum)

The popup menu *Spectrum Configuration* contains three tabs to define the parameters of the spectrum measurement including the error tolerances.

The popup menu *Spectrum Configuration* is called up by pressing the measurement control softkey in the top right of the graphical measurement menu *Spectrum* twice (this softkey reads *due to Modulation* or *due to Switching*, depending on the selected application). By pressing the associated hotkeys, it is possible to change between the tabs.

Measurement Control (Spectrum Configuration – Control)

The *Control* tab controls the spectrum measurement by defining

- The *Repetition* mode
- The *Stop Condition* for the measurement
- The measurement curve displayed *(Display Mode*)
- The number of bursts/evaluation periods forming a statistics cycle *(Statistic Count)*
- The frequency at which the time domain measurement results are acquired *(Time D. @ Freq.)*
- The area(s) within the burst where the power is measured and averaged *(Averaging Areas,* for *Modulation* only)
- The number of slots measured and displayed in the time domain diagram *(Slot Count,* for *Switching* only)

Besides, it influences the appearance of the measurement diagram by adding or removing the *Grid*.

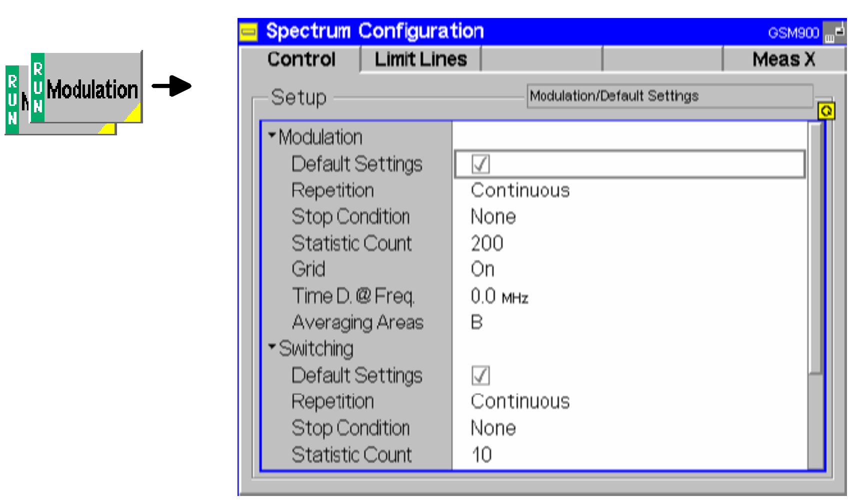


Fig. 4-31 Spectrum Configuration – Control

The statistical settings can be defined separately for the three applications *Modulation, Switching* and *Modulation & Switching*. They are analogous to those of the *Control* tab in the menu group *Power* (see page 4.29). In the remote-control commands, the keyword `POWer` is to be replaced by `SPECtrum:MODulation` or `SPECtrum:SWITching`.

The following parameters are specific to the *Spectrum* measurement:

Time D. @ Freq. *Time D. @ Freq.* selects the measurement frequency for the time domain (power vs. time) diagrams in the *Modulation* and *Switching* applications. The frequency is defined relative to the carrier frequency *(Analyzer Settings – Frequency).* All fixed and variable frequencies defined and enabled in the *Meas X* tab are available as time domain frequencies.

Remote control
`CONFigure:SPECtrum:MODulation:TDFSelect`
`CONFigure:SPECtrum:SWITching:TDFSelect`

Averaging Areas *Averaging Areas* selects one or two 40-bit sections of the burst which are measured and averaged in order to calculate the *Modulation* results. In accordance with the test specification the areas A and B do not overlap with the training sequence. Area A is located before, area B after the training sequence. The selected area(s) are indicated with a gray bar in the time domain diagram.

This setting has no impact on the *Switching* measurement.

Remote control
`CONFigure:SPECtrum:MODulation:AVGareas`

Cont. Stat. Mode *Cont. Stat. Mode* defines the analyzer settings for the *Spectrum due to Switching* measurement:

F. Dom. & T. Dom. Peak Hold The results in the frequency and time domain diagram reflect the maximum signal power since the start of the measurement. The old results are only cleared when a new measurement is started.

F. Dom.: Stat. Count / T. Dom.: Current The results in the frequency domain diagram are equal to the peak value over the last n bursts where n is the selected *Statistic Count* (moving window). If a *Statistic Count* larger than 100 is selected, then the peak value is taken over the last 100 bursts. The time domain measurement always represents the current burst.

Both settings are equivalent for single shot measurements.

Remote control
`CONFigure:SPECtrum:SWITching:CSMode  PHOL | SCO`

Slot Count

Slot Count defines the number of timeslots which are considered for the *Spectrum due to Switching* measurement:

1	The CMU measures the peak power in a fixed timeslot. The measured timeslot (MTS) is given by the trigger time plus the *Trig. Slot Offset;* see Fig. 4-3 on p. 4.18. A measurement cycle with *Statistic Count* = *n* extends over n (not necessarily consecutive) TDMA frames, where only the fixed timeslot, including the burst edges, is measured.
1 < n ≤ 8	The CMU measures the peak power in the MTS (see definition above), the MTS – 1, and the n–2 timeslots MTS + 1, MTS + 2, …, MTS + n – 2. The carrier output power (central bar in the *Spectrum due to Switching* diagram) is measured in the MTS; whereas the off-carrier powers represent the maximum power over all measured timeslots; see Fig. 4-30 on p. 4.69. A measurement cycle with *Statistic Count* = *n* extends over n TDMA frames.

The single slot measurement *(Slot Count: 1)* is faster and is correct if the DUT operates in single slot mode. By increasing the slot count it is possible to obtain the correct *Spectrum due to Switching* for any multislot configuration and for any levels in the individual UL timeslots. The measured off-carrier power does not depend on the *Measured Timeslot,* however, the *Measured Timeslot* has an influence on the measured carrier output power and thus on the limit lines (see Table 4-3 on p. 4.77). The *Measured Timeslot* can be changed in order to select the highest MS output power as a reference for the tolerance template, in close analogy to single slot mode.

Remote control
`CONFigure:SPECtrum:SWITching:NOSLots 1 to 8`

Tolerance Values (Spectrum Configuration – Limit Lines)

The tab *Limit Lines* defines upper limits for the output spectrum around the RF carrier frequency. All relative limit values are referred to the actual carrier output power of the base station.

a) Spectrum due to Modulation

The limit lines for the *spectrum due to modulation* as specified in GSM 05.05 and GSM 11.10 depend on the GSM band, the frequency, and (for frequencies that differ from the carrier frequency by more than 400 kHz) on the output power of the mobile station. The following values apply up to a frequency offset of 1.8 MHz:

Table 4-1 GSM tolerances for spectrum due to modulation

	GSM400/GT800/850/900 Relative power at MS output power		**GSM1800/1900 Relative power at MS output power**	
Frequency offset / [MHz]	**≤ 33 dBm (in dBc)**	**≥ 39 dBm (in dBc)**	**≤ 24 dBm (in dBc)**	**≥ 36 dBm (in dBc)**
0.1	+0.5	+0.5	+0.5	+0.5
0.2	–30	–30	–30	–30
0.25	–33	–33	–33	–33
0.4	–60 (GMSK mod.) –54 (8PSK mod.)	–60	–60 (GMSK mod.) –54/–60 (8PSK mod.)[3]	–60
≥0.6, ≤1.8	–60	–66	–60	–60

[3] For equipment supporting 8PSK, the limit of –54 dBc applies to MS output powers up to +30 dBm, –60 dBm to MS output powers above +30 dBm.

In the frequency range above 400 kHz from the carrier and for output powers between 33 dBm and 39 dBm (GSM400/GT800/850/900), the limit depends linearly on the output power. The resulting spectral mask for GMSK modulation is shown below (*Fig. 4-32*).

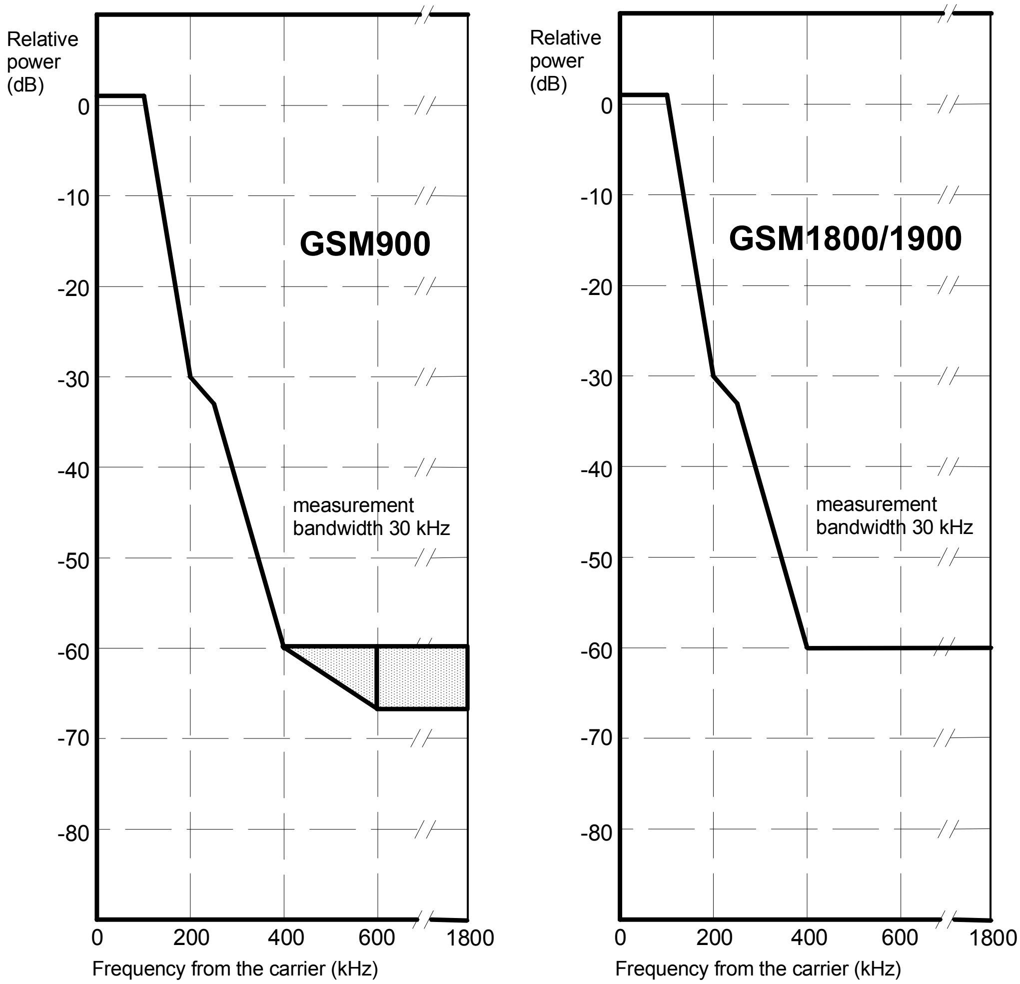


Fig. 4-32 Spectral mask as specified for GSM mobile stations

As an alternative to the relative limit values quoted in *Table 4-1*, GSM specifies the following absolute limits, again depending on the frequency offset from the carrier and the GSM band. If the relative limits are tighter than the absolute limits, the latter shall be applied.

Table 4-2 GSM tolerances for spectrum due to modulation (absolute)

Frequency offset / [MHz]	Absolute power, GSM400/GT800/850/900	Absolute power, GSM1800/1900
< 0.6	–36 dBm	–36 dBm
≥0.6, <1.8	–51 dBm	–56 dBm
≥1.8	–46 dBm	–51 dBm

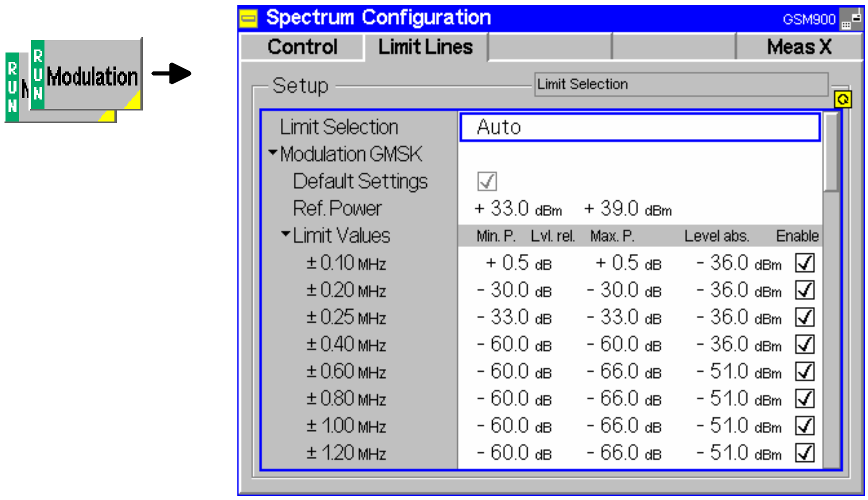


Fig. 4-33 Spectrum Configuration – Limit Lines

Limit Selection

Selects the limit line template to be applied.

Auto The CMU uses the GMSK template. After detecting the first 8PSK modulated burst it uses the 8PSK template until the end of the measurement. Occasional GMSK modulated bursts within the 8PSK burst sequence will not disturb the limit lines.

GMSK The GMSK template is used irrespective of the actual modulation scheme of the received signal.

8PSK The GMSK template is used irrespective of the actual modulation scheme of the received signal.

Remote control
```
CONFigure:SPECtrum:LIMit:LINE:SELect GMSK | EPSK | AUTO
```

Default Settings

The *Default All Settings* switch assigns default values to all settings in the *Limits* tab (the default values are quoted in the command description in chapter 6 of this manual). In addition, default switches for the individual spectrum types are provided.

Remote control
```
CONFigure:SPECtrum:MODulation[:GMSK]:LIMit:LINE:DEFault
          ON|OFF etc.
```

Ref. Power

The *Ref. Power* line defines the MS carrier output power domain where the limit lines are to be determined by linear interpolation (see *Table 4-1*). Below *Min. P.*, the lower limit line applies, above *Max. P.*, the upper limit line applies. The *Ref. Power* domain can be modified.

Remote control
```
CONFigure:SPECtrum:MODulation[:GMSK]:LIMit:LINE
          :REFPower[:UPPer] <Min_Power>,<Max_Power>
```

Limit Values

The *Limit Values* table section defines upper limits for the power at eleven fixed, GSM-specific frequency offsets:

Lvl. rel. Upper limit for the RF power referred to the MS output power measured in 30 kHz on the carrier. The two values are valid for output powers below the *Ref. Power* domain *(Min. P.)* and for output powers above the *Ref. Power* domain *(Max. P.)*. Inside the

Ref. Power domain, *Lvl. rel.* is determined by linear interpolation.

Level abs. Alternative absolute power limits (see *Table 4-2*), applied if the relative limits *Lvl. rel.* are tighter.

Enable Switches the limit check at the frequency on and off.

Remote control

```
CONFigure:SPECtrum:MODulation[:GMSK]:LIMit:LINE
   :UPPer<nr> <RelLow>,<RelUpp>,<Abs>,<Enable>
CONFigure:SPECtrum:MODulation[:GMSK]:LIMit:LINE:MODE[:UPPer]
   ON|OFF etc.
```

b) Spectrum due to Switching

The limit lines for the *spectrum due to switching* as specified in GSM 05.05 and GSM 11.10 cover offset frequencies between 0.4 and 1.8 MHz. They are equal for all three GSM bands but depend on the output power of the mobile station. The measurement of the spectrum due to switching is complicated by the fact that at high power levels, the modulation spectrum is being measured using a peak hold measurement. The tolerances in the following table allow for the additional effects due to the modulation spectrum:

Table 4-3 GSM tolerances for spectrum due to switching plus modulation effects:

GSM400/ GT800 GSM850/ GSM900	**Maximum MS level measured (peak hold) / [dBm] at frequency offset**			
MS power / [dBm]	**0.4 MHz**	**0.6 MHz**	**1.2 MHz**	**1.8 MHz**
≥39	–13	–21	–21	–24
+37	–15	–21	–21	–24
+35	–17	–21	–21	–24
+33	–19	–21	–21	–24
+31	–21	–23	–23	–26
+29	–23	–25	–25	–28
+27	–23	–26	–27	–30
+25	–23	–26	–29	–32
+23	–23	–26	–31	–34
≤21	–23	–26	–32	–36

GSM1800	**Maximum MS level measured (peak hold) / [dBm] at frequency offset**			
MS power / [dBm]	**0.4 MHz**	**0.6 MHz**	**1.2 MHz**	**1.8 MHz**
≥36	–16	–21	–21	–24
+34	–18	–21	–21	–24
+32	–20	–22	–22	–25
+30	–22	–24	–24	–27
+28	–23	–25	–26	–29
+26	–23	–26	–28	–31
+24	–23	–26	–30	–33
+22	–23	–26	–31	–35
≤20	–23	–26	–32	–36
–	–	–	–	–

GSM1900	Maximum MS level measured (peak hold) / [dBm] at frequency offset			
MS power / [dBm]	0.4 MHz	0.6 MHz	1.2 MHz	1.8 MHz
≥33	–19	–22	–22	–25
+32	–20	–22	–22	–25
+30	–22	–24	–24	–27
+28	–23	–25	–26	–29
+26	–23	–26	–28	–31
+24	–23	–26	–30	–33
+22	–23	–26	–31	–35
≤20	–23	–26	–32	–36

The GSM limit specifications are equal for GMSK and 8PSK modulation, however, the limits can be chosen independently on the CMU.

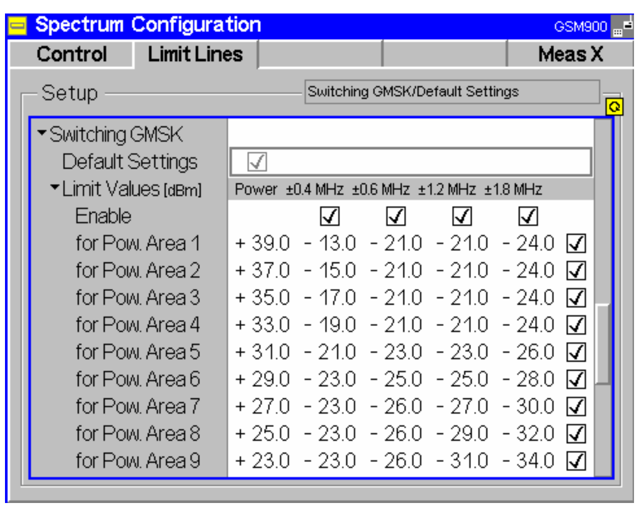


Fig. 4-34 Spectrum Configuration – Limits

Default Settings The *Default All Settings* switch assigns default values to all settings in the *Limits* tab (the default values are quoted in the command description in chapter 6 of this manual). In addition, default switches for the individual spectrum types are provided.

Remote control
`CONFigure:SPECtrum:SWITching[:GMSK]:LIMit:LINE:DEFault ON|OFF`

Limit Values The *Limit Values* table section defines upper limits for the absolute output power of the mobile station, measured at zero frequency span and with a filter bandwidth of 30 kHz.

Enable Switches the limit check at the frequency or power level on and off

Power Lvl. User-defined MS output power level (not necessarily identical with the GSM power control levels). The CMU offers considerable flexibility with regard to the limit line definition: They are specified at four fixed, GSM-specific frequency offsets and up to 10 arbitrary MS power levels (see

Table 4-3). For measured MS powers between the power levels, the limits are determined by linear interpolation.

Remote control

```
CONFigure:SPECtrum:SWITching[:GMSK]:LIMit:LINE
      :UPPer<nr>
      <PowLvl>,<Value1>,<Value2>,<Value3>,<Value4>,<Enable>
CONFigure:SPECtrum:SWITching[:GMSK]:LIMit:LINE:MODE[:UPPer]
      ON|OFF
```

Selection of Measurement Points (Spectrum Configuration – Meas X)

The tab *Meas X* defines at which frequencies a *Spectrum* measurement is performed.

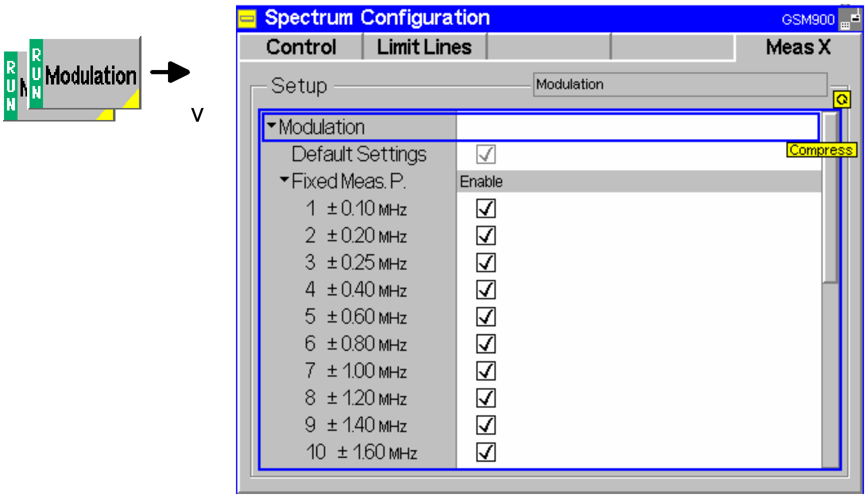


Fig. 4-35 Spectrum Configuration – Meas X

Default Settings The *Default All Settings* switch assigns default values to all settings in the *Meas X* tab (the default values are quoted in the command description in chapter 6 of this manual). In addition, default switches for the individual spectrum types are provided.

Remote control

```
CONFigure:SPECtrum:MODulation:CONTrol:DEFault ON|OFF
CONFigure:SPECtrum:SWITching:CONTrol:DEFault ON|OFF
```

Fixed Meas. Points *Fixed Meas. Points* enables (*Enable* box checked) or disables the spectrum measurement at individual frequency points. All frequencies listed in *Table 4-1* (spectrum due to modulation) and *Table 4-3* (spectrum due to switching) can be selected. In the diagrams, blue bars denote the results at fixed measurement points.

A reduction of the measurement points enhances the measurement speed. To be selected as the frequency for the time domain measurement, a measurement point must be enabled.

Remote control

```
CONFigure:SPECtrum:MODulation
     :CONTrol:MPOint<nr>:ENABle ON|OFF
```
etc.

Variable Meas. Points

Variable Meas. Points enables the spectrum measurement at additional frequencies. By default the additional points are switched *Off.* Setting a frequency enables the measurement at the variable measurement point. No limit check is performed. In the diagrams, black bars denote the results at variable measurement points.

A reduction of the measurement points enhances the measurement speed. To be selected as the frequency for the time domain measurement, a measurement point must be enabled.

Remote control
```
CONFigure:SPECtrum:MODulation:CONTrol:VMPoint<nr>
CONFigure:SPECtrum:SWITching:CONTrol:VMPoint<nr>
```

Audio Measurements

The menu group *Audio* comprises the functions for generating and measuring single or multitone audio signals. The menu group is available with option CMU-B41, *Audio Generator and Analyzer*. All *Audio* menus and remote-control commands are described in the CMU 200/300 operating manual.

The *Audio* option supports two independent test circuits. In *Non Signalling* mode the input and output connectors for both circuits are fixed; they are indicated in the *AF/RF* tab of the *Connection Control* menu; see section *AF/RF Connectors (Connection Control – AF/RF)* on p. 4.95 ff. This test mode corresponds to the standalone Audio tests described in the CMU 200/300 operating manual.

In Signalling mode, it is possible to send and receive audio data modulated onto the RF carrier and thus test the audio circuit of a connected mobile phone (see section *AF/RF Connectors (Connection Control – AF/RF)* on p. 4.203 ff.).

Connection Control

The popup menu *Connection Control* contains several tabs to configure the inputs and outputs of the CMU and the respective signals in the function group *GSM400/GT800/850/900/1800/1900-MS Non Signalling* and the trigger settings.

The menu group is activated via the softkey *Connect. Control* to the right of the header of each measurement menu. The individual tabs *(Analyzer, Generator, AF/RF*, *Sync., Trigger, I/Q-IF)* can be accessed via the hotkey bar at the lower edge of the screen.

RF Analyzer Settings (Connection Control – Analyzer)

The *Analyzer* tab determines the maximum input level *(Max. Level)* of the RF analyzer, defines the frequency *(RF Channel, Frequency Offset)* and the *Training Sequence* of the analyzed RF input signal and configures the RF input path. Besides it controls the wideband peak power measurement *(Power)* and indicates the result.

The CMU provides a softkey-oriented version of the *Analyzer* tab and a table-oriented version with extended functionality. The *Analyzer* hotkey toggles between the two versions if it is pressed repeatedly.

Softkey-Oriented Version

The softkey-oriented version of the *Analyzer* tab determines

- The maximum input level *(Max. Level)*
- The frequency *(RF Channel, Frequency Offset)* and the *Training Sequence* of the analyzed RF input signal.

Besides it controls the wideband peak power measurement *(Power)* and indicates the result. All setting values of this menu are also displayed in the main menu *Analyzer/Generator* (see page 4.2).

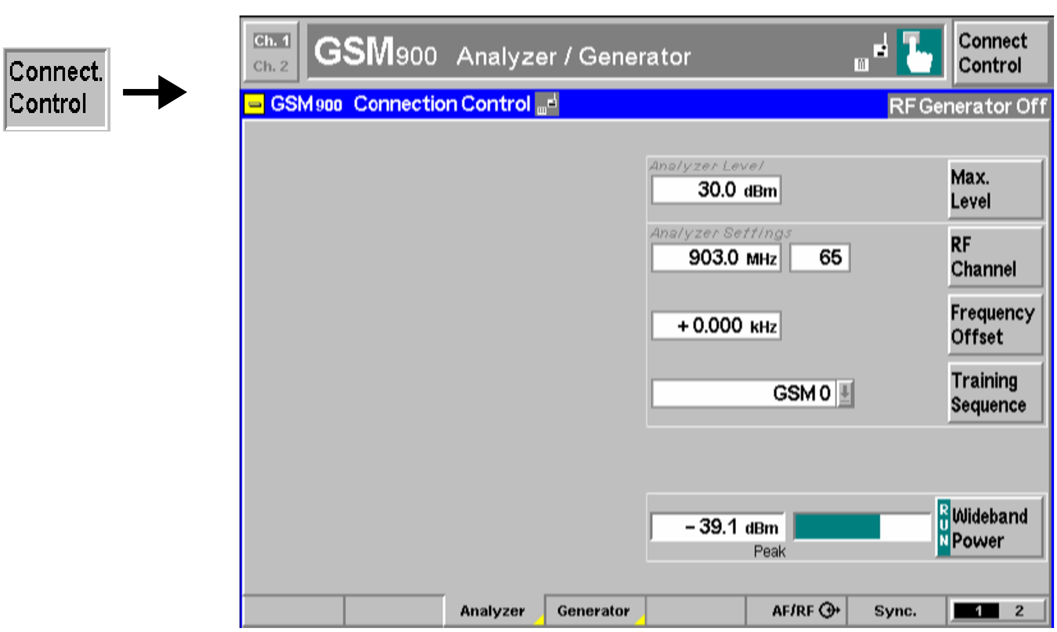


Fig. 4-36 Connection Control – Analyzer (softkey)

Max. Level

The *Max. Level* softkey sets the maximum expected input level (overload level). This level corresponds to the maximum peak envelope power (PEP) of the GSM signal that the CMU is able to measure. For GSM signals, the PEP is very close to the average burst power (low crest factor), however, it is appropriate to allow for a display margin of a few dB. Input levels exceeding the *Max. Level* overdrive the input path and cause invalid results ("– – –").

In the table-oriented version of the *Analyzer* tab, either manual or automatic setting of the input level can be selected. The behavior of the *Max. Level* softkey depends on the way the input level is set:

- In manual mode, the input level is indicated in the input field to the left of the softkey. This field can be activated and the level can be changed by pressing the *Max. Level* softkey. Note the remarks on external output attenuation on p. 4.90.
- If autoranging is selected, *Auto* is indicated in the input field to the right of the softkey. *Max. Level* is not active. To change the input level and mode, the table-oriented *Analyzer* tab must be opened by pressing the *Analyzer* hotkey again.

Remote control
```
[SENSe:]LEVel:MAXimum <Level>
```

RF Channel

The *RF Channel* softkey defines the channel number and frequency of the measured signal. The assignment between channel numbers and frequencies is defined in the GSM specification for both directions of transmission (uplink and downlink). Therefore, it is sufficient to enter only one value (frequency **or** channel number), the other one is automatically adjusted.

The following tables contain the channel assignment in the uplink direction (i.e. from mobile to base station/CMU). Compared to the downlink, all channel frequencies are shifted by a constant frequency offset depending only on the GSM band (duplex spacing, see *Table 4-5* on p. 4.91). Channel numbers which are not listed in the tables are not assigned.

Table 4-4 GSM channels in uplink direction

Frequency / [MHz]	Channel	GSM400 Band
0.2 ↓ 450.4	--- ↓ ---	–
450.6 ↓ 457.4	259 ↓ 293	GSM 450 band
457.6 ↓ 478.8	--- ↓ ---	
479.0 ↓ 485.8	306 ↓ 340	GSM 480 band
486.0 ↓ 2700	--- ↓ ---	–

Frequency / [MHz]	Channel	GSM900 Band
0.2 ↓ 876	--- ↓ ---	–
876.2 ↓ 880	955 ↓ 974	R-GSM band (European railway netw.)
880.2 ↓ 889.8 890.0	975 ↓ 1023 0	E-GSM band (extended GSM)
890.2 ↓ 914.8	1 ↓ 124	P-GSM-Band (primary GSM)
915 ↓ 2700	↓ ---	–

Frequency / [MHz]	Channel	GSM1800 Band
0.2 ↓ 1710	--- ↓ ---	–
1710.2 ↓ 1784.8	512 ↓ 885	GSM 1800 band
1785 ↓ 2700	--- ↓↓ ---	–

Frequency / [MHz]	Channel	GSM1900 Band
0.2 ↓ 1850	--- ↓ ---	–
1850.2 ↓ 1909.8	512 ↓ 810	GSM 1900 band
1910 ↓ 2700	--- ↓ ---	–

Frequency / [MHz]	Channel	GSM850 Band
0.2 ↓ 824.0	--- ↓ ---	–
824.2 ↓ 848.8	128 ↓ 251	GSM 850 band
849.0 ↓ 2700	--- ↓ ---	–

Frequency / [MHz]	Channel	GSM GT800 Band
0.2 ↓ 805.8	--- ↓ ---	–
806.0 ↓ 821.0	350 ↓ 425	GSM GT 800 band
821.2 ↓ 2700	--- ↓ ---	–

According to the channel width of the three GSM bands, the RF frequency can be set in multiples of 200 kHz. It can be modified by an additional *frequency offset* entered in the input field below.

Remote control
`[SENSe:]RFANalyzer:CHANnel <Number>`

Frequency Offset

The Frequency Offset softkey defines an offset for the frequency set under RF Channel. This enables fine tuning of the frequency measured by the CMU, e.g. in order to simulate a Doppler shift (caused by a relative movement between mobile and base station) or detuning of the mobile.

Remote control
`[SENSe:]RFANalyzer:FREQuency:OFFSet <Number>`

Training Sequence

The Training Sequence softkey defines a training sequence for the measured signal.

The training sequence is located in the middle of the symmetrical normal burst and is used for synchronization and to assess the transmission conditions in the RF channel.

TB	Useful Information	F	Training sequence	F	Useful Information	TB	GP

TB	Tail bits (end or start bit)	Bits 0 to 2, 145 to 147
Useful information		Bits 3 to 59, 88 to 144
F	Flag Bit, Stealing Flag	Bits 60, 87
Training sequence		Bits 61 to 86
GP	Guard Period, transmission-free time of 8.25 bit periods	

Fig. 4-37 Bit structure of a GSM normal burst

Compared to a normal burst, the access burst (see section *Limit lines (Power Configuration – Limit Lines)* on page 4.35) has a longer guard period (68.25 symbols instead of 8.25 symbols) whereas the useful duration is shortened by 60 symbols.

Here the training sequence is used to distinguish different burst types: If a definite training sequence is specified, the CMU only analyzes bursts with this training sequence. The following settings are provided:

GSM 0 to 7	GSM standard training sequences
Dummy	GSM-specific dummy burst
Off	Measurement of all bursts regardless of their training sequence

GSM training sequences

The 8 standard training sequences *GSM 0 to GSM 7* are specified in the GSM standard.

TSC	training sequence code for numbering the sequences
Bit pattern	26-bit training sequence

They read as follows:

TSC	**Bit pattern (Bits No. 61 to 86)**																									
0	0	0	1	0	0	1	0	1	1	1	0	0	0	0	1	0	0	0	1	0	0	1	0	1	1	1
1	0	0	1	0	1	1	0	1	1	1	0	1	1	1	1	0	0	0	1	0	1	1	0	1	1	1
2	0	1	0	0	0	0	1	1	1	0	1	1	1	0	1	0	0	1	0	0	0	0	1	1	1	0
3	0	1	0	0	0	1	1	1	1	0	1	1	0	1	0	0	0	1	0	0	0	1	1	1	1	0
4	0	0	0	1	1	0	1	0	1	1	1	0	0	1	0	0	0	0	0	1	1	0	1	0	1	1
5	0	1	0	0	1	1	1	0	1	0	1	1	0	0	0	0	0	1	0	0	1	1	1	0	1	0
6	1	0	1	0	0	1	1	1	1	1	0	1	1	0	0	0	1	0	1	0	0	1	1	1	1	1
7	1	1	1	0	1	1	1	1	0	0	0	1	0	0	1	0	1	1	1	0	1	1	1	1	0	0

Note: *In Signalling Mode, no training sequence but signalling parameters such as the color code of the base station can be specified for analyzed signals. This also serves to search for bursts with a particular characteristic.*

Remote control
`[SENSe:]RFANalyzer:TSEQuence <Number>`

Wideband Power

The *Wideband Power* softkey controls the wideband power measurement and indicates its status *(RUN | HLT | OFF)*. The status can be changed after softkey selection (pressing once) by means of the *ON/OFF* key or the *CONT/HALT* key. The measurement result is in units of dBm. The analog bar to the right of the softkey shows the measured power relative to the *Max. Level:* The display range is between *Max. Level – 10 dB* and *Max. Level + 10 dB*.

The wideband power measurement is performed at the RF Frontend of the CMU and yields the peak power of the input signal inside a wide frequency range. For GMSK modulated GSM signals, the result of the wideband power measurement is usually slightly higher than the result of the *Power* measurement which is obtained with different filter characteristics. The main purpose of the wideband power measurement is to indicate whether an input signal is available and whether it is advisable to change the *Max Level* settings.

Note: *An additional quick and precise power measurement is available in remote control (keyword* `NPOWer`*).*

Remote control
```
INITiate:WPOWer
FETCh:WPOWer:STATus?
READ[:SCALar]:WPOWer?
FETCh[:SCALar]:WPOWer?
SAMPle[:SCALar]:WPOWer?
```

Table-Oriented Version

The table-oriented version of the *Analyzer* tab defines:

- The maximum expected input level *(RF Max. Level)* and the way it is defined *(RF Mode)*
- An external input attenuation or gain *(RF Attenuation)*
- The delay time (integer number of GSM timeslots) between the trigger time and the measured timeslot *(Trigger Slot Offset)*
- All *Analyzer Settings* described in section *Softkey-Oriented Version* on p. 4.82 ff.

Connect. Control →

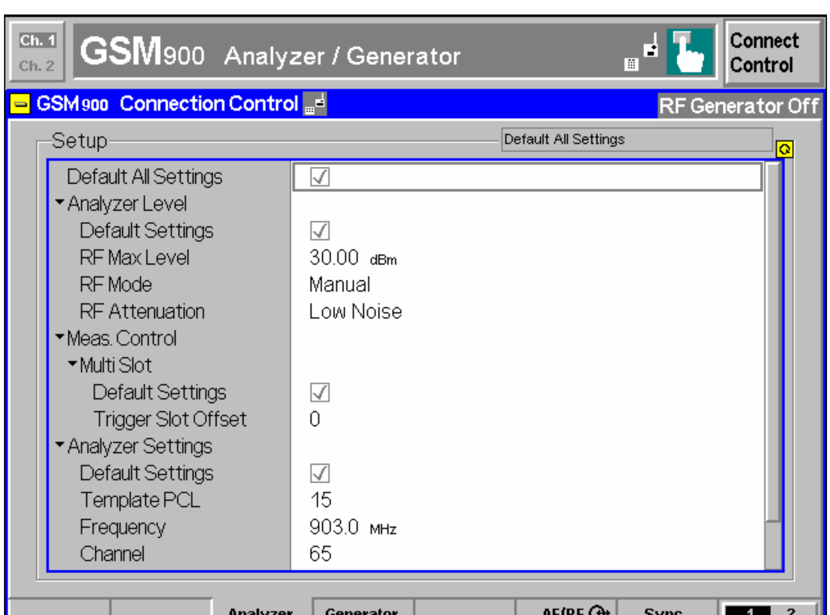


Fig. 4-38 Connection Control – Analyzer (table)

The following settings are not provided in the table-oriented version of the *Analyzer* tab:

Default Settings

The *Default All Settings* switch assigns default values to all settings in the *Analyzer* tab (the default values are quoted in the command description in chapter 6 of this manual).

Remote control
`RFANalyzer:DEFault`

Analyzer Level – RF Mode

The *Analyzer Level* table section sets the maximum input level that can be measured. The maximum input level is displayed next to the softkey *Max. Level* in the main menu *Analyzer/Generator* (see page 4.2) and in the parameter lines above the graphical measurement menus. Two alternative *RF Modes* for defining this value are provided:

Manual	Manual input of maximum input level in the *RF Max. Level* field
Auto	Automatic setting of maximum input level *(autoranging)* according to the peak power (PEP) of applied signal

Remote control
`[SENSe:]LEVel:MODE <Mode>`

Analyzer Level – RF Max. Level

The maximum expected input level can be entered in the *RF Max. Level* input field. Input levels exceeding the *RF Max. Level* overdrive the input path and cause invalid results (“– – –“).

External input attenuation

The range of *RF Max. Level* values depends on the RF input used. If an external input attenuation is reported to the instrument to compensate for a known path loss (see section *AF/RF Connectors (Connection Control – AF/RF)* on page 4.95), all levels measured are referenced to the output of the DUT and therefore shifted with respect to the actual level at the input connectors of the CMU. The level ranges for the input connectors are shifted as well.

Error messages

If the value determined for *RF Max. Level* is too high or too low, a window with the error message *"<Max_Level> is out of range. <permissible max. value> is limit*." and three fields will appear:

Accept	The permissible max. value is accepted as *RF Max. Level*,
Re-edit	*RF Max. Level* is entered once again,
Cancel	The last valid input value is maintained.

When switching over to another input, the current value of *RF Max. Level* is automatically adapted, if required:

- Towards lower values to the maximum value of the new input,
- Towards upper values to the minimum value of the new input.

Note: *A maximum input level can be entered even if automatic level setting (autoranging) is selected. The entered level is used as a start value for the autoranging routine and is also important to ensure safe switchover to manual setting.*

Remote control
`[SENSe:]LEVel:MAXimum <Level>`

Analyzer Level – RF Attenuation

The *RF Attenuation* parameter defines how the RF analyzer of the CMU is tuned to meet the requirements of the current measurement type. In general, a compromise between the acceptable noise level in the displayed result and the contribution of internally generated distortion must be reached.

Normal Mixer level in normal range,

Low noise Mixer level enhanced by +10 dB (full dynamic range of CMU, therefore recommended for *Power* and *Spectrum* measurements),

Low distortion Mixer level reduced by –10 dB (high intermodulation spacing, therefore recommended for *Modulation* measurements).

The *Attenuation* setting permits the CMU to be adapted to the requirements of the measurement. The advantages and disadvantages of the settings *Low noise* and *Low distortion* are listed in the following table.

	Advantages	**Disadvantages**
Low noise	Low noise high dynamic range	No RF overdrive reserve Risk of intermodulation
Low distortion	High intermodulation spacing	Lower dynamic range

Remote control
`[SENSe:]LEVel:ATTenuation NORMal | LNOise | LDIStortion`

Meas. Control – Multi Slot – Trigger Slot Offset

Trig. Slot Offset defines a delay time (integer number of GSM timeslots) between the trigger time and the timeslot that is measured in all *Multislot* configurations; see *Fig. 4-3* on p. 4.18.

Remote control
`CONFigure:RFANalyzer:MCONTrol:TSOFfset 0 to 7`

Analyzer Settings – Template PCL

Template PCL sets a power control level to correct the limit lines. See *Template PCL* softkey on p. 4.13.

Remote control
`CONFigure:RFANalyzer:TPCL <PCL>`

Generator Settings (Connection Control – Generator)

The *Generator* tab controls and configures the RF generators. The CMU provides two independent RF signals *TX* and *Aux TX* (with one of the options R&S CMU-B95 or R&S CMU-B96, *Additional RF Generator).* There is a softkey-oriented version of the *Generator* tab and a table-oriented version with extended functionality. The *Generator* hotkey toggles between the two versions if it is pressed repeatedly.

Softkey-Oriented Version

The softkey-oriented version of the *Generator* tab provides the following RF generator settings:

- Generator control and level in the used and unused timeslots (measurement control softkeys *generator* and *Generator Aux TX*)
- The generator frequency *(RF Channel, Frequency Offset)*
- A *Training Sequence* and a *Bit Modulation* sequence to be modulated onto the generated RF signal
- The *Transmission* mode (continuous or burst signal)

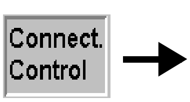
Aux TX signal:

If option CMU-B95, *Additional RF Generator,* is fitted, the CMU provides a second RF signal Aux TX that can be applied to one of the RF connectors RF1 or RF2. It is possible to superimpose both RF signals at the same output connector or use different connectors (see section *AF/RF Connectors (Connection Control – AF/RF)* on p. 4.95 ff.). Moreover, it is possible to assign independent external attenuation factors to both signals.

With option CMU-B96, *Additional RF Generator,* the CMU provides two additional AuxTX signals:

- A low-level signal *AuxTX* can be configured with a specific frequency and level.
- An additional *Overrange* signal at the frequency of the low-level AuxTX signal but with possibly higher level can be generated together with the low-level signal. If it not needed, this signal can be switched off.

Again it is possible to superimpose AuxTX and TX signals and to assign independent external attenuation factors. AuxTx is generated with the *Training Sequence* and *Bit Modulation* settings of the primary TX signal (in remote control: `...RFGenerator:MODulation...`) but with no ramping (the *Transmission* mode is always *Continuous,* the carrier signal level is constant over all timeslots). Option R&S CMU-B95/B96 is primarily used to maintain a stable BCCH in *Signalling* mode while the main TX generator provides a TCH in all 8 timeslots, see *Aux TX* description in the *BS Signal* tab section.



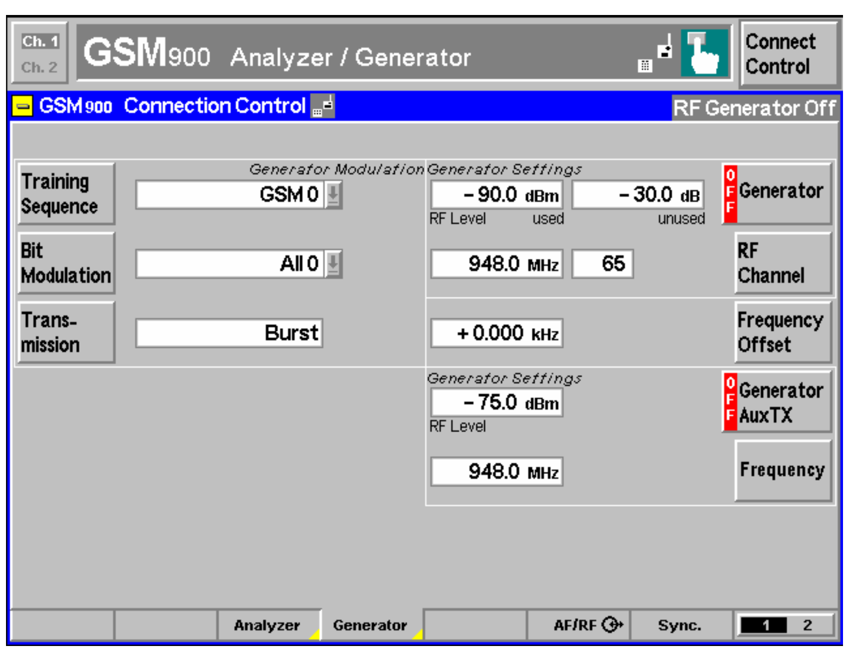


Fig. 4-39 Connection Control – Generator (softkey)

Generator

The *Generator* softkey defines the *TX* generator level and indicates the operating status of the RF generator *(ON* or *OFF)*. Pressing the *Generator* softkey and the *ON/OFF* key switches the generator on or off.

For the generator level, a distinction is made between the used timeslot (selected and used for later measurements) and the remaining, unused timeslots. This feature is useful for many tests specified for GSM mobile phones. E.g. the adjacent time slot level is set to a higher value than the used time slot level in order to test whether the mobile receiver can quickly adapt to fast level changes.

Remote control
```
INITiate:RFGenerator
ABORt:RFGenerator
FETCh:RFGenerator:STATus?
```

Used

The level is indicated as absolute value (in dBm).

Remote control
```
SOURce:RFGenerator:LEVel:UTIMeslot <Level>
```

Unused

The level is defined relative to the level in the used timeslot (in dB). The absolute level in the unused timeslots, i.e. the sum of numerical values set under used and unused must lie within the permissible range for the RF outputs. This condition further restricts the permissible level for the unused timeslots.

External output attenuation

If an external output attenuation or gain is known and reported to the instrument (see softkey *Ext. Att. Output)* the RF generator level is adjusted to maintain the commanded power after the attenuation or gain. As a consequence, all levels indicated are referred to the input of the DUT and no longer correspond to the actual level at the output connectors of the CMU (see section *AF/RF Connectors (Connection Control – AF/RF)* on page 4.95). The default value for the generator power is also shifted provided that the generator can output the required power, compensating for the external attenuation or gain. Otherwise it is adapted to the level closest to the shifted default value.

Error messages

If the level defined for RF Level is too high or too low, a window will appear with the error message "<RF_Level> is out of range. <Permissible max. value> is limit." and three fields:

Accept	Permissible max. value is accepted as generator level
Re-edit	The generator level is entered once again
Cancel	The last valid input is maintained

When switching over to a different output, the current value of the generator level is automatically adapted, if required:

- Towards lower values to the maximum permissible value of the new output
- Towards higher values to the minimum value of the new output

Remote control
```
SOURce:RFGenerator:LEVel:UNTimeslot <Level>
```

RF Channel

The *RF Channel* softkey defines the channel number or the frequency of the generated RF signal.

The assignment of channel numbers and frequencies is unambiguously defined in the GSM specification for both directions of transmission. Therefore, it is sufficient to enter only one value (frequency or channel number), the other one is automatically determined by the CMU.

The following tables contain the channel assignment in the downlink direction (i.e. from base station/CMU to mobile). Compared to the uplink, all channel frequencies are shifted by a constant frequency offset depending only on the GSM band (duplex spacing, see *Table 4-4* on p, 4.83). Channel numbers which are not listed in the tables are not assigned.

Table 4-5 GSM channels in downlink direction

Frequency / [MHz]	Channel	GSM400 Band
0.2 ↓ 460.4	--- ↓ ---	–
460.6 ↓ 467.4	259 ↓ 293	GSM 450 band
467.6 ↓ 488.8	--- ↓ ---	
489.0 ↓ 495.8	306 ↓ 340	GSM 480 band
496.0 ↓ 2700	--- ↓ ---	–

Frequency / [MHz]	Channel	GSM900 Band
0.2 ↓ 921	--- ↓ ---	–
921.2 ↓ 925	955 ↓ 974	R-GSM band (European railway netw.)
925.2 ↓ 934.8 935.0	975 ↓ 1023 0	E-GSM band (extended GSM)
935.2 ↓ 959.8	1 ↓ 124	P-GSM-Band (primary GSM)
960 ↓ 2700	--- ↓ ---	–

Frequency / [MHz]	Channel	GSM1800 Band
0.2 ↓ 1805	--- ↓ ---	–
1805.2 ↓ 1879.8	512 ↓ 885	GSM 1800 band
1880 ↓ 2700	--- ↓ ---	–

Frequency / [MHz]	Channel	GSM1900 Band
0.2 ↓ 1930	--- ↓ ---	–
1930.2 ↓ 1989.8	512 ↓ 810	GSM 1900 band
1990 ↓ 2700	--- ↓ ---	–

Frequency / [MHz]	Channel	GSM850 Band
0.2 ↓ 869.0	--- ↓ ---	–
869.2 ↓ 893.8	128 ↓ 251	GSM 850 band
893.0 ↓ 2700	--- ↓ ---	–

Frequency / [MHz]	Channel	GSM GT800 Band
0.2 ↓ 849.8	--- ↓ ---	–
851.0 ↓ 866.0	350 ↓ 425	GSM GT 800 band
866.2 ↓ 2700	--- ↓ ---	–

According to the channel width of the three GSM bands, the RF frequency can be set in multiples of 200 kHz. It can be modified by an additional *frequency offset* entered in the input field below.

Remote control
`SOURce:RFGenerator:FREQuency[:CHANnel] <Number>`

Frequency Offset

The *Frequency Offset* softkey defines a frequency offset modify the frequency set under RF Channel. This enables fine tuning of the RF frequency generated by the CMU, e.g. in order to simulate a Doppler shift (caused by a relative movement between mobile and CMU) or detuning of the mobile. The *Frequency Offset* applies to both the *TX* and the *Aux TX* signal.

Remote control
`SOURce:RFGenerator:FM:DEViation <FrequencyOffset>`

Generator Aux TX

The *Generator Aux TX* softkey controls the *Aux TX* generator, defines the generator level (in 1-dB steps) and indicates the operating status of the *Aux TX* generator *(ON* or *OFF)*. Pressing the *Aux TX Generator* softkey and the *ON/OFF* key switches the generator on or off.

The Aux TX level is continuous and equal in all timeslots; see background information on the Aux TX signal above.

Remote control
```
INITiate:RFGenerator:AUXTx
ABORt:RFGenerator:AUXTx
FETCh:RFGenerator:AUXTx:STATus?
SOURce:RFGenerator:AUXTx:LEVel
```

Frequency

Frequency defines the frequency of the generated RF signal.

Note: *The frequency of the Aux Tx signal is restricted to three separate ranges; see remote control description.*

Remote control
`SOURce:RFGenerator:AUXTx:FREQuency`

Training Sequence

The *Training Sequence* softkey defines the training sequence that is superimposed on the RF carrier signal. The following settings are provided:

GSM 0 to 7 GSM standard training sequences
Dummy GSM-specific dummy burst

The 8 GSM standard training sequences are listed above (see page 4.85).

Remote control
`CONFigure:RFGenerator:MODulation:TSEQuence:SELection`
`GSM0 | ... | GSM7 | DUMMy`

Bit Modulation

The *Bit Modulation* softkey defines a bit sequence that is modulated onto the RF carrier signal. The following types of modulation sequence can be selected:

Off	No signal superimposed, "empty" carrier
All 0	Modulation sequence consisting of zeros
PRBS	Pseudo random bit sequence
Dummy Bursts	Fixed bit sequences (Dummy Bursts) with selectable training sequence, see next softkey
8PSK All 0	Modulation sequence consisting of zeros, 8PSK modulation
8PSK PRBS	Pseudo-random bit sequence, 8PSK modulation

Remote control
`CONFigure:RFGenerator:MODulation:BIT:SELection`
`OFF | PRBS | DUMMyburst | ALL0 | EALL0 | EPRBS`

Trans-mission

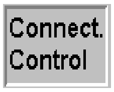
The softkey *Transmission* determines the shape of the generated RF signal. The RF generator generates either a burst or a continuous signal, i.e. a carrier with a constant level. An 8PSK-modulated signal is always bursted.

Remote control
`CONFigure:RFGenerator:MODulation:TRANsmission`
`BURSt | CONTinuous`

Table-Oriented Version

The table-oriented version of the *Generator* tab provides all settings described in section *Softkey-Oriented Version* on p. 4.89 ff. In addition it provides extended settings for the *AuxTX* signal.

Note: *An additional* RX Calibration *test signal is available with option R&S CMU-K47,* Smart Alignment @ GSM-MS. *For a description refer to Chapter 8 of this manual.*



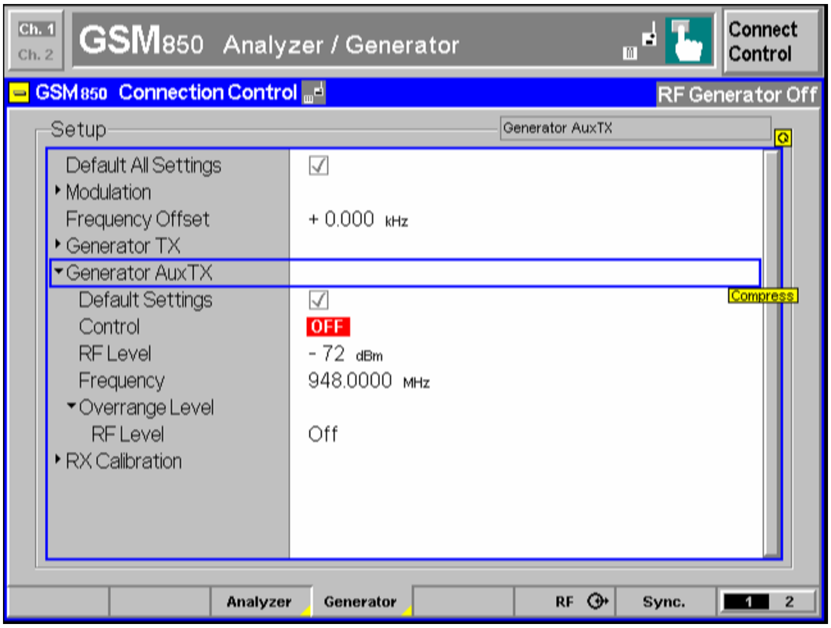


Fig. 4-40 Connection Control – Generator (table)

The following settings are not provided in the table-oriented version of the *Generator* tab:

Default Settings

The *Default Settings* switches assign default values to all *Modulation, Generator TX,* and *Generator AuxTX* parameters (the default values are quoted in the command description in chapter 6 of this manual).

Remote control
–

Generator TX

The *Generator TX* settings are also provided in the softkey-oriented version of the *Generator* tab; see p. 4.89 ff.

Generator AuxTX

The settings for the low-level AuxTX signal are also provided in the softkey-oriented version of the *Generator* tab; see p. 4.89 ff. In addition the table-oriented version of the tab configures the *Overrange* signal (with option R&S CMU-B96 only):

Overrange Level Sets the level of the additional overrange signal (in 1-dB steps) or switches the overrange signal off.

Note: *Superimposing the Overrange signal with the Tx signal at the same output connector can impair the Tx level accuracy. Refer to the data sheet for option R&S CMU-B96 for details.*

Remote control
`SOURce:RFGenerator:AUXTx:OLEVel <Level>`

AF/RF Connectors (Connection Control – AF/RF)

The *AF/RF* tab (function group *GSMxxx-MS*, *Non Signalling* mode) configures the connectors for RF input and output signals including the two RF output signals *Tx* and *Aux Tx* (with one of the options R&S CMU-B95 or R&S CMU-B96, *Additional RF Generator;* see section *Generator Settings (Connection Control – Generator)* on p. 4.88 ff.). This includes selection of

- The RF signal type *(TX / Aux Tx)*
- The RF input and output of the CMU *(RF Output, RF Input)*
- An external attenuation at the connectors *(Ext. Att. Output, Ext. Att. Input)*

The tab also controls the wideband peak power measurement *(Wideband Power)* and indicates the result. The name and function of the AF connectors is indicated in addition.

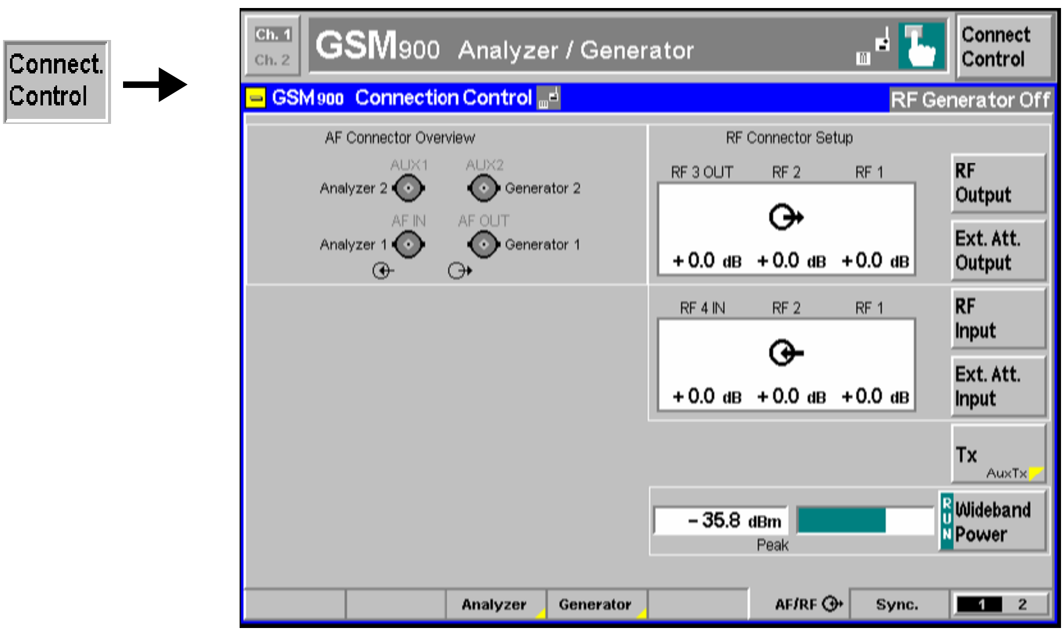


Fig. 4-41 Connection Control – AF/RF connectors

The *Wideband Power* measurement is explained in section *Softkey-Oriented Version* on p. 4.82 ff.

AF Connector Overview

The *AF Connector Overview* shows the destination of the input signals fed in via AF IN and AUX 1 and the signal sources for the two audio output connectors AF OUT and AUX 2. In contrast to the *Signalling* test mode (see section *AF/RF Connectors* on p. 4.203 ff.), the routing of input and output signals is fixed: The connectors AF IN and AF OUT are used as input and output for the primary audio circuit (Analyzer 1, Generator 1). AUX 1 and AUX 2 are used as input and output for the secondary audio circuit (Analyzer 2, Generator 2).

Audio measurements on the CMU can be performed with option CMU-B41, *Audio Generator and Analyzer.* For more information refer to section *Audio Measurements* on p. 4.81 ff. and to the CMU 200/300 operating manual.

RF Output

The *RF Output* softkey defines which of the three connectors RF 1, RF 2 and RF 3 OUT is to be used as RF output connector for the *TX* signal. A symbol indicates the selected RF output.

If the additional RF signal *Aux TX* is selected (see below), the softkey is labeled *RF Aux TX Output* and selects the output connector for *Aux TX. Aux TX* must be output at RF1 or RF2.

Note: *It is possible to combine any pair of input and output connectors. The bidirectional connectors RF 1 and RF 2 can be selected as RF inputs and outputs at the same time.*

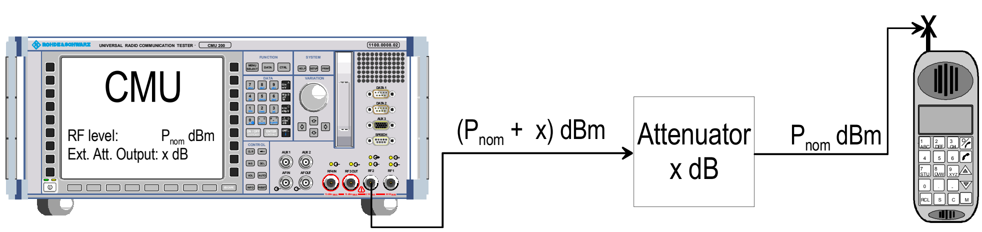
The LEDs on the front panel are only „on“ (lit) if the output level is switched on.

Remote control
```
OUTPut[:STATe] RF1 | RF2 | RF3
OUTPut:AUXTx[:STATe] RF1 | RF2
```

Ext. Att. Output

The softkey *Ext. Att. Output* defines an external attenuation (or gain, if the value is negative) at the selected RF output. Input of an external attenuation is suitable if, for example, if attenuation (such as a cable) is included in the test setup path, which is to be corrected by an increased signal level.

If an external attenuation is reported to the instrument, the output signal level is referred to the input of the DUT, the generator level is therefore shifted with respect to the actual level at the output connector of the CMU. The default value for the generator power and the level ranges for the RF outputs are also shifted provided that the generator can output the required power, compensating for the external attenuation or gain. Otherwise it is adapted to the level closest to the shifted default value.



Remote control
```
[SENSe:]CORRection:LOSS:OUTPut<nr>[:MAGNitude]
SOURce:CORRection:LOSS:OUTPut<nr>[:MAGNitude]
[SENSe:]CORRection:LOSS:OUTPut<nr>:AUXTx[:MAGNitude]
SOURce:CORRection:LOSS:OUTPut<nr>:AUXTx[:MAGNitude]
[SENSe:]CORRection:LOSS:OUTPut<nr>AUXTx:OLEVel[:MAGNitude] <Loss>
SOURce:CORRection:LOSS:OUTPut<nr>AUXTx:OLEVel[:MAGNitude] <Loss>
```

RF Input

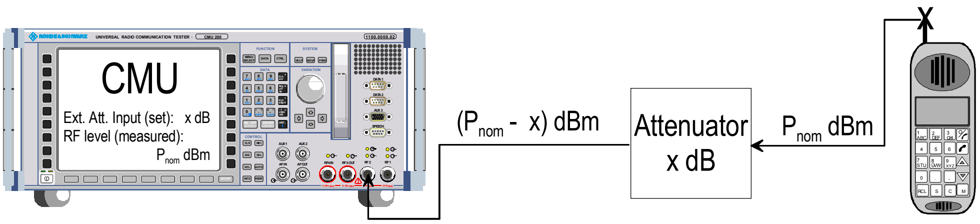
The *RF Input* softkey determines which of the three connectors RF 1, RF 2 and RF 4 IN is to be used as RF input connector. If a connector is selected as RF input, a symbol will appear in the respective field. It is possible to combine any pair of input and output connectors.

Remote control
```
INPut[:STATe] RF1 | RF2 | RF4
```

Ext. Att. Input

The softkey *Ext. Att. Input* enters the value of the external attenuation (or gain) at the selected RF input. Input of an external attenuation is required if, for example, external attenuator pads are used for protection of the sensitive RF inputs of the CMU or if a path attenuation is included in the test setup.

If an external input attenuation is reported to the instrument all levels measured are referenced to the output of the DUT and therefore shifted with respect to the actual level at the input connectors of the CMU. The level ranges for the input connectors are shifted as well.



Note: *The LEDs on the front panel are only "on" (lit) if the measurement is active.*

Remote control
`[SENSe:]CORRection:LOSS:INPut<nr>[:MAGNitude]`
`SOURce:CORRection:LOSS:INPut<nr>[:MAGNitude]`

Tx Aux TX

Tx / Aux Tx toggles between the primary RF signal *Tx* and the additional signal *Aux TX,* to be routed to one of the RF output connectors of the instrument.

The two RF signals are independent from each other. It is possible to route the signals to different RF output connectors or superimpose them at the same connector. If *Aux TX* is selected, *RF Output* changes to *RF Aux TXOutput,* the *RF Input* softkey is replaced by *Ovr. Lev. AuxTx,* and *Ext. Att. Input* by *Ext. Att. Output.*

Remote control
The keywords `[:TX]` and `:AUXTX` in the `OUTPut:…[:STATe]` commands distinguish between the Tx and the Aux Tx signal.

Ovr. Lev. AuxTx

The *Ovr. Lev. AuxTx* softkey selects the output connector for the *Overrange* signal (with option R&S CMU-B96). The selected RF output is indicated by a ⟳ symbol.

Note: *The output connectors for the Overrange signal and the (low-level) AuxTx signal are independent from each other. The following restriction holds for a combination of the Tx and the Overrange signal: While the Overrange signal is at RF 1 the Tx signal cannot be fed to RF 3 OUT and vice versa.*

Superimposing the Overrange signal with the Tx signal at the same output connector can impair the Tx level accuracy. Refer to the data sheet for option R&S CMU-B96 for details.

An attenuation factor for the Overrange signal can be defined with the *Ext. Att. Output* softkey below *Ovr. Lev. AuxTx*.

Remote control
```
OUTPut:AUXTx:OLEVel[:STATe] RF1 | RF2 | RF3
[SENSe:]CORRection:LOSS:OUTPut<nr>AUXTx:OLEVel[:MAGNitude] <Loss>
SOURce:CORRection:LOSS:OUTPut<nr>AUXTx:OLEVel[:MAGNitude] <Loss>
```

Reference Frequency (Connection Control – Sync.)

The *Sync.* tab defines the reference signals for synchronization. This includes

- The internal or external *Reference Frequency*
- The output mode for the network-specific system clock *(REF OUT 2)*

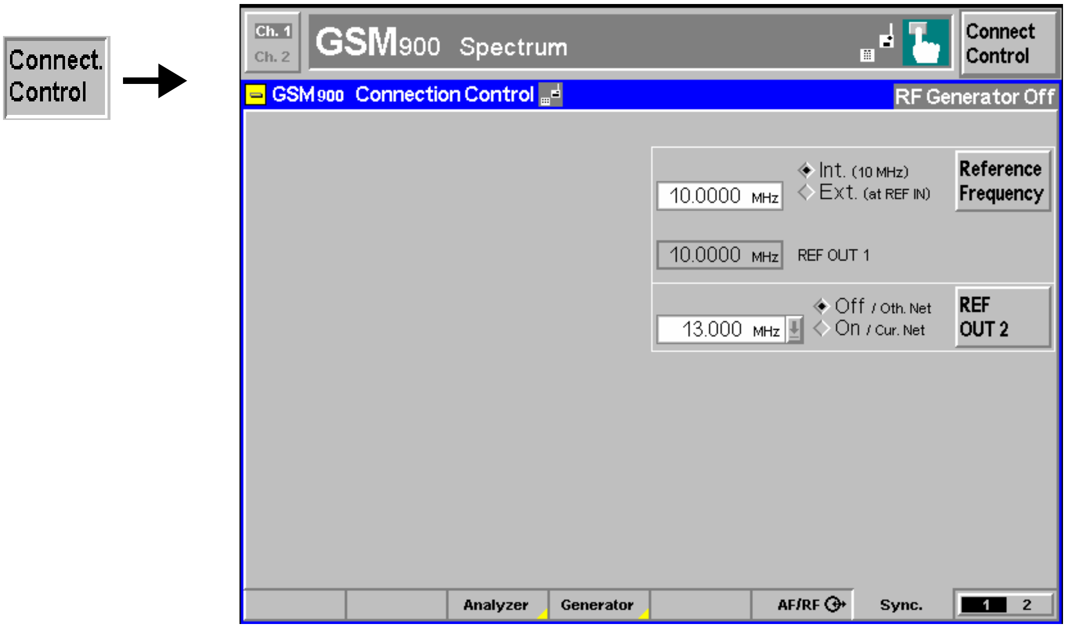


Fig. 4-42 Connection Control – Synchronization

Reference Frequency

The *Reference Frequency* softkey determines the source and the frequency of the reference signal.

The associated field allows to select between two alternatives:

Int. (10 MHz) Internal synchronization by means of a 10 MHz reference frequency (TCXO or OCXO, CMU-B11/-B12).

Ext. (at REF IN) Synchronization to external reference signal to be fed in via input REF IN. The external reference signal can be used for synchronization of the CMU to another instrument. Its frequency must be entered in the input field next to the *External* button.

The frequency of the external reference signal must be entered in the input field next to the left of the *Ext. (at REF IN)* radio button.

The reference signal used is also routed to output *REF OUT 1* so that it can be fed to other instruments as well.

Note:

1. *The header cyclically displays a warning if no synchronization could be achieved e.g. because of missing or faulty input signal with external synchronization selected. At the same time, bit no. 6 (RFNL, Reference Frequency Not Locked) is set in the STATus:OPERation:CMU:SUM1:CMU1 sub-register associated to the CMU base system and the query `[SENSe:]SYNChronize :FREQuency:REFerence:LOCKed?` returns the value `ON`.*

2. *In the case of external synchronization with squarewave signals (TTL) ensure correct signal matching to avoid reflections. Otherwise, resulting overshoots may cause trigger problems at the CMU input. A possible remedy is to use a lowpass filter or an attenuator pad directly at the CMU input. Correct synchronization may be checked by comparing the signal REF OUT 1 or REF OUT 2 with the input signal.*

3. *This configuration is valid in all CMU function groups.*

Caution: The reference frequency is set to *Int. (10 MHz)* whenever the base system is reset. After switching back to *Ext. (at REF IN)* it is necessary to allow for a setting time (~1 s) before the CMU can synchronize to the external reference frequency. The delay is avoided by a partial reset of all function groups with the exception of the base system.

Remote control
The commands for the reference frequency are part of the CMU base system (see CMU200/300 operating manual):

```
CONFigure:SYNChronize:FREQuency:REFerence:MODE
   INTernal | EXTernal
CONFigure:SYNChronize:FREQuency:REFerence <Frequency>
[SENSe:]SYNChronize:FREQuency:REFerence:LOCKed?
```

REF OUT 2

The softkey *REF OUT 2* configures a network-specific system clock REF OUT 2 to be fed to the output REF OUT 2 at the rear of the instrument.

The associated field permits to select between two alternatives:

OFF (other network) The clock frequency of the current function group is not fed to the output *REF OUT 2*.

With this setting the system clock of another active function group (e.g. the network GSM1800 while the current network is GSM900) is still applied to *REF OUT 2* provided that the output *REF OUT 2* is switched on in the other function group. However, if *REF OUT 2* is explicitly switched over from *On* to *Off* the clock signal is definitely removed.

On (current network) The network-specific system clock of the current function group is fed to output REF OUT 2. The system clock of any other function group applied to REF OUT 2 before is replaced.

Besides the basic clock frequency of 39 MHz one of the following clock frequencies may be selected:

39.000 MHz,	19.500 MHz,	13.000 MHz,	9.750 MHz,	7.800 MHz,	6.500 MHz,	5.571 MHz,
4.875 MHz,	4.333 MHz,	3.900 MHz,	3.545 MHz,	3.250 MHz,	3.000 MHz,	2.786 MHz,
2.600 MHz,	2.438 MHz,	2.294 MHz,	2.166 MHz,	2.053 MHz,	1.950 MHz,	1.857 MHz,
1.773 MHz,	1.696 MHz,	1.625 MHz,	1.560 MHz,	1.500 MHz,	1.444 MHz,	1.393 MHz,
1.349 MHz,	1.300 MHz,	1.258 MHz,	1.219 MHz			

(The values are calculated according to the formula $F_{out} = 39.000\ MHz / n$ where $n = 1, ..., 32$.)

The clock frequency can be used to synchronize other instruments.

Remote control

```
SOURce:DM:CLOCk:STATe ON | OFF
SOURce:DM:CLOCk:FREQuency <Frequency>
```

Trigger (Connection Control – Trigger)

The *Trigger* tab is part of the second group of tabs in the *Connection Control* menu. It is accessible after pressing the *1 / 2* toggle hotkey once. Pressing *1 / 2* again switches back to the first group of tabs described above.

The *Trigger* tab defines the trigger condition for the measurement and the input for the external trigger signal.

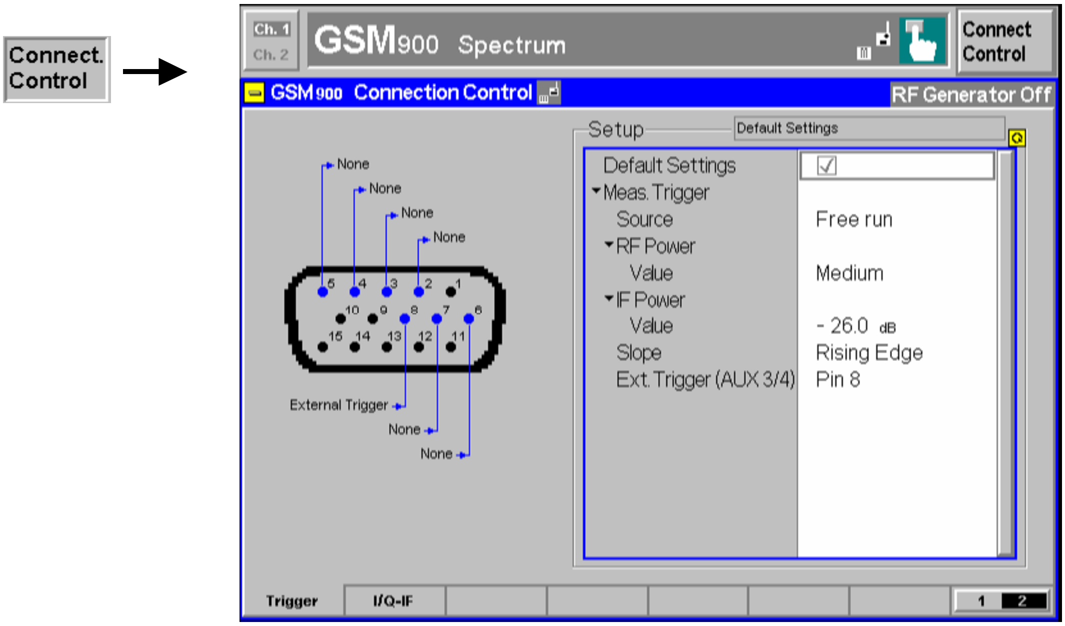


Fig. 4-43 Connection Control – Trigger

Default Settings The *Default Settings* checkbox assigns the default setting to all functions in the *Trigger* tab (the default values are quoted in the command description in chapter 6 of this manual).

Remote control `TRIGger[:SEQuence]:DEFault ON | OFF`

Meas. Trigger – Source *Source* selects the source for the trigger event:

Free Run Trigger by the GSM input signal: The CMU detects the burst; the exact timing is given by the training sequence. This setting may slow down the measurements. *P/t Multislot, P/Slot*, and *P/Frame* measurements can not be performed in *Free Run* trigger mode.

Note: *In* Spectrum *measurements, Free Run trigger mode means that the measurement is not correlated with the burst timing. The* Switching *spectrum must be measured with another trigger source, e.g.* IF Power *trigger.*

RF Power The measurement is triggered by the level of the incoming burst (rising or falling edge; see *Slope* setting below), the trigger level is specified via the *Level* parameters. Wideband power trigger on the RF Front End.

IF Power The measurement is triggered by the level of the IF signal (rising or falling edge; see *Slope* setting below), the trigger level is specified via the *Level* parameter. Narrow-band IF power trigger.

Extern External trigger signal fed in via connector AUX 3 or AUX 4; see *Ext. Trigger ...* setting below.

For the *Free Run, RF Power* and *IF Power* settings the input signal must be a burst signal. The external trigger can be selected for all *Non Signalling* measurements. In contrast, *Signalling* measurements must be triggered by the signal from the signalling unit or from the mobile phone.

RF Power trigger signals have a small dynamic range which may not be sufficient for triggering. It is recommended to trigger by the *IF Power* instead.

Note: *If no measurement result can be obtained the trigger mode may not fit to the trigger signal applied. Check the trigger mode and signal.*

Remote control
```
TRIGger[:SEQuence]:SOURce FRUN | EXTern | RFPower | IFPower
```

RF Power / IF Power

…Value

The *Value* parameters define the trigger thresholds if the measurement is triggered by the *RF Power* or *IF Power* (see *Source* function above) respectively. Both thresholds are defined relative to the maximum input level set in the *Analyzer* tab (see *Max. Level* softkey on p. 4.83). The *Level* settings have no influence on *Free Run* or *External* trigger measurements.

Note: *The trigger levels are always relative to the **current** maximum input level. If* RF Max. Level *is set manually* (RF Mode = Manual)*, the current input level is constant and equal to the setting value. In autoranging mode* (RF Mode = Auto)*, the current maximum input level is dynamically adapted to the measured RF input level; the trigger levels change accordingly.*

The ***RF Power*** trigger threshold is the RF input signal level *(Wideband Power*, see p. 4.86) beyond which the trigger condition is satisfied and a measurement is initiated.

Low	Low trigger threshold, equal to approx. the *RF Max. Level* –26 dB
Medium	Medium trigger threshold, equal to approx. the *RF Max. Level* –16 dB
High	High trigger threshold, equal to approx. the *RF Max. Level* –6 dB

The ***IF Power*** trigger threshold is the IF trigger signal level beyond which the trigger condition is satisfied and a measurement is initiated. The *IF Power* input value defines the trigger threshold relative to the maximum input level:

IF power trigger threshold = <RF Max. Level> + <IF Power>

Remote control
```
TRIGger[:SEQuence]:THReshold:RFPower LOW | MEDium | HIGH
TRIGger[:SEQuence]:THReshold:IFPower <Power>
```

Slope

Slope qualifies whether the trigger event occurs on the *Rising Edge* or on the *Falling Edge* of the trigger signal. The setting has no influence on *Free Run* measurements.

Remote control
```
TRIGger[:SEQuence]:SLOPe POSitive | NEGative
```

Ext. Trigger (AUX 3/4)

Ext. Trigger (AUX 3/4) qualifies whether the external trigger signal is fed in at *Pin 6, Pin 7,* or *Pin 8* of the AUX 3 connector. The setting only has effect if the trigger source is an *External* signal.

The CMU can be ordered with the auxiliary connector AUX 4 on the rear panel configured as an external trigger input. In this case the *Ext. Trigger...* pin selection refers to AUX 4; the front panel connector AUX 3 is disconnected.

Remote control
```
TRIGger[:SEQuence]:SOURce:EXTernal PIN6 | PIN7 | PIN8
```

I/Q-IF Interface (Connection Control – I/Q-IF)

The *I/Q-IF* tab is part of the second group of tabs in the *Connection Control* menu. It is accessible after pressing the *1 / 2* toggle hotkey once. Pressing *1 / 2* again switches back to the first group of tabs described above.

The *I/Q-IF* tab configures the signal paths for I/Q and IF signals. With option CMU-B17, *I/Q and IF Interfaces,* I/Q and IF signals can be used in the framework of *RF* measurements and in many network tests. For a detailed description of rear panel connectors for I/Q and IF input/output signals, test scenarios and application examples refer to the CMU200/300 operating manual.

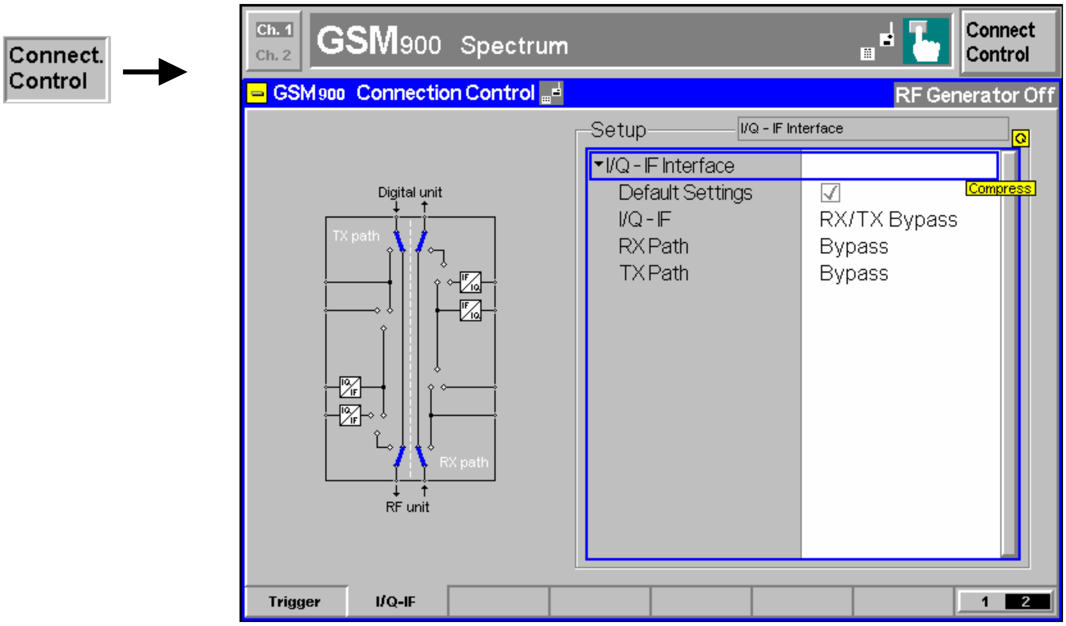


Fig. 4-44 Connection Control – I/Q-IF

Default Settings The *Default Settings* checkbox assigns the default setting to all functions in the *I/Q-IF* tab.

Remote control `IQIF:DEFault ON | OFF`

I/Q-IF Selects the I/Q-IF test scenario, overwriting the current *RX Path* and *TX Path* settings. Six different predefined test scenarios with fixed RX and TX path are provided; see *Table 4-6 below*.

Additional scenarios may be defined by selecting any other combination of RX and TX paths. When this is done *I/Q-IF* is set to *User-defined.* The circuit diagram to the left of the *Setup* table shows the current RX and TX signal paths.

Remote control
```
CONFigure:IQIF:RXTXcombined
        BYP | BYIQ | XOIO | IOIO | IOXO | FPAT | UDEF
```

RX Path Selects the RX signal path, leaving the *TX Path* unchanged but adapting the I/Q-IF test scenario to the new RX/TX path combination: If the combination corresponds to a predefined scenario, then *I/Q-IF* is set to the predefined scenario; otherwise it is set to *User-defined*.

The circuit diagram to the left of the *Setup* table shows the current RX and TX signal paths.

Remote control
```
CONFigure:IQIF:RXPath
        BYP | BYIQ | XOIO | IOIO | IOXO | FPAT | UDEF
```

RX Path Selects the TX signal path, leaving the *RX Path* unchanged but adapting the I/Q-IF test scenario to the new RX/TX path combination: If the combination corresponds to a predefined scenario, then *I/Q-IF* is set to the predefined scenario; otherwise it is set to *User-defined*.

The circuit diagram to the left of the *Setup* table shows the current RX and TX signal paths.

Remote control
```
CONFigure:IQIF:TXPath
       BYP | BYIQ | XOIO | IOIO | IOXO | FPAT | UDEF
```

Table 4-6 I/Q-IF scenarios and path settings

I/Q-IF	**RX Path**	**TX Path**	**Remark/Application** (see also CMU manual)
RX/TX Bypass	Bypass	Bypass	No I/Q or IF inputs/outputs connected Direct signal analysis and transmission with full measurement accuracy
Byp. w. I/Q-OF OUT	Bypass w. I/Q-IF OUT	Bypass w. I/Q-IF OUT	No I/Q or IF inputs connected Analysis of received and transmitted signal via I/Q or IF
I/Q IN/OUT	I/Q IN/OUT	I/Q IN/OUT	Insertion of signal to be analyzed and transmitted on I/Q level
IF IN_I/Q IN/OUT	IF IN_I/Q IN/OUT	IF IN_I/Q IN/OUT	Additional processing of received and transmitted signal on IF level (filters etc.) and analysis via I/Q
IF IN/OUT	IF IN/OUT	IF IN/OUT	Insertion of signal to be analyzed and transmitted on IF level
Fading	Bypass	I/Q IN/OUT	Direct analysis of received signal Modification (fading) of transmitted signal by means of an external fading simulator (SMIQ, ABFS)
User-defined	Any combination of RX Path and TX Path not listed above		Any combination of RX and TX test cases listed above

GSM Mobile Tests (Signalling)

The structure of this section is based on the configuration and measurement groups defined in function group *GSM400/GT800/850/900/1800/1900-MS Signalling*. The menus are described in the following order:

1. Call setup to the mobile station *(Connection Control – Connection)*
2. Overview of measurements and global settings *(Overview)*
3. Measurement menus *(Power, Modulation, Spectrum, Receiver Quality):* Purpose of the measurements and relation to the test specifications and conformance requirements, description of measurement results, specific measurement configurations
4. General device configurations *(Connection Control)*

The most important menus within function group *GSMxxx-MS Signalling* are shown in an overview at the end of chapter 3 in the present GSM manual.

A lot of menus and controls are identical in the two test modes *Signalling* and *Non Signalling*. In this chapter, these menus are only presented with a summary explanation; the detailed description can be found in the section *GSMxxx-MS Non Signalling*.

Setting up a Connection (Popup Menu Connection Control – Connection)

The menu group *Connection Control* controls the signalling procedures (call setup and release, services, signalling parameters) and configures the inputs and outputs with the external attenuation values and the reference frequency.

The term signalling denotes all procedures that are necessary for call setup and release and for control of a connection in the mobile radio network. In the case of GSM mobile tests, a distinction is made between five different signalling states:

Signal Off	CMU transmits no signal
Signal On	CMU transmits a GSM control channel signal to which a mobile station can synchronize
Synchronized	Synchronization with the mobile station and location update performed
Alerting	Mobile is being called by the CMU (after location update or without location update)
Call Established	Call to mobile station established

A number of control commands which can be initiated both by the CMU *(Connect Mobile, Mobile Terminating Call)* and by the mobile station *(Call from MS, Mobile Originated Call)* switch between these states (the dashed lines in *Fig. 4-45* denote processes initiated by the mobile station).

A lot of applications within the function group *GSMxxx-MS Signalling* are only possible or useful in a particular signalling state (for example, handover between various networks requires a connection between CMU and mobile station, i.e. it is only possible in the *Call Established* state). Accordingly, the possible functions of menus vary depending on the present signalling state. For reference see the *Sig. State* field in the command tables in Chapter 6.

The purpose of the *Signalling* test mode is to perform transmitter and receiver tests with an existing call (or data transfer) connection between the CMU and the mobile. Therefore the menus for setting up a connection (*Connection Control – Connection)* appear immediately after the function group and mode *GSMxxx-MS Signalling* is activated. Besides, all the tabs in the *Connection Control* menu can be called up by pressing the *Connect. Control* softkey at the top right in every measurement menu. They are linked with each other via the hotkey bar at the lower edge of the screen. Pressing the *Escape* key closes the active *Connection Control* menu and re-activates the underlying measurement menu.

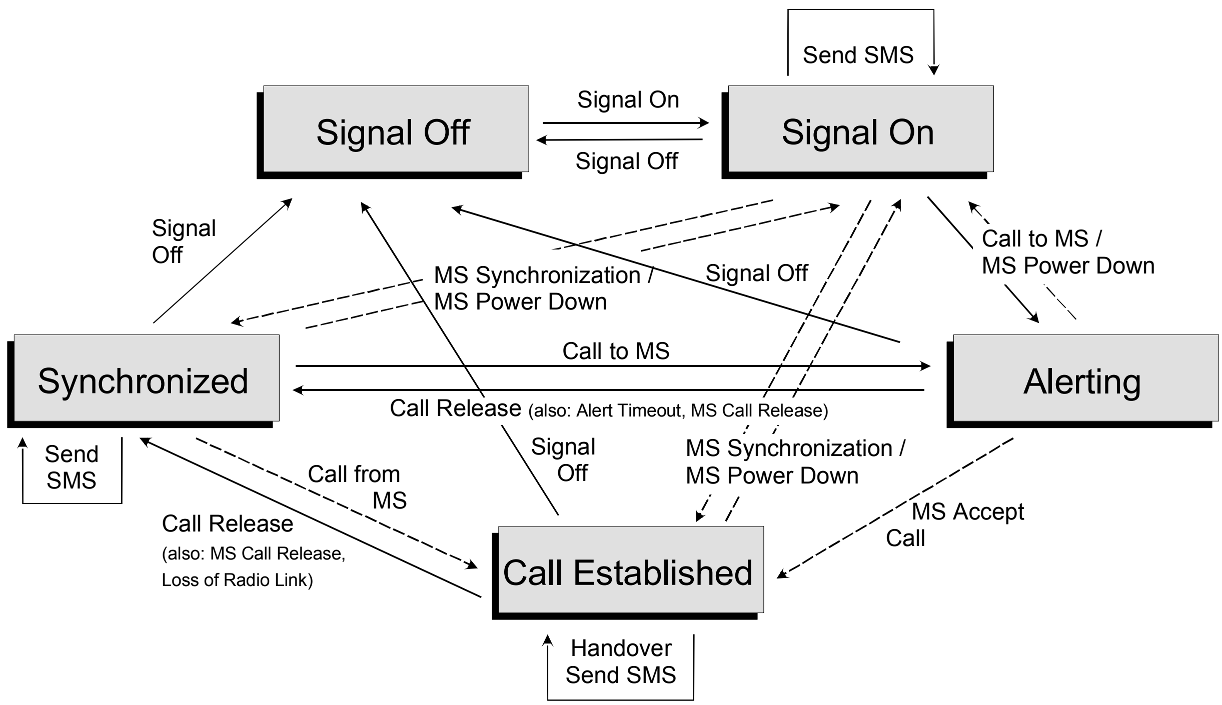


Fig. 4-45 Signalling states of the CMU (circuit switched mode)

Corresponding to the five possible signalling states, five different *Connection* tabs are available. When a signalling state is reached, the corresponding menu is opened automatically (exceptions: see *Connect. Control Guidance* parameter in section *Display Control (Connection Control – Misc.)* on p. 4.211 ff.).

Note1: Handover

For a complete overview of signalling states including the Handover process see Fig. 6.1 in chapter 6 of this manual.

Note2: Packet switched mode (GPRS and EGPRS)

The connection scheme described in this section is designed and valid for circuit switched traffic (GSM, HSCSD or EDGE). With option CMU-K42(-K43), the CMU is also able to test the packet switched operating mode of mobile phones supporting (E)GPRS. (E)GPRS is an additional mode of the MS so that the circuit switched GSM signalling scheme of Fig. 4-45 above is complemented by a largely independent GPRS signalling scheme. For a detailed description of the CMU's (E)GPRS functionality see section GPRS Signalling on p. 4.213 ff.

Note 3: Dual Transfer Mode

With option CMU-K44, Dual Transfer Mode, the CMU is also able to set up a combined circuit switched and packet data connection and perform RX and TX measurements. Refer to Chaper 9 of this manual for detailed information.

In the following the first two tabs *Connection Control – Connection* displayed during the call setup are described. The other tabs of the *Connection Control* menu provide general measurement settings; they are described in section *Connection Control* on p. 4.166 ff.

Signalling Control without Signal (State Signal Off)

The *Connection (Signal Off)* tab provides information on:

- The current GSM *(Circuit Switched)* and (E)GPRS *(Packet Switched)* signalling states

- The characteristics of the MS under test *(MS Capabilities* and *Signalling Info*, if available, i.e. if a connection was set up before)
- The most important parameters characterizing the frequency and level of the signal sent by the CMU in the state Signal On *(BS Signal)*
- The *Network* code
- Selected AF and RF connectors and external attenuation *(AF/RF)*
- Status and result of wideband peak power measurement *(Wideband Power)*

Besides, it contains softkeys which lead to other operating modes or signalling states:

- Select another operating mode of the MS, e.g. (E)GPRS mode *(Network Support* and *Main Service)*
- Activate the control channel signal to which the mobile station can synchronize *(Signal On)*

The popup menu *Connection (Signal Off)* is opened when the function group *GSM-MS Signalling* is selected, or if the control channel signal is switched off *(Signal Off* softkey*)* while the system is in another signalling state. It is replaced by the *Connection (Signal On)* menu after the control channel signal on the CMU is switched on (Softkey *Signal On,* see Fig. 4-45).

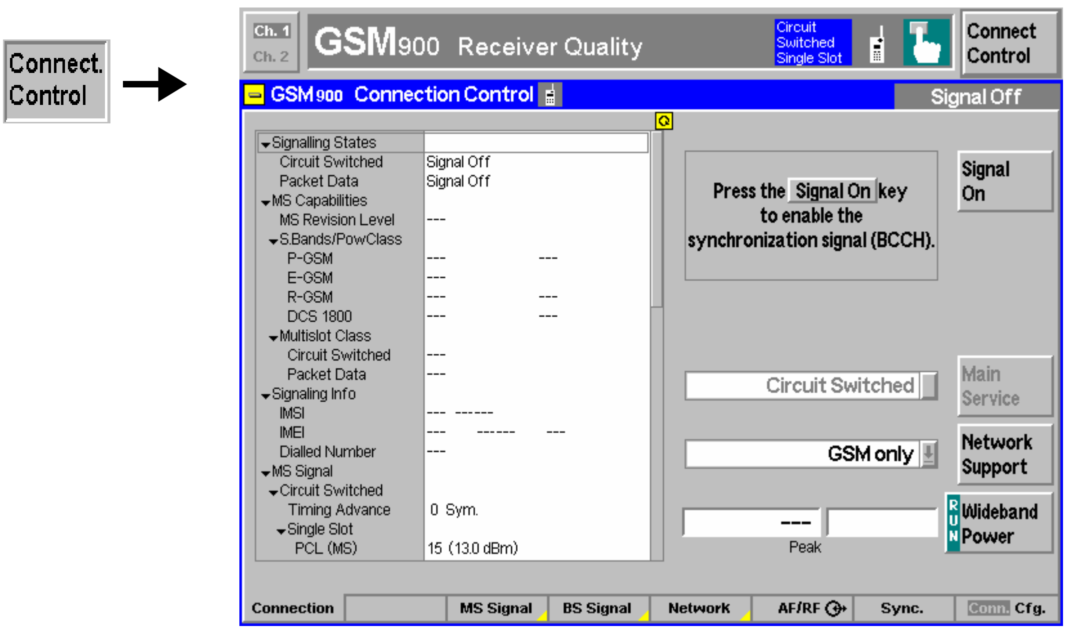


Fig. 4-46 Connection Control – Connection (Signal Off)

The parameter overview in the left half of the menu is also indicated in the other *Connection* tabs and is described in section *Connection Control with Call Established* on p. 4.169 ff. Some parameters are not always available, depending on the current and previous signalling states and settings. In this case the table shows invalid or unavailable settings ("---").

Header Message A Header Message (here: *Press the Signal On key to enable the synchronization signal (BCCH))* displayed on top of each *Connection* tab informs on the current instrument state or indicates how to proceed to get to other signalling states.

Signal On

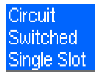
The *Signal On* softkey switches on a control channel signal to which the mobile station can synchronize. By switching on the signal, the CMU changes to the signalling state *Signal On*. A user prompt below the header indicates the function of this softkey.

Remote control
`PROCedure:SIGNalling[:CSWitched]:ACTion SON`

Main Service

The *Main Service* softkey selects *Circuit Switched* or *Packet Data* (GPRS or EGPRS) operation of the MS under test. This softkey is disabled (grayed) if the *Network Support* is set to GSM. See also section *GPRS Signalling* on p. 4.213 ff.

The *Main Service* is shown in the configuration icon in the menu title bar, e.g.:



Remote control
`[:SENSe:]NETWork:MSERvice?` (query only)
The keywords `[:CSWitched]` and `:PDATa` in many signalling commands distinguish *Circuit Switched* or *Packet Data* main service, so there is no command needed for an explicit switchover except in *Dual Transfer Mode* (option R&S CMU-K44, see Chapter 9):
`CONFigure:NETWork:MSERvice`

Network Support

The *Network Support* softkey determines whether the CMU acts as a BTS that supports GSM only or GSM and (E)GPRS.

GSM	Circuit switched GSM operation without GPRS support
GSM + (E)GPRS	Circuit switched GSM operation with (E)GPRS support: The CMU reports to the MS that the CMU/current cell supports (E)GPRS. The MS can react to this message and attempt a GPRS attach provided that it also supports (E)GPRS.

The *Network Support* parameter is available only before the MS is synchronized (i.e. in the GSM signalling states *Signal Off* or *Signal On).* The *GSM + (E)GPRS* setting is a pre-condition for all (E)GPRS-related signalling procedures and measurements such as the *Main Service* selection.

If the *Packet Data* main service is selected, the *Network Support* must be either *GSM + GPRS* or *GSM + EGPRS*.

Remote control
`CONFigure:NETWork:NSUPport GSM | GGPR | GEGP`

Wideband Power

The *Wideband Power* softkey controls the wideband power measurement and indicates its status *(RUN | HLT | OFF)*. The status can be changed after softkey selection (pressing once) by means of the *ON/OFF* key or the *CONT/HALT* key. The measurement result is in units of dBm. The analog bar to the right of the softkey shows the measured power relative to the expected level from the MS, i.e. the nominal output power corresponding to its power class and PCL. The display range is between *Nominal Power – 10 dB* and *Nominal Power + 10 dB*.

The wideband power measurement is performed at the Front End of the CMU and yields the peak power of the input signal inside a wide frequency range. For GMSK modulated GSM signals, the result of the wideband power measurement is usually slightly higher than the result of the *Power* measurement which is obtained with different filter characteristics. The main purpose of the wideband power measurement is to indicate whether an input signal is available and whether it is in the expected range.

Note: *An additional quick and precise power measurement is available in remote control (keyword `NPOWer`).*

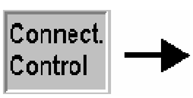
Remote control
```
INITiate:WPOWer
FETCh:WPOWer:STATus?
READ[:SCALar]:WPOWer?
FETCh[:SCALar]:WPOWer?
SAMPle[:SCALar]:WPOWer?
```

Connection Control with Signal (State Signal On)

In addition to the parameter overview described in section *Connection Control with Call Established* on p. 4.169 ff, the *Network Support* and *Main Service* softkeys, and the wideband power measurement described in section *Signalling Control without Signal (State Signal Off)* on p. 4.105 ff., the *Connection (Signal On)* tab contains the following softkeys which lead to other services or signalling states:

- Switch off the control channel signal for synchronization *(Signal Off* –> state *Signal Off)*
- Set up a call to the mobile station (*Connect Mobile* –> state *Alerting)*
- Short message service (*Send SMS* –> return to state *Signal On)*

The popup menu *Connection (Signal On)* is opened after the control channel signal of the CMU is switched on (Softkey *Signal On* in the popup menu *Connection (Signal On))*. It is replaced by the *Connection (Synchronized)* menu after the mobile station initiates a location update by itself. It is replaced by the *Connection (Call Established)* menu if the mobile station sets up a call to the CMU. It is replaced by the *Connection (Alerting)* menu if a mobile is called via the *Connect Mobile* softkey (see Fig. 4-45).



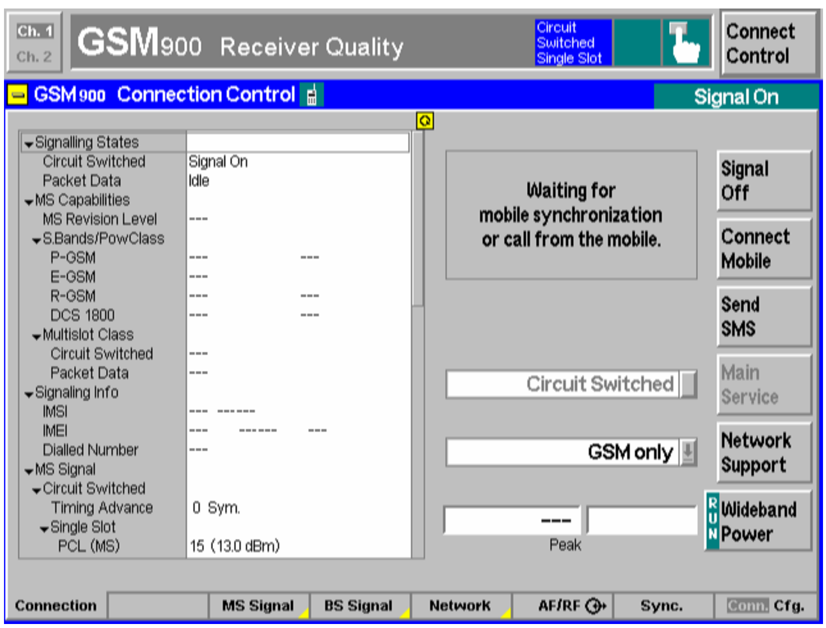


Fig. 4-47 Connection Control – Connection (Signal On)

The parameter overview in the left half of the menu is also indicated in the other *Connection* tabs and is described in section *Connection Control with Call Established* on p. 4.169 ff. Some parameters are not always available, depending on the current and previous signalling states and settings. In this case the table shows invalid or unavailable settings ("---").

Header Message A Header Message (here: *Waiting for mobile synchronization or call from the mobile)* displayed on top of each *Connection* tab informs on the current instrument state or indicates how to proceed to get to other signalling states.

Signal Off

The *Signal Off* softkey switches off the CMU's control channel signal to which the mobile station can synchronize. The CMU changes to the signalling state *Signal Off*.

Remote control
`PROCedure:SIGNalling[:CSWitched]:ACTion SOFF`

Connect Mobile

The *Connect Mobile* softkey sets up a call to the mobile station. The header message indicates that the mobile station is to synchronize to the CMU signal first. After successful synchronization, the two successive messages *Paging in progress ... Location update in progress ...* are displayed below the header; the CMU changes to the signalling state *Alerting*. As soon as the call is accepted at the mobile the CMU changes to the signalling state *Call Established*.

If the mobile does not respond to the CMU's paging messages within a fixed period of time, the notice message *Call to mobile was no successful* is displayed and bit no. 6 of the STATus:OPERation:CMU:SUM1|2:CMU<nr> sub-register, *Paging Failed,* is set.

Remote control

```
PROCedure:SIGNalling[:CSWitched]:ACTion MTC
```

Send SMS

The *Send SMS* softkey activates the short message service. It opens the *Short Message Service* popup menu:

A text with a maximum of 160 alphanumeric characters can be entered in the input field. Two front panel keys control the short message service menu:

CLR	Clear the whole short message from the input field
ENTER	Send the short message in the input field to the mobile.

Remote control

```
PROCedure:SIGNalling[:CSWitched]:ACTion SMS
CONFigure:SIGNalling[:CSWitched]:SMS <Text>
SENSe:SIGNalling[:CSWitched]:SMS?
```

Overview Menu

The *Overview* menu displays the essential results of the *P/t Norm. GMSK,* the *Ext. Phase Err. GMSK*, and the *Overview 8PSK* applications and provides access to the most important measurement settings. In particular, it configures the GSM downlink signal that the CMU transmits in order to set up and control a connection *(BS Signal)* and defines the properties of the uplink signal expected from the device under test *(MS Signal)*. The *Overview* menu is analogous to the *Analyzer/Generator* menu described on p. *4.2* ff.

- The measurement control softkey (measurement control softkey) *P/t Norm. GMSK* changes to *Ext. Phase Err. GMSK* or *Overview 8PSK,* depending on the application selected. This softkey controls the measurement, indicates its status *(RUN | HLT | OFF)* and opens the configuration menu *Power Configuration* or *Modulation Configuration*. The hotkeys associated to the measurement control softkey define the scope of the *Power* or *Modulation* measurement.
- The other softkeys on the right side are combined with various hotkeys (see *Fig. 4-48 below).* The softkey/hotkey combinations provide test settings and switch over between different measurements.

The *Overview* menu is opened by selecting the function group in the *Menu Select* menu (with associated key at the front of the instrument) and after closing the configuration menu *Connection Control - Connection* (using the *Escape* key or automatically after establishing a connection). The hotkeys associated to the *Menus* softkey switch over between the *Overview* menu and the remaining measurement menus of function group *GSM400/GT800/850/900/1800/1900-MS Signalling*.

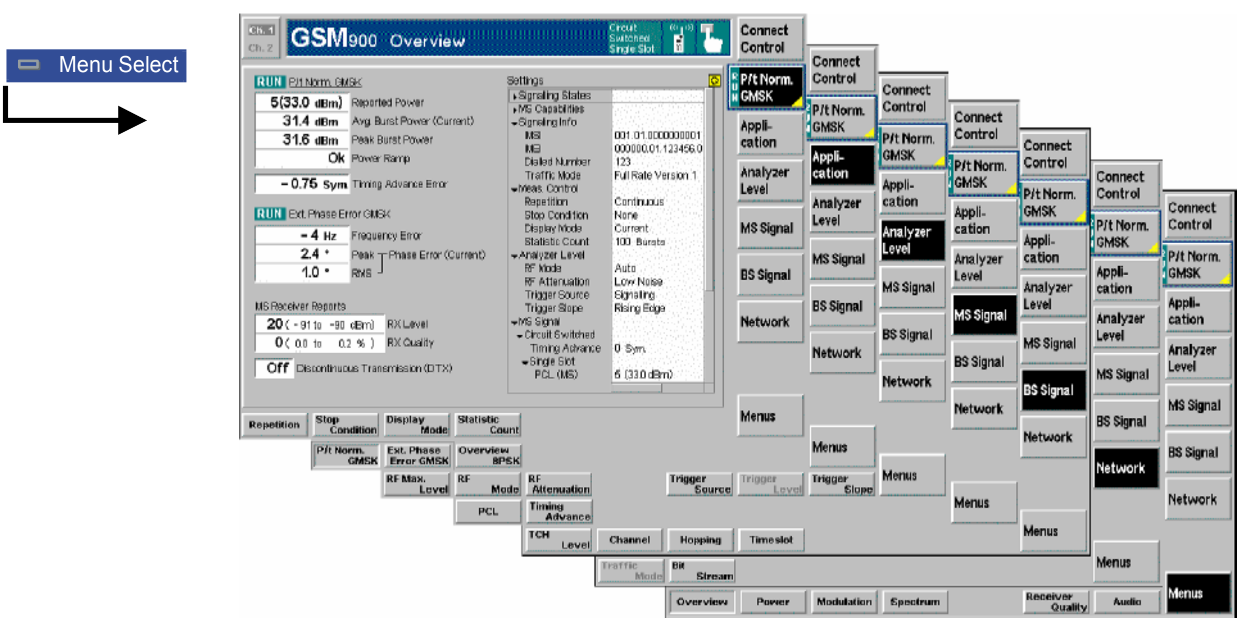


Fig. 4-48 Overview of settings and measurements

Test Settings

The settings for the *Overview* menu are accessible via softkey/hotkey combinations. The function of the measurement control softkeys *P/t Norm. GMSK, Ext. Phase Err. GMSK*, and *Overview 8PSK* is analogous to the measurement control softkeys in the *Analyzer/Generator* menu; see section *Measurement Control* on p. *4.4*. The same holds for the selection of the application; see section *Selecting the Application* on p. *4.5*.

The *Overview* menu provides a number of general or application-specific settings. All of these settings are always identical to the corresponding settings in the *Power* and *Modulation* menus. Changes made in the *Overview* menu overwrite the *Power* and *Modulation* settings and vice versa.

Description of settings

- The settings to be made in the *P/t Normal GMSK* application are described in section *Test Settings* on p. 4.113 ff.
- The settings associated to the measurement control softkey and the *Analyzer Level* settings to be made in the *Ext. Phase Error GMSK* and in the *Overview 8PSK* application are identical with the corresponding settings in the *Analyzer/Generator* menu. The *MS Signal, BS Signal* and *Network* settings are described in section *Test Settings* on p. 4.113 ff.

Settings table The *Settings* table in the right half of the *Overview* menu gives an overview of the measurement settings belonging to the current application. It changes when a different application is selected. The rollkey scrolls and expands the *Setup* table.

Measurement Results

The measurement results and their relation to the three measurement applications are analogous to the results in the *Analyzer/Generator* menu; see section *Measurement Results* on p. *4.6* f. The results in the *Overview* menu represent only a small fraction of the power and modulation results and of the MS reports that the CMU is able to acquire. A comprehensive set of test results is displayed in the *Power, Modulation,* and *Receiver Quality* measurement menus. More information about the measurement results is to be found in the documentation on these measurement menus:

Power	Burst power	*Power* menu, p. 4.112 ff.
Ext. Phase Err. GMSK	Modulation (phase and frequency error)	*Modulation* menu, p. 4.129 ff.
MS Rcv. Reports	Measurement reports from mobile station	*Sensitivity* menu, p. *4.145* ff.

Power Measurements

The menu group *Power* is designed to measure the RF output power of the MS transmitter. The power of a normal burst in a single timeslot or in up to 4 consecutive timeslots, the power of an access burst, the averaged power and its evolution over several slots or frames can be analyzed. In addition, the average power can be measured as a function of the power control level (PCL) of the mobile. The different measurements are treated as different applications; the results are displayed in separate *Power* measurement menus. The popup menu *Power Configuration* is used to configure the measurements.

Most applications and settings of the *Power* menu do not depend on the signalling state and correspond to those of the menu *Power* in the test mode *GSM400/GT800/850/900/1800/1900-MS Non Signalling*. For a detailed description of these applications refer to p. *4.9* ff. The following two applications are related to signalling issues and therefore not available in *Non Signalling* mode:

- Application *P/PCL*
- Application *P/t Access GMSK*

P/PCL

In *Signalling* mode, the average burst *Power* can be measured as a function of the PCL of the connected mobile phone. This parameter is not available under the conditions of a module test. Therefore, application *P/PCL* is not included in the *Non Signalling* measurements.

The *P/PCL* measurement represents a fast method of measuring the average burst power transmitted on all PCLs supported by a mobile. The measurement relies on the fact that a GSM mobile, when changing from one PCL to another, steps through the whole range of intermediate PCLs, dwelling on each level for a period corresponding to 13 TDMA frames (577 µs x 8 x 13 ≈ 60 ms). The CMU measures the average burst power in the whole PCL range, starting with the highest output power level (i.e. the smallest PCL, see *Table 4-8* on page 4.127).

The P/PCL measurement is combined with frequency hopping on seven uplink GSM channels. In addition, a limit check with PCL-dependent tolerances is performed. The results are output in tabular form.

P/t Access GMSK

The *P/t Access GMSK* application measures the power of an access burst over one burst period. The measurement curve obtained can be further processed to determine an average, minimum, or maximum result and calculate the average over the whole burst.

The *P/t Access GMSK* is intended for an analysis of the access bursts that the mobile station uses for initial random access to the network and for handover, so it is available in *Signalling* mode only. Only single shot measurements can be made, because the mobile usually does not transmit the access bursts in consecutive TDMA frames. Besides, the *P/t Access GMSK* application is analogous to *P/t Normal GMSK.*

The properties and use of access bursts in GSM networks are described in section *Limit lines (Power Configuration – Limit Lines)* on page *4.35* ff.

Continuous access burst measurement

In packet data mode (with option R&S CMU-K42/-K43), it is possible to use access bursts for the transmission of CONTROL_ACK_TYPE messages. This means that access bursts occur periodically so that the *P/t Access GMSK* application is inappropriate. The bursts can be measured using the *P/t Multislot* application; for an application example refer to section *Continuous Access Burst Measurement* in Chapter 2.

Note: Power *measurements on normal bursts are performed at the MS output power set via* PCL *(see* PCL *softkey on p.* 4.178*) or the corresponding parameters for multislot or packet data mode. In contrast, the access burst is transmitted before a call is set up. The* P/t Access Burst *measurement is performed at the maximum power for the cell* PMAX *(see* PMAX *parameter on p.* 4.183*).*

Measurement Menu (Power)

The graphical measurement menu *Power* displays the results of the power measurement.

- The measurement control softkey *P/t Normal GMSK* (which changes to *P/Frame, P/PCL etc.,* depending on the power measurement application selected) controls the *Power* measurement, indicates its status *(RUN | HLT | OFF),* and opens the configuration menu *Power Configuration*. The hotkeys associated to the measurement control softkey define the scope of the *Power* measurement.
- The other softkeys to the right of the test diagram are combined with various hotkeys (e.g. the hotkeys *PCL, Channel, Timeslot,* and *Timing Advance* are associated with the softkey *MS Signal).* If a softkey is selected and an associated hotkey is pressed, a popup window will appear which indicates the current setting and enables an entry.

The measurement menu *Power* is opened from the *Menu Select* menu (with the associated key at the front of the instrument) or using the *Menus* softkey and the *Power* hotkey.

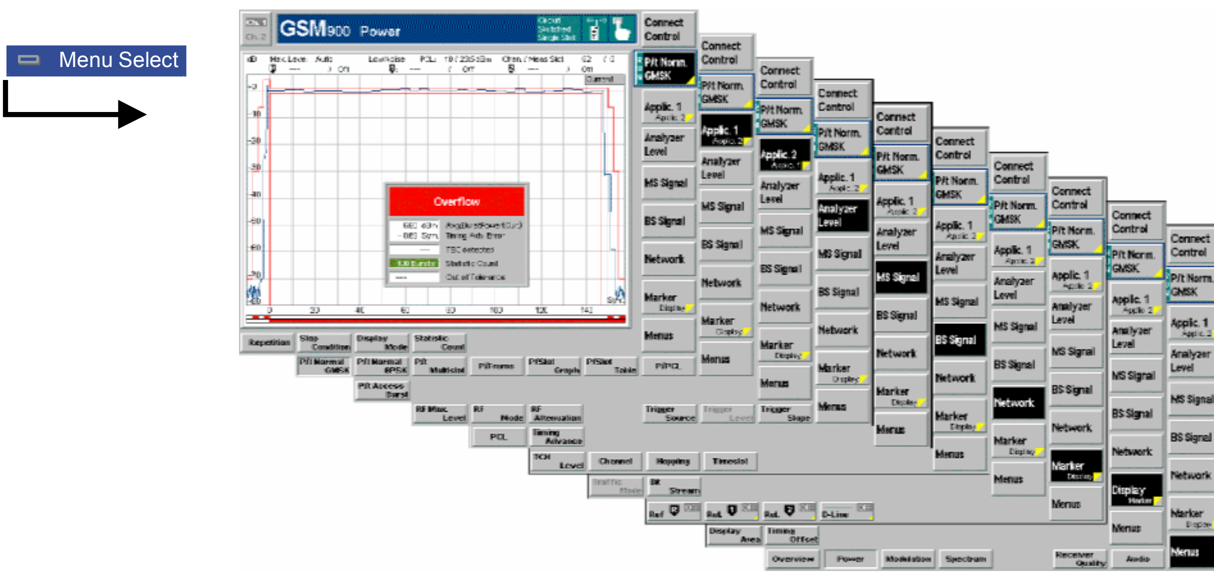


Fig. 4-49 Measurement menu Power – P/t Normal GMSK

Test Settings

The *P/t Norm. GMSK* measurement control softkey (which changes to *P/Frame, P/PCL etc.,* depending on the power measurement application selected) is analogous to the measurement control softkey of the *Power* menu in *Non Signalling* mode. The same holds for statistical measurement settings associated to the measurement control softkey and the *Marker/Display* test settings. For a detailed description of these functions refer to p. 4.9 ff.

The following softkey/hotkey combinations differ from the *Non Signalling* mode:

P/t Norm. GMSK

The *P/t Norm. GMSK* measurement control softkey controls the *P/t Norm. GMSK* measurement; see detailed explanation in section Measurement Control on p. 4.4. Besides, the measurement control softkey provides hotkeys to define the scope of the measurement. All these settings are described in more detail in section Measurement Control (Power Configuration – Control) on page 4.29 ff.

Applic1 Applic 2

The *Applic1/Applic2* softkey selects the power measurement application.

The applications *P/t Normal <Mod_Type>* depend on the modulation scheme of the analyzed signal. In the *P/t Multislot* application, the modulation in each measured slot can be defined separately. The *P/Frame, P/Slot Graph,* and *P/Slot Table* menus and settings do not depend on the modulation scheme.

The *Power* measurement menu and the measurement control softkey change with the application selected; the results are explained in section *Measurement Results* on page 4.119 ff.

P/t Normal GMSK

The *P/t Normal GMSK* hotkey selects the power versus time measurement for GMSK modulated normal burst signals (see explanation of GSM burst structure at the beginning of section *Limit lines (Power Configuration – Limit Lines)* on page *4.35*).

Remote control
The *P/t Normal GMSK* application is selected by the keywords `[:NORMal][:GMSK]` in the 3rd and 4th level of the `POWer` commands, e.g. `CONFigure:POWer[:NORMal][:GMSK]...`

P/t Normal 8PSK

The *P/t Normal 8PSK* hotkey selects the power versus time measurement for 8PSK modulated normal burst signals (see explanation of GSM burst structure at the beginning of section *Limit lines (Power Configuration – Limit Lines)* on page *4.35*).

Remote control:
The *P/t Normal 8PSK* application is selected by the keywords `[:NORMal]:EPSK` in the 3rd and 4th level of the POWer commands, e.g. `CONFigure:POWer[:NORMal]:EPSK...`

P/t Multislot

The *P/t Multislot* hotkey selects the power versus time measurement for multislot configurations (see explanation of GSM burst structure at the beginning of section *Limit lines (Power Configuration – Limit Lines)* on page *4.35*).

Remote control:
The *P/t Multislot* application is selected by the 3rd level keyword `:MSLot` in the POWer commands, e.g. `CONFigure:POWer:MSLot...`

P/Frame

The *P/Frame* hotkey selects the power versus frame measurement. In this application, the average burst power in a particular timeslot is measured over a range of consecutive TDMA frames and displayed in tabular form.

Remote control
The *P/Frame* application is selected by the keyword `:FRAMe` in the 3rd level of the `POWer` commands, e.g. `CONFigure:POWer:FRAMe...`

P/Slot Graph

The *P/Slot Graph* hotkey selects the power versus slot measurement with graphical display. In this application, the average burst power in all eight timeslots of a TDMA frame is measured and displayed in a bar graph.

Remote control
The *P/Slot Graph* application is selected by the keyword `:SLOT` in the 3rd level of the `POWer` commands, e.g. `CONFigure:POWer:SLOT...`

P/Slot Table

The *P/Slot Table* hotkey selects the power versus slot measurement with tabular display. In this application, the average burst power in all eight timeslots of several consecutive TDMA frames is measured and displayed in a table.

Remote control
The *P/Slot Table* application is selected by the keyword `:XSLot` in the 3rd level of the `POWer` commands, e.g. `CONFigure:POWer:XSLot...`

P/PCL

The *P/PCL* hotkey selects the power versus PCL measurement. In this application, the average burst power in three GSM channels is measured as a function of the PCL of the mobile phone and displayed in tabular form.

Remote control
The *P/PCL* application is selected by the keyword `:PCL` in the 3rd level of the `POWer` commands, e.g. `CONFigure:POWer:PCL...`

P/t Access Burst

The *P/t Access Burst* hotkey selects the power versus time measurement of the access burst.

Note: *There is no mode where the mobile transmits access bursts in consecutive TDMA frames. As a consequence, in the* P/t Access GMSK *application, only one access burst can be measured when the mobile attempts a location update (activate the application before performing a location update). See also explanations at the beginning of section Power Measurements on page 4.112.*

Remote control
The *P/t Access Burst* application is selected by the keywords `:ABURst[:GMSK]` in the 3rd and 4th level of the `POWer` commands, e.g. `CONFigure:POWer:ABURst[:GMSK]...`

The following test settings depend on the application selected.

a) P/t Normal GMSK, P/t Normal 8PSK, P/t Access Burst

Analyzer Level

The *Analyzer Level* softkey controls the level in the RF input signal path and provides the trigger settings for the Power measurement.

Difference from *Non Signalling* mode (see p. *4.9* ff):

- In *GSMxxx-MS Signalling*, the measurement is triggered by the signal from the signalling unit or the mobile phone. Use of an external trigger signal is not possible.
- In *GSMxxx-MS Signalling*, the maximum input level *(RF Max. Level)* can be set automatically according to the PCL of the mobile phone *(RF Mode* hotkey, setting *PCL*, see also *MS Signal* tab, section *Table-oriented Version* on p. 4.182 f.).

MS Signal

The *MS Signal* softkey controls the traffic channel transmitter output signal of the mobile phone. The MS output signal parameters are indicated in the *Overview Menu* (see p. 4.110). For a detailed explanation see section *RF Signals of the MS (Connection Control – MS Signal)* on p. 4.176 ff.

PCL

The *PCL* hotkey sets the mobile transmitter output power. This power is defined in terms of power control levels without dimension (see section *Limit Values for Average Burst Power (Power Configuration – Limits)* on page 4.127.

PCL is available only if the mobile station is set to single slot mode (see *Slot Mode* softkey on p. 4.177). If the MS is in multislot mode, the *Slot Config.* softkey is displayed instead; see below.

Remote control
`CONFigure:MSSignal[:CSWitched][:TCH][:SSLot]:MS:PCL`

Slot Config.

The *Slot Config.* hotkey opens the *Slot Configuration Editor* window to determine the levels in all uplink and downlink timeslots. The *Slot Configuration Editor* is described in section *Softkey-oriented Version: MS Multislot Mode* on p. 4.179 ff.

Slot Config. is available only if the mobile station is set to multislot mode (see *Slot Mode* softkey on p. 4.177). If the MS is in single slot mode, the *PCL* softkey is displayed instead; see above.

Remote control
`CONFigure:MSSignal[:CSWitched][:TCH]:MSLot:SCONFig`
`CONFigure:MSSignal:PDATa[:TCH]:MSLot:SCONFig`

Timing Advance

The *Timing Advance* hotkey sets a (zero or positive) delay time correcting the MS timing. See also section *RF Signals of the MS (Connection Control – MS Signal)* on p. 4.176 ff.

Remote control
`PROCedure:SIGNalling[:TCH]:TADVance`
`CONFigure:MSSignal[:TCH]:TADVance`

BS Signal

The *BS Signal* softkey controls the traffic channel signal transmitted by the CMU. See also section *RF Signals of the CMU (Connection Control – BS Signal)* on p. 4.184 ff.

TCH Level

The *TCH Level* hotkey sets the level in the used timeslot of the CMU traffic channel signal.

TCH Level is available only if the mobile station is set to single slot mode (see *Slot Mode* softkey on p. 4.177). If the MS is in multislot mode, the *Slot Config.* softkey is displayed instead; see below.

Remote control
`CONFigure:BSSignal[:CSWitched][:TCH]:LEVel:UTIMeslot`

Hopping

The *Hopping* hotkey selects the frequency hopping sequence for the CMU traffic channel signal.

TCH Level is available only in the *Call Established* signalling state and if the mobile station is set to single slot mode (see *Slot Mode* softkey on p. 4.177). The hopping sequences can be edited in the *BS Signal* tab of the *Connection Control* menu.

Remote control
```
PROCedure:SIGNalling[:CSWitched][:TCH][:SSLot]:FHOPping:
  SEQuence
```

Channel

The *Channel* hotkey sets the traffic channel number used for the circuit switched or packet data connection. For an overview of GSM channel structure see tables in section *Control of Input and Output Signals* on page *4.82*.

Remote control
`CONFigure:BSSignal[:CSWitched][:TCH]:CHANnel <number>`

```
PROCedure:SIGNalling[:CSWitched][:TCH]:CHANnel <number>
CONFigure:BSSignal:PDATa[:TCH]:MSLot:CHANnel
```

Timeslot

The *Timeslot* hotkey sets the traffic channel timeslot used for the circuit switched single slot connection.

Timeslot is available only if the mobile station is set to single slot mode (see *Slot Mode* softkey on p. 4.177). If the MS is in multislot mode, the *Slot Config.* softkey is displayed instead; see below.

Remote control

```
CONFigure:BSSignal[:CSWitched][:TCH][:SSLot]:TIMeslot
PROCedure:SIGNalling[:CSWitched][:TCH][:SSLot]:TIMeslot
```

Slot Config.

The *Slot Config.* hotkey opens the *Slot Configuration Editor* window to determine the levels in all uplink and downlink timeslots. The *Slot Configuration Editor* is described in section *Softkey-oriented Version: MS Multislot Mode* on p. 4.179 ff.

Slot Config. is available only if the mobile station is set to multislot mode (see *Slot Mode* softkey on p. 4.177). If the MS is in single slot mode, the *TCH Level* and *Timeslot* softkeys are displayed instead; see above.

Remote control

```
CONFigure:BSSignal[:CSWitched][:TCH]:MSLot:SCONFig:UUNused
CONFigure:BSSignal[:CSWitched][:TCH]:MSLot:SCONFig:INDividual
PROCedure:SIGNalling[:CSWitched][:TCH]:MSLot:SCONFig
CONFigure:BSSignal:PDATa[:TCH]:MSLot:SCONfig
PROCedure:SIGNalling:PDATa[:TCH]:MSLot:SCONfig
```

Network

The *Network* softkey defines network parameters that the CMU reports to the mobile station. See also section *Network Parameters (Connection Control – Network)* on page 4.192.

Traffic Mode

The *Traffic Mode* hotkey selects the speech and data coding scheme for the MS traffic channel.

Remote control

```
CONFigure:NETWork[:CSWitched]:SMODe:TRAFfic
```

Bit Stream

The *Bit Stream* hotkey selects the data to be transmitted on the traffic channel.

Remote control

```
CONFigure:NETWork[:CSWitched]:SMODe:BITStream?
PROCedure:NETWork[:CSWitched]:SMODe:BITStream?
CONFigure:NETWork:PDATa:BITStream?
PROCedure:NETWork:PDATa:BITStream
```

b) P/t Multislot

The settings accessible via the *Application, Analyzer Level, MS Signal, and BS Signal* softkey are identical with those of application *P/t Normal GMSK*, see above. The *Marker/Display* softkey is identical with the *Marker/Display* softkey in *Non Signalling* mode.

The settings associated to the measurement control softkey are analogous to the *Non Signalling* settings. The important difference is due to the fact that in *Signalling* mode, CMU and MS under test are synchronized so that the true TDMA timing of the MS signal is known. Instead of a *Trig. Slot Offset*, the actual timeslot number *(Meas. Slot)* can be used in *Signalling* mode.

P/t Multislot

The *P/t Multislot* measurement control softkey controls the *P/t Multislot* measurement. Two of the hotkeys associated to the *Multislot* softkey are different from the *Non Signalling* mode:

Slot Count

The hotkey *Slot Count* defines an integer number of timeslots to be measured. The actual measured time range is larger than the integer number of slots because it comprises an additional display margin; for details see remote control command description. The *Meas. Slot* hotkey defines the position of the measurement range within the TDMA frame*;* see *Fig. 4-86* on p. 4.210*.*

The display range is adapted to the *Slot Count* settings by default but can be modified by means of the *Display Marker – Time Scale* and *Display Marker – Default Scale* hotkeys. Changing the *Slot Count* overrides the *Time Scale* settings and restores the default display range.

Remote control
`CONFigure:POWer:MSLot:SCOunt`

Meas Slot

The hotkey *Meas. Slot* determines the timeslot that is measured in all Multislot configurations. In the graphical display, this measured timeslot is marked by Meas. Slot.

Meas. Slot is a general parameter that is valid for all measurement groups and also provided in the *Analyzer* tab of the *Connection Control* menu. For more information see p. 4.210.

Remote control
`CONFigure:MCONtrol:MSLot:MESLot`

c) P/Frame, P/Slot Graph, P/Slot Table

The settings accessible via the measurement control softkey, the *Application, Analyzer Level, MS Signal, and BS Signal* softkey are identical with those of application *P/t Normal GMSK*, see above. The *Marker/Display* softkey is not needed.

d) P/PCL

The settings of the *Application, Analyzer Level*, and *BS Signal* softkey are identical with those of application *P/t Normal GMSK*, see above. In application P/PCL, the *P/PCL – Channel Count* and the *MS Signal* softkey are used for channel selection.

P/PCL

The *P/PCL* softkey controls the power measurement and indicates its status (RUN | HLT | OFF).

Channel Count

The *Channel Count* hotkey determines whether the P/PCL measurement is performed on 3 or 7 different GSM channels. If only 3 channels are selected, the P/PCL measurement is faster; the last four columns in the output table of the *Power* menu are suppressed.

Remote control
`CONFigure:POWer:PCL:CCOunt C3 | C7`

MS Signal

The *MS Signal* softkey defines seven channels for the P/PCL measurement.

1st Chan

The *1st Chan* hotkey defines the first GSM channel to be measured. For a list of GSM channels refer to the tables in section *Control of Input and Output Signals* (p. *4.82* ff; the analyzed channels are uplink channels).

Remote control
`CONFigure:POWer:PCL:CHANnel <Channel1>,...,<Channeln>`

BS Signal

The *BS Signal* softkey controls the traffic channel signal transmitted by the CMU. See also section *RF Signals of the CMU (Connection Control – BS Signal)* on p. 4.184 ff.

Main Timeslot

The *Main Timeslot* hotkey determines the timeslot that the MS and the BS/CMU use for signalling. The main timeslot can not be switched off in both the downlink and uplink.

This hotkey is available only if the mobile station is set to multislot mode (see *Slot Mode* softkey on p. 4.177).

Remote control
`PROCedure:SIGNalling[:CSWitched][:TCH]:MSLot:MTIMeslot`
`CONFigure:BSSignal[:CSWitched][:TCH]:MSLot:MTIMeslot`

The remaining hotkeys select the second up to the 7th channel, respectively.

Measurement Results

The measurement results depend on the application selected.

a) P/t Normal GMSK

The results displayed in the measurement menu *Power*, application *P/t Normal GMSK,* can be divided into three groups:

- Settings
- Scalar measurement results (single values)
- Arrays (the measurement curve plotted as a function of time)

The measurement results are indicated in two parameter lines, the test diagram and an info box:

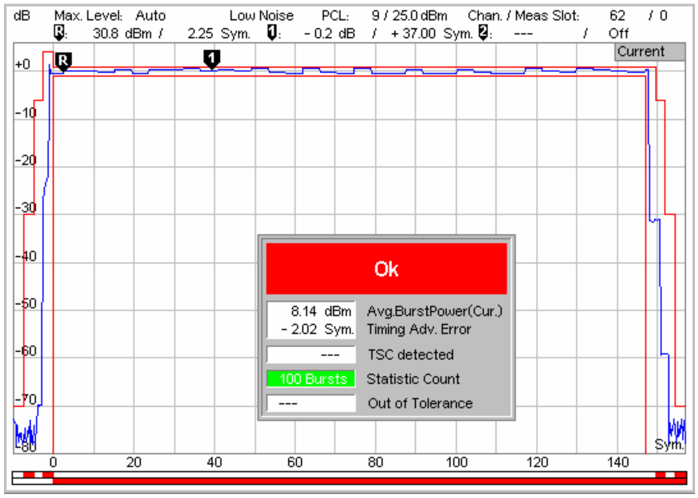


Fig. 4-50 Display of measurement results (P/t Normal GMSK menu)

Settings/ scalar results

Scalar measurement results and settings are indicated in the two parameter lines above the test diagram and in the info box, a popup window in the middle of the graphical screen *Power*.

1st parameter line

The first parameter line contains the following settings:

Max. Level	Maximum input level as set in *Input Level – Max. Level* (p. 4.209)
Attenuation	Setting for the attenuation of the input level *(Normal, Low Noise, Low Distortion)*
PCL	Power control level and corresponding output power of mobile
Chan./Meas. Slot	RF channel and measured slot; see *Meas. Slot* softkey on p. 4.210

2nd parameter line

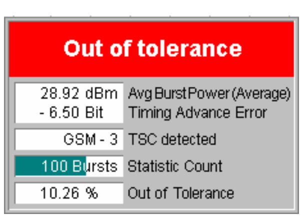
The second parameter line contains the following marker values:

 Level and time of reference marker

 Level and time of delta marker 1 (setting *absolute*) and/or difference from reference marker (setting *relative*)

 Level and time of delta marker 2 (setting *absolute*) and/or difference from reference marker (setting *relative*)

Info box



The info box contains the following settings:

Statistic Count	Number of bursts per measurement cycle.

In addition, it indicates the results for the scalar measured values:

Avg. Burst Power	Average burst power, depending on the display mode set (see upper right corner of the diagram).
Timing Adv.	Error due to timing advance in symbols. This measured value replaces the setting value *Symbol Offset (or Timing Offset)* in *Non Signalling* mode. See also section *Measurement Results* on page 4.130.

TSC detected	Training sequence of the measured RF signal.
Out of Limit	Relative number of measured bursts that are out of the tolerances defined by the limit lines.
Burst Matching	Error message if the displayed curve is out of tolerance.

Remote control
Settings are read out using the query corresponding to the setting command (setting command with appended question mark).

For scalar measurement results:
```
READ[:SCALar]:POWer[:NORMal][:GMSK]?
CALCulate:POWer[:NORMal][:GMSK]:LIMit:MATChing?
FETCh[:SCALar]:POWer[:NORMal][:GMSK]?
SAMPle[:SCALar]:POWer[:NORMal][:GMSK]?
```

Measurement curves (arrays)

The measurement result is displayed as a continuous measurement curve in the test diagram together with the limit lines, markers, and the D-line, if defined. The curve is derived from 668 equidistant measurement points with a ¼ symbol spacing covering a time range between –10 symbols and 156 ¾ symbols.

The measurement curve in the *Power* measurement menu shows the measured burst power (in dB) as a function of time (in symbol periods). The displayed result depends on the test settings. The display mode for the measurement curve *(Minimum, Maximum, Average, Current)* is indicated in the upper right corner of the diagram.

The scale of both axes can be changed via the *Display Area* hotkey.

Remote control
```
READ:ARRay:POWer[:NORMal][:GMSK]...?
READ:ARRay:POWer[:NORMal][:GMSK]:LIMit:MATChing:...?
FETCh:ARRay:POWer[:NORMal][:GMSK]...?
SAMPle:ARRay:POWer[:NORMal][:GMSK]...?
```

Limit Check

The result of the limit check is visualized in two colored bars below the diagram. In each area of the burst, the upper (lower) bar turns red if the result exceeds (falls below) the power/time template defined in the *Limit Lines* tab of the *Power Configuration* menu.

Note: Limit check for multislot configurations

In the P/t Normal... applications it is possible to analyze the MS signal in a single timeslot, irrespective of the DUT's multislot configuration. The CMU uses the tolerance template according to the measurement application.

The single slot template (see section Limit Lines *on page 4.35 ff.) can cause ambiguities if the MS also transmits on one of the timeslots adjacent to the measured slot. The multislot template doesn't specify the burst edges in the guard period between two active timeslots, so the single slot limit check may erroneously indicate an excess signal level. To avoid any misleading results the upper limit check in the* P/t Normal... *applications is disabled for MS multislot configurations with adjacent active timeslots (Signalling mode only). The info box shows invalid results "---".*

Remote control
```
CALCulate[:SCALar]:POWer[:NORMal][:GMSK]:LIMit:MATChing...?
```

b) P/t Normal 8PSK

As shown in *Fig. 4-51* below, the *P/t Normal 8PSK* measurement results are similar to the *P/t Normal GMSK* results. The x-axis scale of both diagrams is equal because 8PSK and GMSK symbol periods are of equal length. The following differences occur:

- The default limit lines differ from the GMSK limit lines.

See explanation of GSM burst structure and power/time templates in section *Limit lines (Power Configuration – Limit Lines)* on page *4.35* ff.

Parameter line 1, 2

Test diagram

Info box

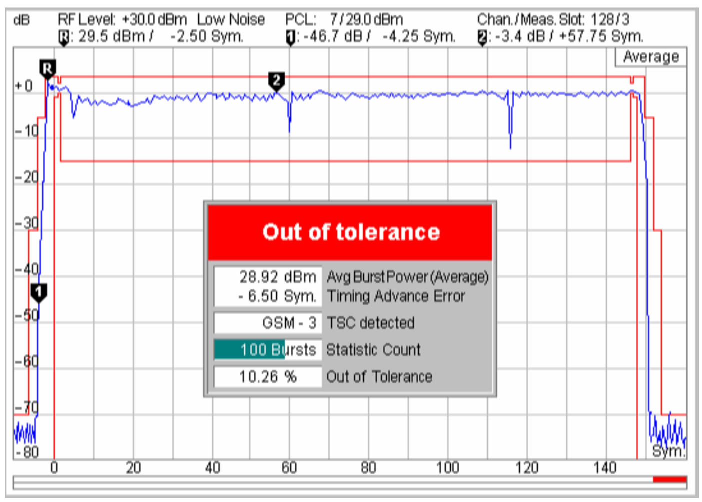


Fig. 4-51 Display of results (Power – P/t Norm. 8PSK)

c) P/t Multislot

As shown in *Fig. 4-52* below, the *P/t Multislot* measurement results are analogous to the corresponding *Non Signalling* mode results; see section Measurement Results on page *4.20* ff. The following differences occur:

- The first parameter line indicates the PCL of the mobile phone under test instead of the *Frequency Offset* of the RF input signal.
- The actual TDMA timeslot *(Meas. Slot)* replaces the *Trig. Slot Offset;* see section *P/t Multislot* on p. *4.117*.

Note: *In an EGPRS test mode connection, it is possible to measure and display GMSK and 8PSK modulated bursts simultaneously. A measurement example is reported in Chapter 2; section* Multislot Measurement with Mixed Modulation Schemes.

In a packet data connection (with option R&S CMU_K42/-K43), the P/t Multislot *measurement can be used to analyze access bursts that the MS transmits periodically while a connection is established; see Chapter 2; section* Continuous Access Burst Measurement.

Parameter line 1, 2

Test diagram

Info boxes

Limit Check

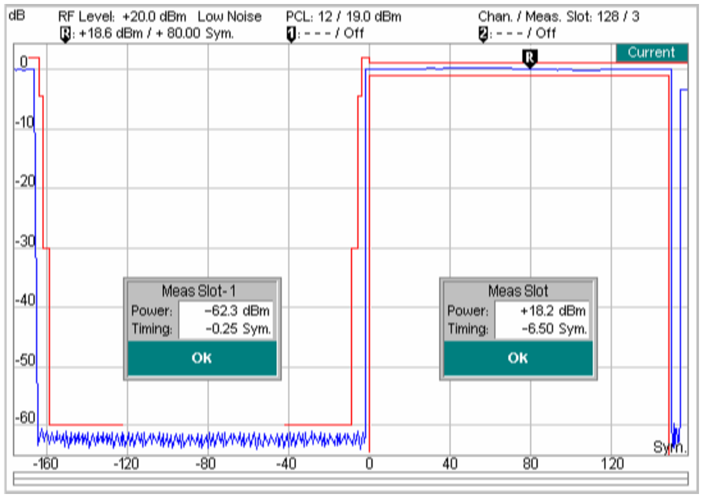


Fig. 4-52 Display of results (Power – P/t Multislot)

d) P/Frame, P/Slot Graph, P/Slot Table

The results displayed in the measurement menu *Power*, applications *P/Frame, P/Slot Graph,* and *P/Slot Table* are analogous to the corresponding *Non Signalling* mode results; see section Measurement Results on page *4.20* ff. In *Signalling* mode, the PCL of the mobile phone under test is indicated in the parameter line instead of the *Frequency Offset* of the RF input signal.

In *Signalling* mode, the burst timing and the numbering of the timeslots within a TDMA frame is known. Therefore, the *P/Slot Graph* menu always shows a full TDMA frame (slot 0 to 7); the first timeslot doesn't have to be determined with a trigger condition. In the *P/Slot Table* application, the first timeslot displayed corresponds to the beginning (slot 0) of a TDMA frame. In the *P/Slot Frame* application, the used timeslot in all consecutive TDMA frames is displayed.

e) P/PCL

The measurement menu *Power*, application *P/PCL,* contains a table of all measured average burst powers.

PCL/Channel	1st 1	2nd 32	3rd 64	4th 96	5th 124	6th 955	7th 1023
5 (33.0 dBm)	33.2	33.2	33.0	33.0	33.1	33.2	33.1
6 (31.0 dBm)	31.5	31.5	31.4	31.4	31.6	31.5	31.6
7 (29.0 dBm)	29.7	29.7	29.7	29.7	29.6	29.7	29.6
8 (27.0 dBm)	28.0	28.0	27.3	27.3	27.2	28.0	27.2
9 (25.0 dBm)	25.9	25.9	25.8	25.8	25.7	25.9	25.7
10 (23.0 dBm)	23.8	23.8	23.7	23.7	23.6	23.8	23.6
11 (21.0 dBm)	21.5	21.5	21.6	21.6	21.4	21.5	21.4
12 (19.0 dBm)	19.7	19.7	19.5	19.5	17.5	19.7	17.5
13 (17.0 dBm)	17.5	17.5	17.3	17.3	17.3	17.5	17.3
14 (15.0 dBm)	15.2	15.2	15.3	15.3	15.3	15.2	15.3
15 (13.0 dBm)	13.5	13.5	13.7	13.7	13.7	13.5	13.7
16 (11.0 dBm)	11.5	11.5	11.7	11.7	11.7	11.5	11.7
17 (9.0 dBm)	9.2	9.2	9.0	9.0	9.1	9.2	9.1

all results in dBm

Fig. 4-53 Display of measurement results (P/PCL menu)

PCL/Channel

The *PCL/Channel* table contains the average burst power for all PCLs supported by the mobile, starting with the maximum output power (lowest PCL) and in the three or seven channels selected via the *Channel* softkey. If the tolerance value defined in the *Limits* card of the *Power Configuration* menu (see section *Limit Lines (Power Configuration – Limit Lines)* on p. 4.127 ff) is violated, the result is shown on a red background.

If more than 16 different PCLs are supported, the table contains a scrollbar.

Remote control

```
READ[:SCALar]:POWer:PCL?
CALCulate:POWer:PCL:LIMit:MATChing?
FETCh[:SCALar]:POWer:PCL?
SAMPle[:SCALar]:POWer:PCL?
```

f) P/t Access Burst

The results displayed in the measurement menu *Power*, application *P/t Access Burst,* can be divided into three groups:

- Settings
- Scalar measurement results (single values)
- Arrays (the measurement curve plotted as a function of time)

The measurement results are indicated in two parameter lines, the test diagram and an info box:

Parameter line 1 / 2

Test diagram

Info box

Fig. 4-54 Display of measurement results (P/t Access Burst menu)

Settings/ scalar results

Scalar measurement results and settings are indicated in the two parameter lines above the test diagram and in the info box, a popup window in the middle of the graphical screen *Power*.

1st parameter line

The first parameter line contains the following settings:

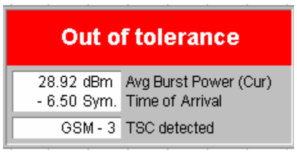
RF Level	Maximum input level as set in *Input Level – Max. Level* (p. 4.209)
Attenuation	Setting for the attenuation of the input level *(Normal, Low Noise, Low Distortion)*
PCL	Power control level and corresponding output power of mobile
Chan./Slot	RF channel and measured timeslot numbert; see *Meas. Slot* softkey on p. 4.210

2nd parameter line

The second parameter line contains the following marker values:

R	Level and time of reference marker
1	Level and time of delta marker 1 (setting *absolute*) and/or difference from reference marker (setting *relative*)
2	Level and time of delta marker 2 (setting *absolute*) and/or difference from reference marker (setting *relative*)

Info box



The info box indicates the results for the scalar measured values:

Avg. Burst Power Average burst power, depending on the display mode set (see upper right corner of the diagram).

Time of Arrival Time offset (in symbol periods) between the expected and the measured timing of the current burst from the mobile. Like in a real GSM network, the timing advance of the mobile is assumed to be unknown and the expected timing is in line with the timing of the BS signal. See also definition of the *Timing Advance Error* in section *Measurement Results* on page 4.130.

TSC detected Training sequence of the measured RF signal.

Remote control
Settings are read out using the query corresponding to the setting command (setting command with appended question mark).

For scalar measurement results:

```
READ[:SCALar]:POWer:ABURst[:GMSK]?
CALCulate:POWer:ABURst[:GMSK]:LIMit:MATChing?
FETCh[:SCALar]:POWer:ABURst[:GMSK]?
SAMPle[:SCALar]:POWer:ABURst[:GMSK]?
```

Measurement curves (arrays)

The measurement result is displayed as a continuous measurement curve in the test diagram together with the limit lines, markers, and the D-line, if defined. The curve is derived from 428 equidistant measurement points with a ¼ spacing covering a time range between –10 symbols and 96 ¾ symbols.

The measurement curve in the *Power* measurement menu shows the measured burst power (in dB) as a function of time (in symbol periods). The displayed result depends on the test settings. The display mode for the measurement curve *(Minimum, Maximum, Average, Current)* is indicated in the upper right corner of the diagram.

The scale of both axes can be changed via the *Display Area* hotkey.

Remote control

```
READ:ARRay:POWer:ABURst[:GMSK]...?
READ:ARRay:POWer:ABURst[:GMSK]:LIMit:MATChing:...?
FETCh:ARRay:POWer:ABURst[:GMSK]...?
SAMPle:ARRay:POWer:ABURst[:GMSK]...?
```

Measurement Configurations (Power Configuration)

The popup menu *Power Configuration* contains three tabs to determine the parameters controlling the power measurement including the tolerance limits.

The popup menu *Power Configuration* is activated by pressing the measurement control softkey at the top right in the graphical measurement menu *Power* twice. It is possible to change between the tabs by pressing the associated hotkeys.

Measurement Control (Power Configuration – Control)

The *Control* tab controls the power measurement by determining

- The *Repetition* mode
- The *Stop Condition* for the measurement (for burst power vs. time measurements only)
- The type of measurement curve displayed *(Display Mode,* for burst power vs. time measurements only)
- The number of bursts/evaluation periods forming a statistics cycle (for burst power vs. time measurements only)
- The measurement *Filter* for *P/t Normal GMSK, P/t Normal 8PSK* and *P/t Multislot* measurements
- The averaging prescription to obtain the reference power *(Ref. Power Mode*, for *8PSK* measurements only)
- The *Timing Offset*, the expected modulation *(Modulation View)* and the number of slots measured *(Slot Count)* in the *P/t Multislot* application
- The number of timeslots measured *(Slot Count)* in the *P/Slot Table* application
- The number of RF channels measured and their GSM channel numbers *(Channel Count, Meas. Channels*, for *P/PCL* measurements only)

Besides, it influences the graphical diagrams by adding or removing the *Info Box* or the *Grid.*

All settings can be defined separately for the individual applications *P/t Normal GMSK, P/t Normal 8PSK, P/t Multislot, P/Frame, P/Slot Graph, P/Slot Table,* and *P/PCL*. They are described in the section *GSMxxx-MS Non Signalling* on page *4.29* ff. The setting of the P/PCL channels is analogous to the setting via the *Channel* softkey; see section *P/PCL* on page 4.118.

Note: *There is no mode where the mobile transmits access bursts in consecutive TDMA frames. As a consequence, in the* P/t Access GMSK *application, only one access burst can be measured (single shot mode) when the mobile attempts a location update (activate the application before performing a location update). See also explanations at the beginning of section Power Measurements on page* 4.112*.*

Limit Lines (Power Configuration – Limit Lines)

The *Limit Lines* tab defines the limit lines for the burst analysis (applications *P/t Normal GMSK* and *P/t Access Burst*). Limit lines are a graphical tool for defining and monitoring tolerance values. The tab provides:

- An overview of the default limit lines and areas *(Area Info)*
- Definition of the limit lines for the normal bursts section by section *(Upper Limit Line/Lower Limit Line*

The functions of this menu are described in the section *GSMxxx-MS Non Signalling* on page *4.35* ff. In contrast to the *Non Signalling* mode, the *dynamic limit line correction* depends on the actual PCL of the mobile phone. No auxiliary parameter like the fictitious *Template PCL* is defined.

The limit lines for access bursts are defined in analogy to the limit lines for normal bursts. In the remote control commands, the keyword `[:NORMal]` is to be replaced by `:ABURst`.

Limit Values for Average Burst Power (Power Configuration – Limits)

The *Limits* tab defines tolerance limits for the average burst power depending on the power control level of the mobile phone *(PCL)*. The limits apply to all applications of the *Power* menu providing a limit check (not to *P/Frame, P/Slot Graph* and *P/Slot Table)*.

GSM mobile phones are divided into different power classes according to their maximum output power:

Table 4-7 GSM Power classes

Power class	Nominal maximum output power in dBm		
	GSM400 GSM GT800 GSM850 GSM900	GSM1800	GSM1900
1	–	30	30
2	39	24	24
3	37	36	33
4	33		
5	29		

Besides, a dimensionless scale of power control levels *(PCL)* is determined for dynamic control of the mobile power:

Table 4-8 GSM Power control levels (PCL)

Power control level, PCL	Nominal output power in dBm		
	GSM400/ GSM GT800 GSM850/ GSM900	GSM1800	GSM1900
0	39	30	30
1	39	28	28
2	39	26	26
3	37	24	24
4	35	22	22
5	33	20	20
6	31	18	18
7	29	16	16
8	27	14	14
9	25	12	12
10	23	10	10
11	21	8	8
12	19	6	6
13	17	4	4
14	15	2	2
15	13	0	0
16	11	0	0
17	9	0	0
18	7	0	0
19 - 28	5	0	0
29	5	36	36
30	5	34	33
31	5	32	32
	PCL 16 to 31 for phase 2 only	PCL 11 to 15, 29 to 31 for phase 2 only	PCL 11 to 15, 29 to 31 for phase 2 only

Besides, tolerance values are specified for all output powers under various conditions. Power control permits to force the mobile power below the maximum value corresponding to its power class.

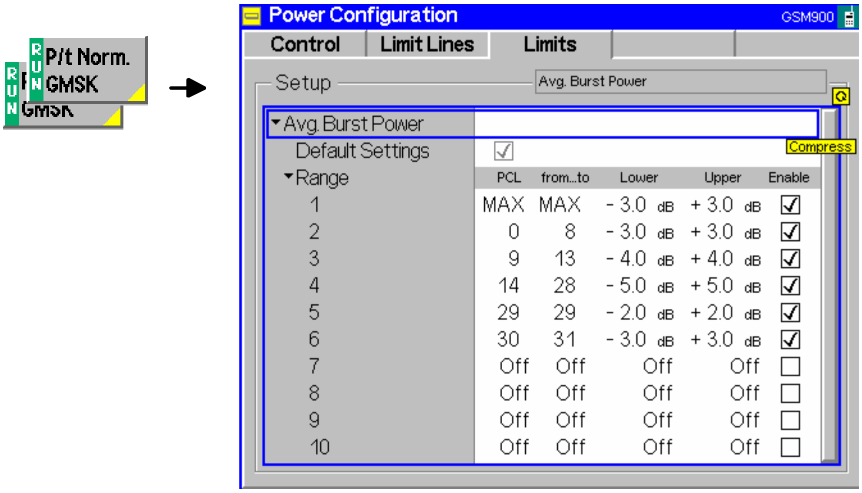


Fig. 4-55 Power Configuration – Limits

Default Settings The *Default Settings* switch overwrites all settings of the *Limits* tab with default values.

Average Burst Power The table *Average Burst Power* defines a tolerance band for the average burst power. Matching of the tolerances is checked for each burst measured.

The limit values are defined relative to the nominal output power corresponding to the mobile's power control level (see *Table 4-8*). An upper and lower limit can be defined for up to 10 arbitrary, continuous ranges of PCLs. In contrast to the modulation measurement, these power limits may also be asymmetrical (i.e. not of the same magnitude). The table contains the following columns:

Range	Current range number
PCL:from	Initial PCL in the range 0 to 31, MAX
... to	Final PCL in the range (greater or equal to the initial PCL)
Lower	Lower level limit relative to nominal output power
Upper	Upper level limit relative to nominal output power
Enable	Enable (box checked) or disable the limit check in the current range

If the initial PCL coincides with the final PCL, the range consists of one power control level only. Unused ranges are marked by the entries *Off*. The entry *MAX* refers to the maximum PCL of the mobile phone according to its power class.

Remote control

```
CONFigure:Power[:NORMal][:GMSK]:LIMit:ABPower<nr>[:ENABle] ON
| OFF
CONFigure:Power[:NORMal][:GMSK]:LIMit:ABPower<nr>
         <StartPCL>,<StopPCL>,<LowerLimit>,<UpperLimit>
```

Modulation Measurements

The menu group *Modulation* contains the functions for measurement of the modulation parameters of the RF signal transmitted by the mobile phone. The popup menu *Modulation Configuration* is used for configuration of the measurements; the measurement results are displayed in the graphical measurement menu *Modulation*.

Apart from few exceptions, the menu group *Modulation* does not differ from its corresponding menu group in the measurement mode *GSM400/GT800/850/900/1800/1900-MS Non Signalling* (see p. *4.42* ff.):

1. The hotkey *Meas. Slot* determines the timeslot that is measured in all *Multislot* configurations. In the graphical display, this measured timeslot is marked by *Meas. Slot*. *Meas. Slot* is a general parameter that is valid for all measurement groups and also provided in the *Analyzer* tab of the *Connection Control* menu. For more information see p. 4.210.
2. In addition to the maximum input level, the attenuation and the RF channel, the first parameter line also contains the power control level (PCL) of the mobile. The PCL can be set via the *PCL/Channel* softkey and can be used to define the input level *(Input Level* softkey).
3. The trigger sources *Signalling, Free Run, RF Power,* and *IF Power* are available. This means that the measurement is triggered by the signal from the CMU's signalling unit or the mobile phone; triggering by an additional external signal (parameter *External)* is not possible.

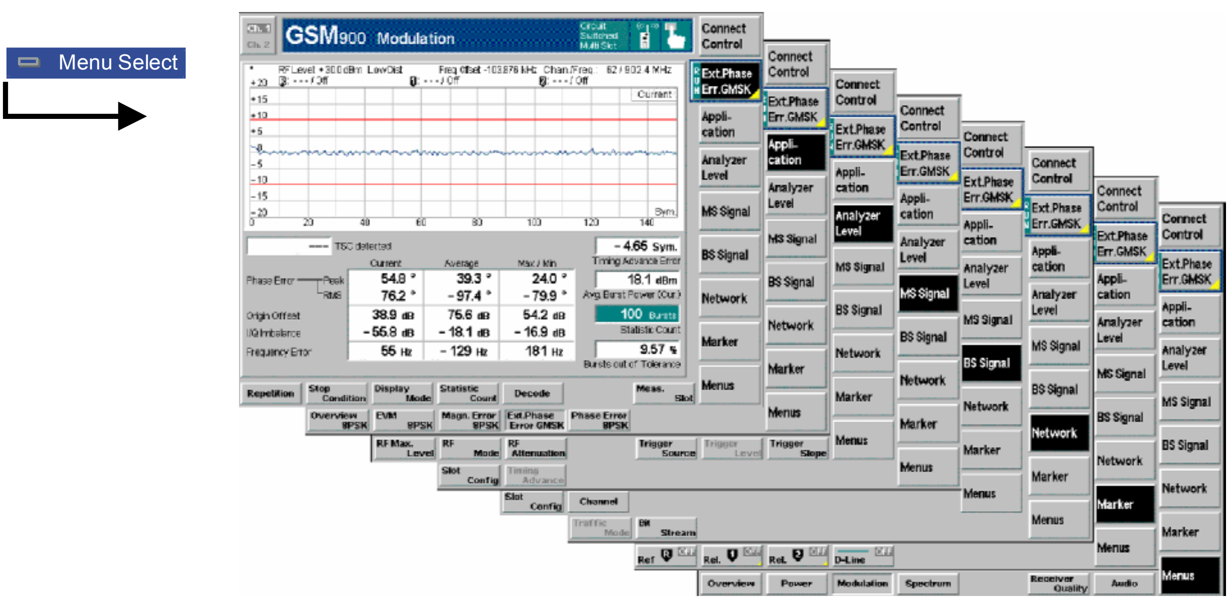


Fig. 4-56 Measurement menu Modulation

Test Settings

The selections and test settings provided by the *Ext. Phase Err. GMSK, Analyzer Level,* and Marker/Display softkeys are identical with those in the *Non Signalling* mode (see section *Test Settings* on page *4.43* ff). The *MS Signal, BS Signal* and *Network* softkeys and the *Meas. Slot* hotkey are equal to the softkeys of the same name in the *Power* menu (see page 4.113 ff).

Measurement Results

The values shown in the measurement menu *Modulation* can be divided into three groups:

- Setting values
- Scalar measurement results (single values)
- Arrays (the measurement curve plotted as a function of time)

The values are indicated in two parameter lines, the test diagram and a tabular overview below:

Parameter line 1 | 2

Test diagram

Output table

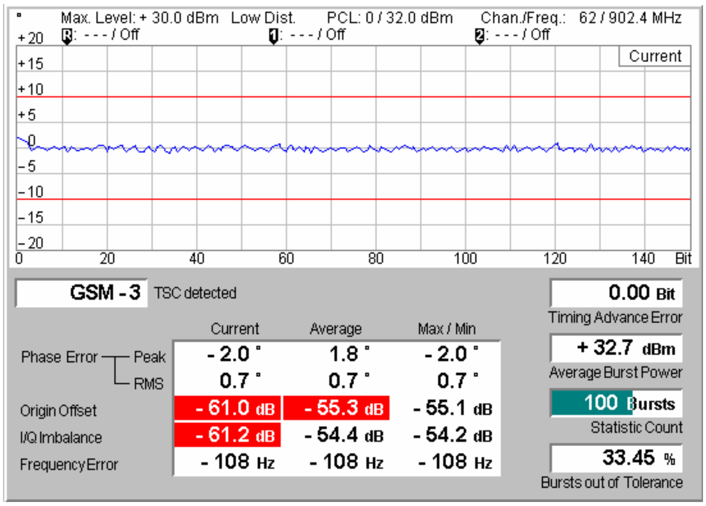


Fig. 4-57 Display of results (modulation menu)

In contrast to the *Non Signalling* mode (see p. 4.45 ff.) the first parameter line contains also the PCL of the mobile station, and the *Timing Advance Error* is indicated. Besides the representation and interpretation of the results are identical.

Timing Advance Error

The *Timing Advance Error* output field, which is displayed in the right-hand output field of the *Modulation* measurement menu, indicates the time offset (in symbol periods) between the expected and the measured timing of the current burst. The expected timing results from the timing of the BS signal and the (known) timing advance of the mobile station. This result is also available in packet data mode (with option R&S CMU-K42 or R&S CMU-K43).

The *Timing Advance Error* can be determined with trigger mode *Signalling* only; see description of the *Trigger* tab starting on p. 4.205.

Measurement Configurations (Modulation Configuration)

The popup menu *Modulation Configuration* contains two tabs which define the parameters of the phase and frequency error measurement including the error tolerances.

The popup menu *Modulation Configuration* is activated by pressing the softkey *Phase/Err. GMSK* in the top right of the graphical measurement menu *Modulation* twice. By pressing the associated hotkeys, it is possible to change between the tabs.

The functions of the *Modulation Configuration* menus are described in section *GSM400/GT800/850/900/1800/1900-MS Non Signalling*, see p. 4.57 ff.

Spectrum Measurements

The menu group *Spectrum* contains the functions for measurement of the off-carrier power, which is due to the modulation and the bursty nature of the RF signal. The popup menu *Spectrum Configuration* is used for configuration of the measurements; the measurement results are displayed in the graphical measurement menus *Spectrum*.

Apart from few exceptions, the menu group *Spectrum* does not differ from its corresponding menu group in the measurement mode *GSM400/GT800/850/900/1800/1900-MS Non Signalling* (see p. 4.42 ff.):

1. The hotkey *Meas. Slot* determines the timeslot that is measured in all *Multislot* configurations. This timeslot is also used to measure the carrier output power and derive the tolerance template if a spectrum due to *Switching* measurement is performed in multislot mode. The *Meas. Slot* is equal to the *Main Timeslot* by default but can be changed, e.g. in order to select the highest MS output power as a reference for the tolerance template.

   In the graphical display, this measured timeslot is marked by *Meas. Slot*. *Meas. Slot* is a general parameter that is valid for all measurement groups and also provided in the *Analyzer* tab of the *Connection Control* menu. For more information see p. 4.210.

2. In addition to the maximum input level, the attenuation, and the RF channel, the first parameter line also indicates the timeslot number of the base station signal. The PCL can be set via the *PCL/Channel* softkey and can be used to define the input level *(Input Level* softkey).

3. The trigger sources *Signalling, RF Power,* and *IF Power* are available. This means that the measurement is triggered by the signal from the CMU's signalling unit or the mobile phone; triggering by an additional external signal (parameter *External)* is not possible. In *Free Run* trigger mode (see section *Trigger (Connection Control – Trigger)* on p. 4.205 ff.), the CMU does not detect the burst edges of the measured RF signal. This mode is unsuitable for spectrum due to *Switching* measurements but can be used for spectrum due to *Modulation* measurements on continuous signals.

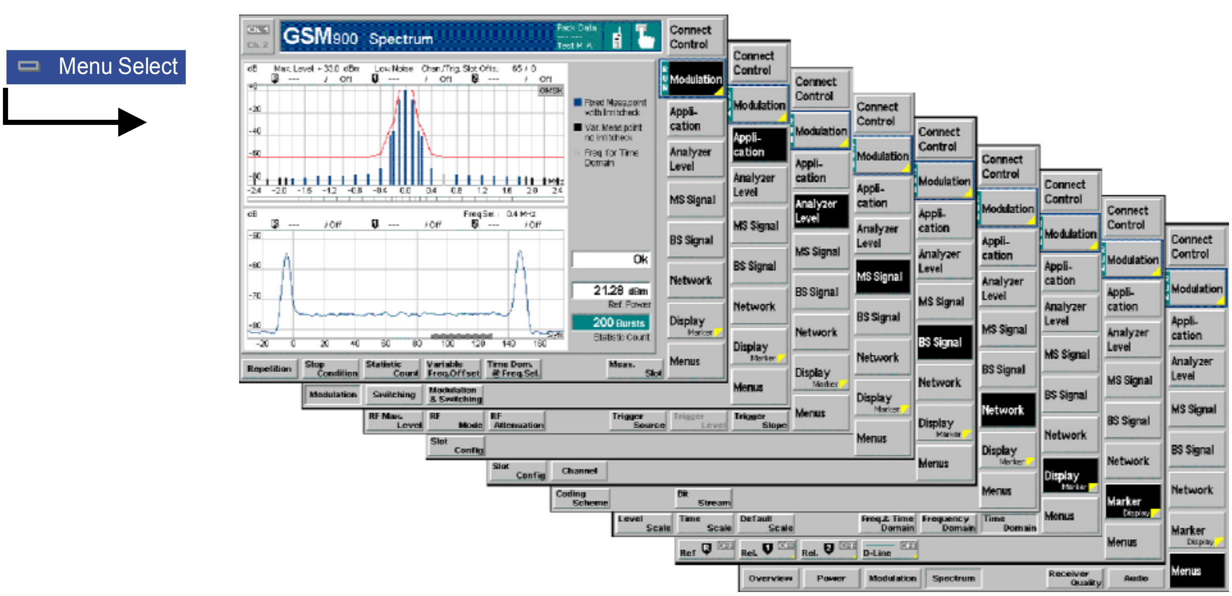


Fig. 4-58 Measurement menu Spectrum (application Modulation)

Test Settings

The selections and test settings provided by the *Modulation, Analyzer Level,* and Marker/Display softkeys are identical with those in the *Non Signalling* mode (see section *Test Settings* on page *4.43* ff).

The *MS Signal, BS Signal* and *Network* softkeys and the *Meas. Slot* hotkey are equal to the softkeys of the same name in the *Power* menu (see page 4.113 ff).

Measurement Results

The *Spectrum* measurement menu and the results depend on the type of spectrum (application *Modulation, Switching,* or *Modulation & Switching*) selected.

In contrast to the *Non Signalling* mode (see p. *4.45* ff.) the first parameter line also contains the PCL of the mobile. Besides, the interpretation of the results is identical.

Measurement Configurations (Spectrum Configuration)

The popup menu *Spectrum Configuration* contains three tabs which define the parameters of the spectrum measurement including the error tolerances.

The popup menu *Spectrum Configuration* is activated by pressing the measurement control softkey in the top right of the graphical measurement menu *Spectrum* twice (this softkey reads *Modulation, Switching* or *Modulation & Switching*, depending on the selected application). By pressing the associated hotkeys, it is possible to change between the tabs.

The functions of the *Spectrum Configuration* menu are described in section *GSM400/GT800/850/900/1800/1900-MS Non Signalling*, see p. *4.57* ff. The *Control* tab of the *Spectrum Configuration* menu provides the following additional trigger modes:

Trigger Mode The *Trigger Mode* selects the burst type for a spectrum measurement on EGPRS packet data channels.

Normal All frames except the ones that contain CTRL_ACK information elements are measured. Most of the bursts in these frames are 8PSK-modulated normal bursts.

Ctrl. Acks Main Slot Only frames with main slot bursts that carry CTRL_ACK information elements are measured. Depending on the *Control ACK Type* parameter (see p. 4.229) the bursts are either GMSK-modulated normal bursts or access bursts.

Ctrl. Acks other Slots Only frames with bursts in other slots that carry CTRL_ACK information elements are measured.

The R&S CMU uses the *Ctrl. Acks trigger* to separate the burst types for the *Spectrum* measurement; see p. 4.208 ff. The limit lines can be adjusted to the burst type using the *Limit Selection* parameter in the *Limits* tab of the *Spectrum Configuration* menu.

Remote control
```
CONFigure:SPECtrum:TMODe NORM | CAMS | CAOS
```

Receiver Quality Measurements

The menu group *Receiver Quality* tests the transmission performance on the complete signal path from the CMU to the device under test (mobile station) and back. To this end the mobile is set to test loop operation where it returns the received data back to the tester. The measurement is especially suitable to assess the sensitivity of the mobile station receiver at low RF power levels.

The popup menu *Receiver Quality Configuration* is used for configuration of the measurements; the measurement results are directly indicated in the *Receiver Quality* menu.

The measurements in the menu group *Receiver Quality* assume that a call has been set up (signalling state *Call Established)*. This is why they are not available in the mode *GSM400/GT800/850/900/1800/1900-MS Non Signalling*.

Principle of the measurement

The *Receiver Quality* measurement is based on the comparison of the output signal sent by the CMU with the signal received (and possibly decoded) by the device under test.

To this end, the mobile station must either detect bit errors by itself and return the result or return the received signal to the CMU in loopback mode. Error detection by the mobile phone is used in the measurement of the Block Error Ratio (BLER); the loopback mode is used for all other receiver quality tests.

Due to the higher signal level, the transmission errors produced on the way back (from the mobile station to the CMU) can usually be neglected. However, frames destroyed on the way back are detected in a cyclic redundancy check (CRC) and counted. They are not taken into account in the calculation of transmission errors.

In most cases, a test SIM card is required for receiver quality measurements. The quality of the mobile station transmitter can be tested separately in the *Modulation* measurement.

Bit classes

In the GSM system, the speech coder combines the speech information into data blocks with a length of 260 bits (full rate version 1, for a detailed overview see tables in section *Frame Structure for Speech and Data Channels* on p. 4.139 ff.), the so-called frames. Within one speech frame, the bits are divided into bit classes:

- The 78 *class II bits* have no error protection which is why they quickly produce transmission errors.
- The 132 *class Ib bits* are partly protected against errors during channel coding (by added guard bits).

The 50 most important *class Ia bits* are well protected. The mobile phone recognizes erroneous *class Ia bits* and clears the complete frame if no correction is possible

Definition of measured quantities

The Bit Error Rate *(BER)* is the ratio of erroneous bits to the total number of transferred bits in percent (also referred to as samples in the operating mode *BER*). The CMU outputs the bit error rate according to bit classes:

BER = Erroneous bits / total number of bits * 100%

BER II = Erroneous class II bits / total number of class II bits * 100%

BER Ib = Erroneous class Ib bits / total number of class Ib bits * 100%

The Frame Erasure Rate *(FER)* is the ratio of frames recognized to be erroneous and erased by the mobile to the total number of transferred frames in percent:

FER = Erroneous frames / total number of frames * 100%

The Residual Bit Error Rate *(RBER)* characterizes the quality of transmission of the valid frames (not erased, therefore residual). It corresponds to the ratio of the erroneous bits to the total number of transferred bits in percent, the numerator and denominator referring only to the **valid frame** *(residual frames, RF)*:

RBER II = Erroneous class II bits (RF) / total number of class II bits (RF) * 100%

RBER Ib = Erroneous class Ib bits (RF) / total number of class Ib bits (RF) * 100%

The Block Error Ratio (BLER) is the ratio of blocks that the MS receives in error to the total number of received blocks, where a block is defined as received in error if the error detection functions in the receiver indicate an error as a the result of the Block Check Sequence (BCS, see GSM 11.10):

BLER = Blocks received in error / total number of blocks * 100%

The Data Block Error Rate (DBLER) is the ratio of data blocks that contain bit errors in their data field to the total number of transferred blocks in percent:

DBLER = Blocks with erroneous data fields / total number of blocks * 100%

The USF Block Error Rate (USF BLER) is the percentage of Uplink State Flags (USFs) in the (E)GPRS packet data blocks which are assigned to the MS but received in error so that the MS fails to start transmission:

USF BLER = Assigned USFs received in error / total number of blocks * 100%

The False USF Detection is the percentage of Uplink State Flags (USFs) in the (E)GPRS packet data blocks which are not assigned to the MS but received in error so that the MS nevertheless starts transmission:

False USF Detection
= Unassigned USFs received in error / total number of blocks * 100%

Statistical Testing

Bit error rate tests are based on the assumption of statistical independence of the single bit error events: The probability of a bit error is equal for each received bit. The exact bit error rate is given by the limit of the ratio <bit errors>/<no. of received bits>, where the number of received bits tends to infinity. As test times are limited, any real bit error rate test necessarily provides an approximation to the exact bit error rate.

The CMU is not only capable of measuring (approximate) bit error rates for a fixed number of received bits but can also use the preliminary results to predict a confidence interval for the exact bit error rate. Confidence BER tests can reduce test times considerably. For more information and application examples see section *Statistical BER Tests* on p. 4.141 ff.

RF Level Search

Instead of determining the receiver quality at definite RF signal levels the R&S CMU can perform repeated receiver quality tests at varying signal levels until a certain target bit error rate for unprotected (class II) bits is found or a stop condition is met. This search mode is activated by means of a stop condition *RF Level Search,* to be set in the *Control* tab of the *Receiver Quality Configuration* menu (see p. 4.160 f.).

BLER and BER/DBLER mode

The BLER and the BER/DBLER measurements assess the receiver quality for packet data traffic channels (PDTCHs) both in circuit switched or packet data mode. For a detailed explanation of these measurements see section *BER Tests of PDTCHs* on p. 4.135 f.

Note: *For circuit switched channels, the reduced signalling scheme (Signalling Channel* = NONE*, see p. 4.199) and one of the packet data coding schemes CS1 to CS4 or MCS1 to MCS9 must be used (see Traffic Mode* softkey *4.193).*

Packet switched data channels (GPRS and EGPRS channels) can be analyzed with option CMU-K42 and CMU-K43.

Burst by Burst mode (fast BER)

In the *Burst by Burst* mode, the CMU transmits only bits without error protection (class II bits); no guard bits are used. The internal test loop of the MS is closed before any channel decoding/encoding (see 3GPP TS 44.014 and *Fig. 4-59 below*), so the bit error rate is evaluated on a burst by burst basis. This increases the number of bits measured per unit of time and thus considerably enhances the measurement speed.

Note: *The* Burst by Burst *bit error rate test is specified for GSM phase II and phase II+ mobiles. Not all mobiles support this test mode. If a mobile* *does not support the* Burst by Burst *bit error rate test, the measurement fails (like for very low signal levels) and an error message is generated:*

Too many errors. Measurement halted !

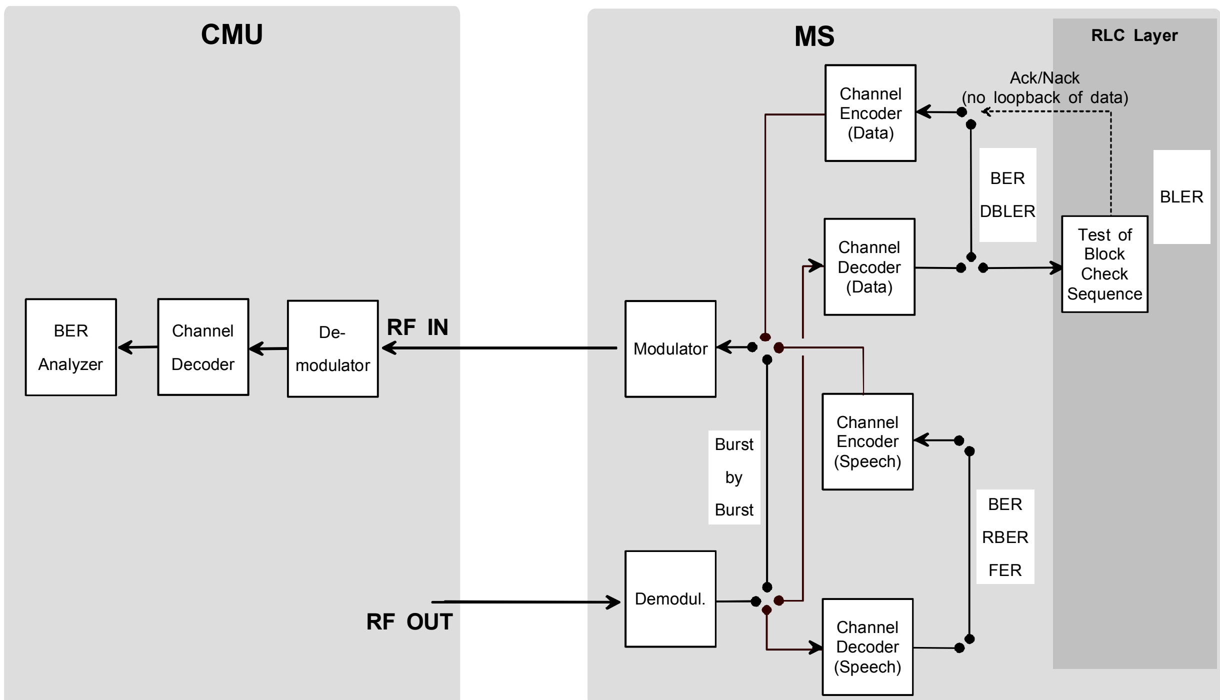


Fig. 4-59 Signal paths for BER measurements

Measured Timeslot

In contrast to TX tests, no distinction is made between the *Main Timeslot* that is used for signalling and the *Meas. Timeslot*. *Receiver Quality* measurements are performed on the *Main Timeslot* selected via the *MS Signal – Slot Config.* hotkey. In the BLER measurement, the MS evaluates the Block Error Ratio on all receive timeslots The result is calculated from the signalling messages returned in the UL *Main Timeslot*.

BER Tests of PDTCHs: BLER and DBLER

According to the conformance specification GSM 11.10 GPRS receiver tests consist of assessing the ratio of blocks received in error to the total number of received blocks (Block Error Ratio, BLER). The CMU provides the standard BLER for GPRS channels. As an alternative, the Data Block Error Rate (DBLER) can be measured for a wide range of packet switched data traffic channels (PDTCHs) and test setups. BLER and DBLER tests are performed on the traffic channel with a connection between the CMU and the mobile station, i.e. the CMU must be in the *Call Established* or in the *TBF Established* state.

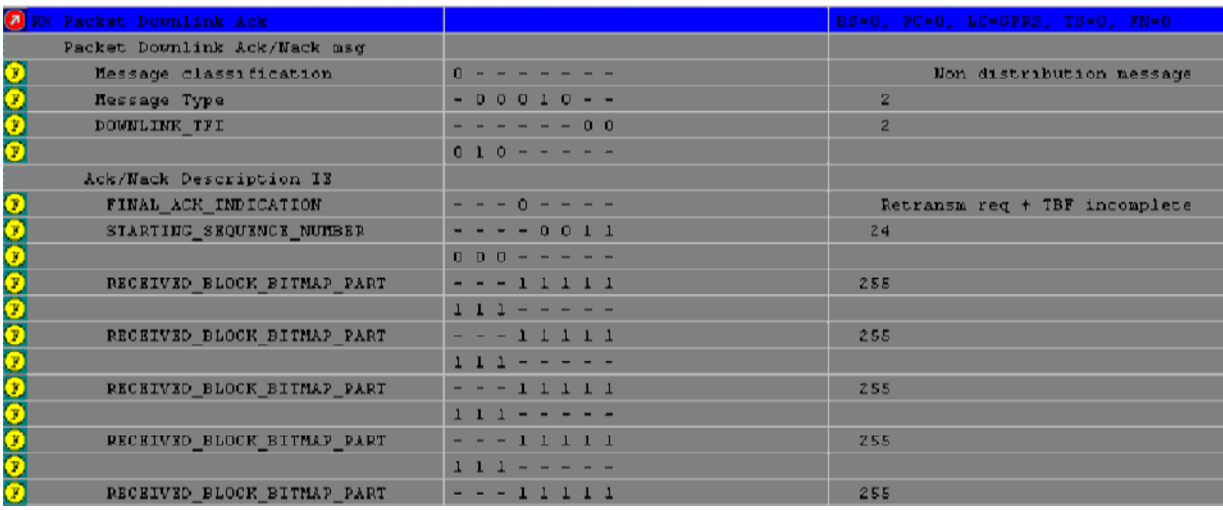
BLER measurement

To evaluate the standard BLER the CMU transmits RLC blocks in different timeslots. The DUT receives the blocks and checks the Block Check Sequence (BCS). If the BCS indicates an error, sends a Packet Not Acknowledge in the *Packet Downlink Ack/Nack* message (see Fig. 4-59 above).

The CMU is capable of simultaneously transmitting RLC blocks in up to 4 DL timeslots (see *Slot Configuration Editor* on p. 4.180) and evaluating the BLER in up to 4 receive slots of the DUT. A Universal Signalling Unit R&S CMU-B21 V14 is required to generate EGPRS channels in 4 DL timeslots (with R&S CMU-B21, only 2 DL timeslots are available).

Message viewing

The *Packet Downlink Ack/Nack* messages received from the mobile are included in the message log files that the R&S CMU generates if buffer writing is enabled (see *DATA – Logging* tab). Log files can be analyzed using the *Message Viewer* (accessory R&S CMU-Z49). For more information refer to the R&S CMU200/300 operating manual and to the *Message Viewer* documentation.



Optimizing the BLER measurement

The number of timeslots that can be evaluated simultaneously is limited by the multislot capabilities of the DUT but also depends on some CMU settings. To obtain maximum flexibility in the BLER measurement, check the following settings:

- To ensure that the CMU can send RLC blocks in several (up to 4) timeslots set the *B52 Mode* (see p. 4.197) to *Multislot Support*.
- To ensure that all 8 timeslots are available as traffic channels as soon as the TBF connection is established, select the *BCCH or TCH* mode (see *Mode* softkey on p. 4.185).
- Use the *Slot Configuration Editor* (see Fig. 4-93 on p. 4.224) to enable the individual BS timeslots and define the signal levels.

DBLER measurement

The bit error rate test for PDTCHs can be modified in such a way that the MS loops back the received data packets on a block by block basis and the CMU measures the BER and the Data Block Error Rate (DBLER). The *Coding Scheme* of the PDTCHs (CS1 to CS4; modulation and coding schemes MCS1 to MCS9) can be selected in the *Network* tabs of the *Connection Control* menu.

The test setup is the same as for Receiver Quality tests on circuit switched speech or data channels: An overview of the different test settings for the DBLER measurement on circuit switched and packet switched channels is given in the table below.

Table 4-9 BLER and DBLER measurement settings

Main Service	Traffic Mode / Coding Scheme	CMU Signalling State	Signalling Channel / Service Selection	Receiver Quality Meas. Mode or Application	Results available
Circuit Switched (GSM)	CS1 to CS4 MCS1 to MCS9	Call Established	NONE (analogous to Reduced Signalling,	BER/DBLER (CMU setting)	BER DBLER

Main Service	Traffic Mode / Coding Scheme	CMU Signalling State	Signalling Channel / Service Selection	Receiver Quality Meas. Mode or Application	Results available
			setup via ext. test interface)		USF BLER CRC Error
Packet Data (Option CMU-K42, GPRS)	CS1 to CS4	TBF Established	Test Mode A or Reduced Signalling Mode A (setup via external test interface)	BER/DBLER or USF BLER only	USF BLER False USF Det. CRC Error
Packet Data (Option CMU-K42, GPRS)	CS1 to CS4	TBF Established	Test Mode B (full signaling via RF connection) or Reduced Signalling Mode B (setup via external test interface)	BER/DBLER	BER DBLER USF BLER False USF Det. CRC Error
Packet Data (Option CMU-K42, GPRS)	CS1 to CS4	TBF Established	Test Mode B (full signaling via RF connection) or Reduced Signalling Mode B (setup via external test interface)	USF BLER only	USF BLER False USF Det. CRC Error
Packet Data (Option CMU-K43, EGPRS)	MCS1 to MCS9	TBF Established	EGPRS Loopb. symm./asymm.[1] or Reduced Signalling EGPRS symm./asymm. (setup via external test interface)	BER/DBLER	BER DBLER USF BLER False USF Det.
Packet Data (Option CMU-K43, EGPRS)	MCS1 to MCS9	TBF Established	EGPRS Loopb. symm./asymm.[1] or Reduced Signalling EGPRS symm./asymm. (setup via external test interface)	USF BLER only	USF BLER False USF Det
Packet Data (Option CMU-K43, EGPRS)	MCS1 to MCS9	TBF Established	Test Mode A or Reduced Signalling Mode A (setup via external test interface)	BER/DBLER or USF BLER only	USF BLER False USF Det. CRC Error
Packet Data (Option CMU-K43, EGPRS)	MCS1 to MCS9	TBF Established	Test Mode B (full signaling via RF connection) or Reduced Signalling Mode B (setup via external test interface)	BER/DBLER	BER DBLER USF BLER False USF Det. CRC Error
Packet Data (Option CMU-K43, EGPRS)	MCS1 to MCS9	TBF Established	Test Mode B (full signaling via RF connection) or Reduced Signalling Mode B (setup via external test interface)	USF BLER only	USF BLER False USF Det. CRC Error

[1] The asymmetric loops require coding schemes MCS5 to MCS9.

Main Service	Traffic Mode / Coding Scheme	CMU Signalling State	Signalling Channel / Service Selection	Receiver Quality Meas. Mode or Application	Results available
Packet Data (Option CMU-K42, GPRS)	CS1 to CS4	TBF Established	BLER	BLER	BLER
Packet Data (Option CMU-K43, EGPRS)	MCS1 to MCS9	TBF Established	BLER	BLER	BLER[2]

Principle of the measurement

Like any other *Receiver Quality* measurement, the PDTCH BER test is based on the comparison of the output signal generated by the CMU with the signal received and decoded by the device under test (mobile station). To this end, the mobile station is set to return the received signal to the CMU in loopback mode. In the case of packet data channels, the MS loops back the packet data after demodulation and channel decoding (see BER/DBLER loop in *Fig. 4-59* on p. 4.135 ff.).

Frame structure

The CMU provides a GPRS or EGPRS signal with a 52-multiframe structure as shown in *Fig. 4-60 below*. Each 52-multiframe contains 12 blocks of 4 consecutive frames (B0 to B12), 2 idle frames (X) and 2 frames used for the Packet Timing Advance Control Channel (X). All blocks in the signal are coded and modulated with the same coding and puncturing scheme.

The mobile station returns the data bits of the received blocks using the coding and puncturing scheme signalled via RF connection (GPRS Test Mode B) or set via an external test interface (reduced signalling). This means that the loopback is done on a block by block basis. The modulation and coding schemes MCS7, MCS8 and MCS9 carry 2 RLC/MAC frames which are coded separately.

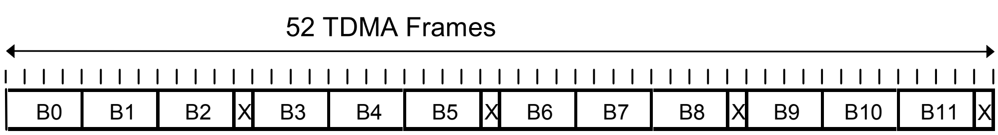


Fig. 4-60 52-multiframe for PDCH

Block structure

Each GPRS/EGPRS radio block is divided into the header information including the Uplink State Flag (USF) and the data bits. The CMU uses downlink header with fixed (circuit switched) or configurable (packet-data) USF and ignores the uplink header received from the MS. This means that only the data bits of a radio block contribute to the BER and DBLER calculation. However, in packet-data mode, where the USF can be explicitly set, the CMU is also capable of evaluating the relative number of blocks with a USF correctly or incorrectly received by the MS under test. These ratios are referred to as USF BLER and False USF Detection.

On the other hand, the MS returns the received data even if the block check sequence indicates that the block was not decoded correctly. In this case the MS calculates a new block check sequence for the received data. The same timeslot is used for downlink and uplink, however, the uplink signal is delayed by 3 timeslot periods.

[2] Depending on the hardware configuration, up to 2 or 4 DL timeslots can be measured simultaneously; see *BLER measurement* above.

Difference between DBLER and BLER

This Data Block Error Rate is not exactly the BLER that is defined in the GSM recommendations, because the possibility of an error in the header is not taken into account. But if the probability for an error in the data field, which depends on the used coding scheme, is much higher than the probability for an error in the header, then the calculated Data Block Error Rate is a good approximation to the BLER.

The difference between the BLER defined in GSM 11.10 and the DBLER measured by the CMU varies from one coding scheme to another. For coding scheme CS4, where no additional effects due to channel coding occur, the difference is determined by the difference of the data field size compared to the complete RLC block size. For other coding schemes, there are additional effects originating from the different channel coding of the header and data fields and from differences in the bit error rate of header and data bits after the channel decoder. A comparison of the two coding schemes CS4 and CS1 is shown in *Fig. 4- below*.

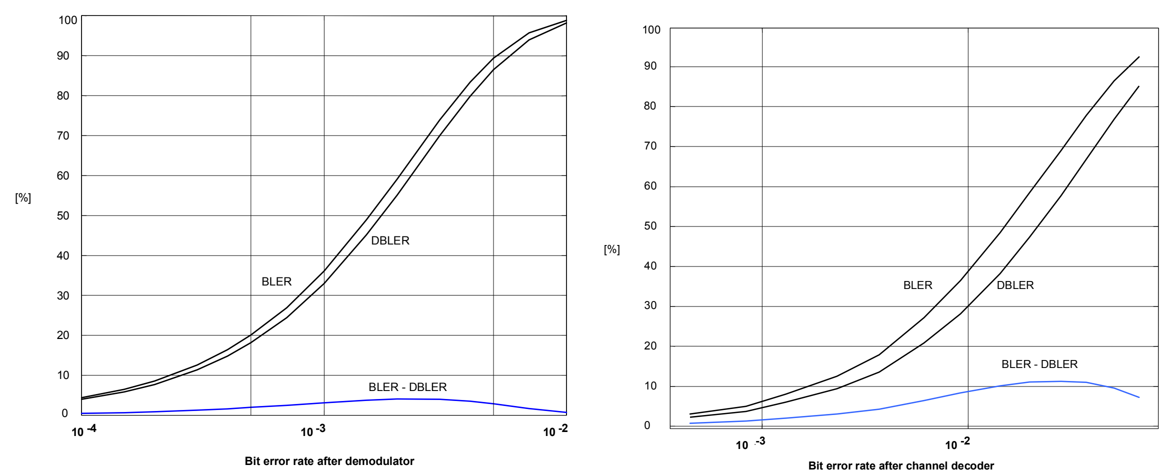


Fig. 4-61 Comparison between BLER and DBLER: CS4 (left diagram) and CS1

Frame Structure for Speech and Data Channels

The data stream used for bit error rate measurements is divided into units containing an equal number of bits, the so-called frames (see parameters *Frames, Average* and *RLC Block Count* in section *Measurement Control (Receiver Quality Configuration – Control)* on p. 4.158 ff.). The bit content of the frames depends on the service (see *Main Service* softkey on p. 4.107 and *Service Selection* softkey on p. 4.217), the frame type (burst, speech, data, RLC data blocks) and the channel coding (see *Traffic Mode* softkey on p. 4.193). The following tables are to shed light on the different frame structures and on the statistics of *Receiver Quality* tests.

Table 4-10 Frame structure for Main Service: Circuit Switched

Frame type	Channel coder	Bits per frame
Bursts	All GMSK Full Rate channel coders (incl. AMR)	114
(Burst by Burst mode)	All GMSK Half Rate channel coders (incl. AMR)	57[3)]
	All 8PSK Full Rate channel coders (MCS5 to MCS9 Test Mode)	346

[3] 114 bits per burst. As every second burst is cancelled the average bit content is 57 bit/burst.

Frame type	Channel coder	Bits per frame
Speech Frames	Full Rate Version 1	260 (50 class Ia + 132 class Ib + 78 class II)
	Full Rate Version 2	244 (50 class Ia + 124 class Ib + 70 class II)
	Half Rate Version 1	112 (22 class Ia + 73 class Ib + 17 class II)
Data Blocks	Full Rate Data 4800	120
	Full Rate Data 9600	240
	Full Rate Data 14400	290
	Half Rate Data 2400	72[4)]
	Half Rate Data 4800	120[5)]
	CS1 Test Mode	160
	CS2 Test Mode	240
	CS3 Test Mode	288
	CS4 Test Mode	400
	MCS1 Test Mode	176
	MCS2 Test Mode	224
	MCS3 Test Mode	296
	MCS4 Test Mode	352
	MCS5 Test Mode	448
	MCS6 Test Mode	592
	MCS7 Test Mode	448
	MCS8 Test Mode	544
	MCS9 Test Mode	592

Table 4-11 Frame structure for Main Service: Packet Data, Service Selection: Red. Sig.– EGPRS sym.

Frame type	Channel coder	Bits per frame (class II bits only)
RLC Data Blocks	MCS1 to MCS4	372
	MCS5 to MCS6	1248
	MCS7 to MCS9	1224

Table 4-12 Frame structure for Main Service: Packet Data, Service Selection: Red. Sig.– EGPRS asym.

Frame type	Channel coder	Bits per frame (class II bits only)
RLC Data Blocks	MCS5 to MCS6	1232
	MCS7 to MCS9	1208

[4] 144 bits per burst. As every second burst is cancelled the average bit content is 72 bit/burst

[5] 240 bits per burst. As every second burst is cancelled the average bit content is 120 bit/burst

Table 4-13 Frame structure for Main Service: Packet Data, any other Service Selection

Frame type	Channel coder	Bits per frame
RLC Data Blocks	CS1	160
	CS2	240
	CS3	288
	CS4	400
	MCS1	176
	MCS2	224
	MCS3	296
	MCS4	352
	MCS5	448
	MCS6	592
	MCS7	448
	MCS8	544
	MCS9	592

Statistical BER Tests

In a normal bit error rate test, a fixed number of bits is transmitted, leading to a fixed test time for each BER result. The idea behind statistical testing is to apply probability theory and predict a range for the BER at an early stage of the measurement. The prediction can be used to stop the measurement if the probability of the DUT to pass or fail the receiver quality test is large enough (early pass or early fail decision). Statistical testing can reduce test times considerably, especially if the exact BER of a receiver is very low or very high.

The general rules for statistical testing are described in the Terminal Conformance Specification 3GPP TS 34.121. The CMU parameters *(Confidence Settings)* are described on p. 4.159. The purpose of the present section is to explain the principle of the test and outline some typical applications.

Performing a confidence BER test

A confidence BER test generally involves the following steps:

1. Activate the test: In the *Receiver Quality* menu, select *Application – BER* and use the *Stop Condition* hotkey associated to the *BER* measurement control softkey to select the stop condition *Confidence Level.*
2. Set the test parameters: Press *BER* for a second time to open the *Receiver Quality Configuration* menu. In the *Control* tab, scroll to the *BER – Common Settings – Confidence Settings* section to select the parameters appropriate for your test (see remainder of this section). Close the configuration menu.
3. View results: Select the measurement control softkey *BER* again and press the *CONT/HALT* key to initiate a single-shot measurement. The result is indicated in an output field together with the *Specified Class II limit.*

Probability distribution

Confidence BER tests are based on the statistical independence of the bit error events: The probability of a bit error is equal for each received bit. The exact bit error rate is given by the limit of the ratio n_e/n_s, where n_e denotes the number of bit errors and n_s the number of received bits, and where the number of received bits tends to infinity. Any real bit error rate test necessarily provides an approximation to the exact bit error rate.

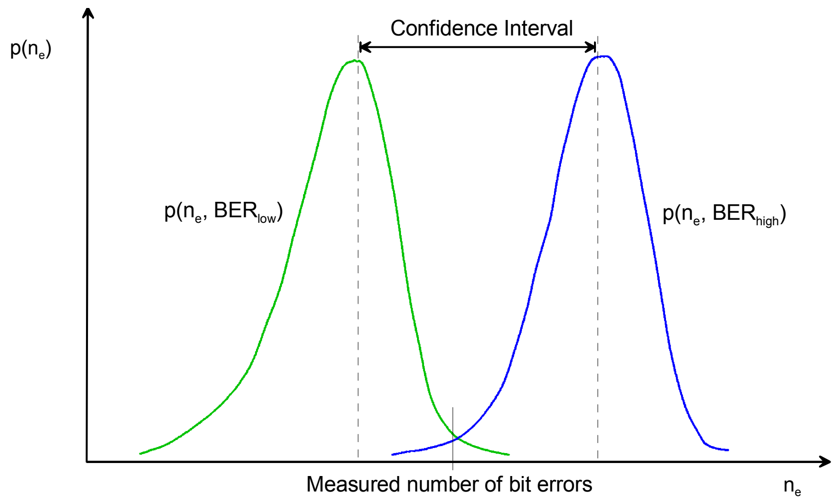
Given the statistical independence of the bit error events, the probability p for any number of bit errors n_e at a given exact BER and a given number of received bits n_s can be described by a binomial distribution or an appropriate approximation, such as the Chi Square distribution. Estimates of the exact BER are based on this distribution.

Confidence Levels

The distributions $p(n_e, n_s, BER)$ provide a confidence interval $[BER_{low}, BER_{high}]$ for the exact BER at any n_e and n_s. The confidence interval has the following meaning:

- The probability for the exact BER to be larger than BER_{low} is larger than the lower confidence level.
- The probability for the exact BER to be smaller than BER_{high} is smaller than the upper confidence level.

In the figure below the lower confidence level is the sum of all probabilities $p(n_e, n_s, BER_{low})$ up to the measured number of bit errors. The upper confidence level is the sum of all probabilities $p(n_e, n_s, BER_{high})$ above the measured number of bit errors.



Example: Assume that 20 bit errors were measured after 1000 received bits (n_e = 20, n_s = 1000, preliminary BER = n_e/n_s = 2 %). The probability of the exact BER to be smaller than 1.1 % is 1 % (lower confidence level: 99 %). The probability of the exact BER to be larger than 3.3 % is 1 % (upper confidence level: 99 %).

If the specified upper BER limit is 1 %, then the measurement can be stopped and the receiver can be failed with a risk of less than 1 % that the exact BER is below the specified limit.

Confidence Fail, Confidence Pass, Bad DUT Factor

In analogy to the calculation in the example above it is possible to calculate confidence intervals $[a(BER_{limit}), b(BER_{limit})]$ for the measured preliminary BER around the specified limit:

- At a given confidence level, any measured preliminary BER below $a(BER_{limit})$ means that the exact BER of the receiver is below BER_{limit} so that the receiver should pass the test (early pass decision, test stopped).
- At a given confidence level, any measured preliminary BER above $b(BER_{limit})$ means that the exact BER of the receiver is above BER_{limit} so that the receiver should fail the BER test (early fail decision, test stopped). $b(BER_{limit})$ is termed the early fail limit; the confidence level for $b(BER_{limit})$ can be set as *Confidence fail* value.
- If a preliminary BER inside the confidence interval $[a(BER_{limit}), b(BER_{limit})]$ is measured, no decision is possible so that the measurement must be continued.

The calculation can be performed for arbitrary BER_{limit} values and confidence levels. Increasing BER_{limit} by multiplication with a factor M > 1 also shifts the confidence interval and increases the number of early pass decisions, causing a further reduction of test times. In practice, a factor M = 1.5 has been proved to provide a reasonable compromise between test time and accuracy requirements.

- At a given confidence level, any measured preliminary BER below the lower interval border a(M*BER_{limit}) means that the exact BER of the receiver is below M*BER_{limit} so that the receiver should pass the test (early pass decision, test stopped). a(M*BER_{limit}) is termed the early pass limit; the confidence level for a(M*BER_{limit}) can be set as *Confidence pass* value. The factor M itself is fixed to the value 1.5 and termed the *Bad DUT Factor.*

Evolution in time, Target Test Time

The probability distribution gets relatively narrower as the measurement goes on and the numbers n_e and n_s increase. For infinitely long measurement times, the early fail limit tends towards the specified limit, the early pass limit tends towards the specified limit times M. This translates into the behavior of the early pass and early fail limits shown in the figure below:

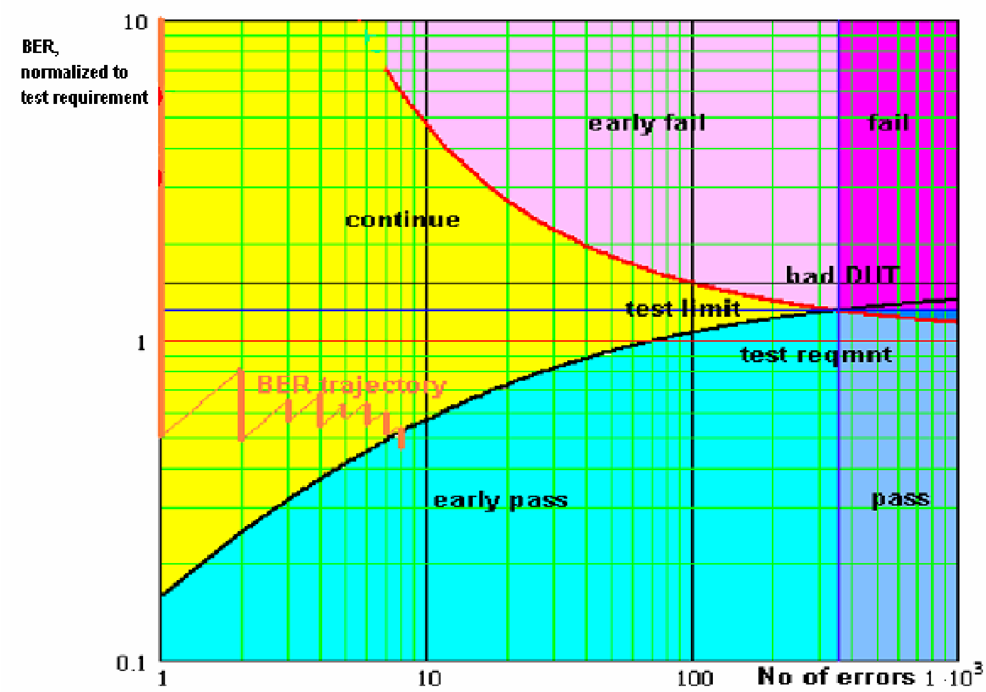


Fig. 4-62 Single-limit confidence BER

For M > 1 the early pass and early fail limits cross at a definite number of errors. If no *Min. Test Time* is set as an additional condition (see below), the crossing corresponds to the maximum possible test time (target test time). After the target test time, the test has either failed or passed the DUT.

The figure also shows an example evolution of the normalized BER in time: At the beginning of the test, an artificial error is introduced to ensure that the BER trajectory starts above the early pass limit. The preliminary BER is recalculated each time that a new error occurs. At n_e = 8, the trajectory crosses the early pass limit and the test is stopped.

Asymmetric confidence levels

The default settings for the *Confidence Fail* and *Confidence Pass* levels are equal. The settings are inappropriate for test sequences involving a large number of independent BER tests where erroneous early fail decisions due to statistical variations are not acceptable.

The solution is to exclude most erroneous early fail decisions by increasing the *Confidence Fail* level to its maximum value (99.98 %), shifting the early fail limit line in upward direction. As only erroneous decisions are affected, this will only marginally increase the test time. The same is generally not true for an increase of the *Confidence Pass* limit, because the early pass limit is responsible for stopping the majority of the tests.

Min. Test Time Some test conditions introduce fluctuations that disturb the statistical independence of the bit error events and must be averaged out. This is achieved by means of a minimum test time during which no early fail or early pass decisions are taken. The standard stipulates minimum test times for multipath fading, birth/death propagation, and moving propagation conditions.

Dual-Limit Test The single-limit BER test described above can be extended to restrict the BER to a band between two limits. For practical reasons, the lower band limit is calculated as <BER Limit> (1 – n %), the upper band limit is calculated as <BER Limit> (1 + n %). Factors of 10 %, 20 % and 30 % are provided; see *Result Window* parameter.

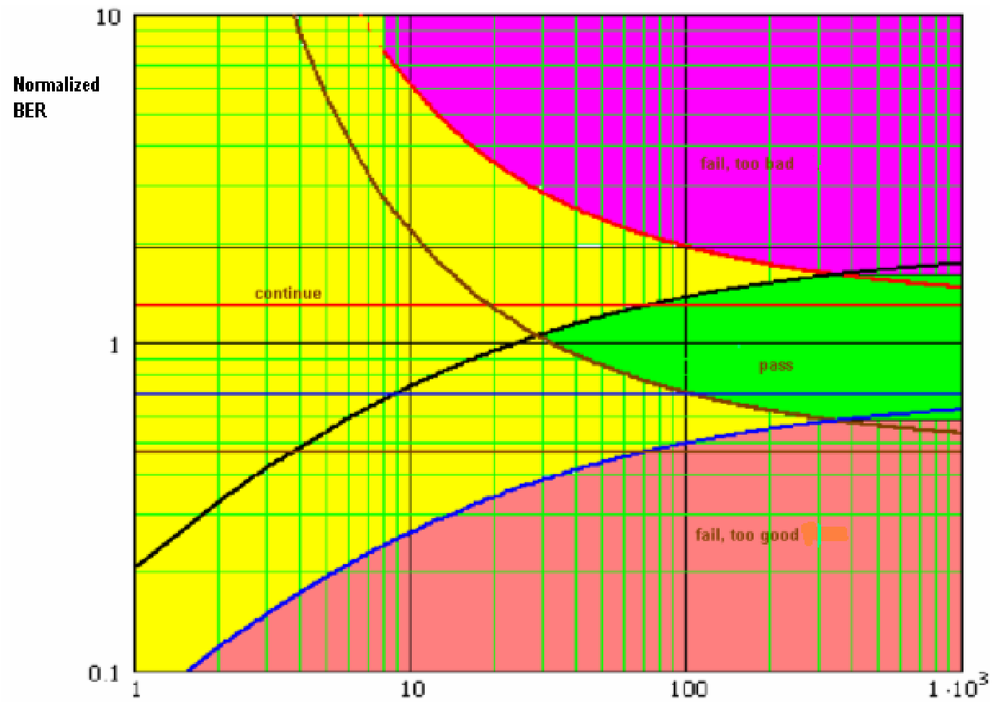


Fig. 4-63 Dual-limit confidence BER

In a dual-limit test, the DUT is failed if it is either too good or too bad. For more information refer to the test specification.

Measurement Menu (Receiver Quality)

The *Receiver Quality* menu shows the results and the most important parameters of the *Receiver Quality* measurement.

- The measurement control softkey *BER* (which changes to *BER Average*, *Neighbor Cell* or *BLER* if one of these applications is selected) controls the *Receiver Quality* measurement, indicates its status *(RUN, HLT, OFF)* and opens the configuration menu *Receiver Quality Configuration*. The hotkeys associated to the measurement control softkey define the scope of the measurement.
- The softkeys *Application, Analyzer Level, MS Signal, BS Signal, Network* and *Menus* on the right softkey bar are combined with various hotkeys. When a softkey is selected and an associated hotkey pressed, a popup window appears which indicates a setting or enables an entry.
- In the tables in the center of the menu, the test settings of the current *Receiver Quality* measurement and the results are displayed.

The measurement menu *Receiver Quality* is opened from the *Menu Select* menu (with the associated key at the front of the instrument) or from the menu group *GSM400/GT800/850/900/1800/1900-MS Signalling* using the hotkey *Receiver Quality*.

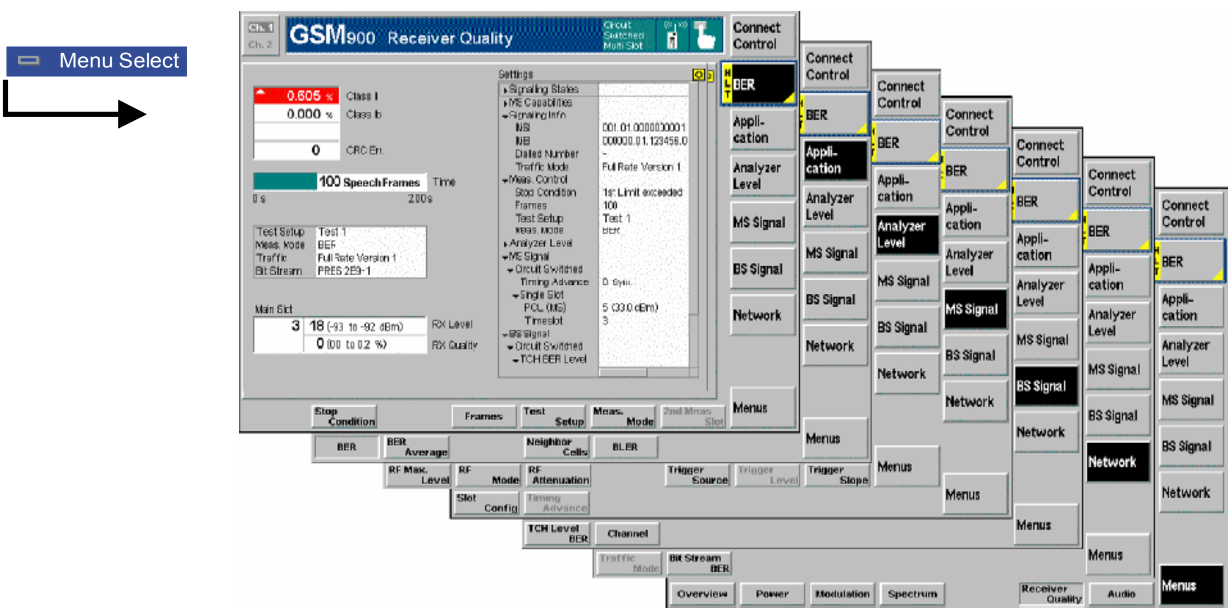


Fig. 4-64 Receiver Quality (BER)

Test Settings

The *Analyzer Level* and *Menus* test settings and most of the *MS Signal* and *BS Signal* settings are identical with those in the *Power* menu (see section *Test Settings* on page 4.113). The following softkey/hotkey combinations differ from the *Power* measurement:

BER

The *BER* softkey controls the receiver quality measurement in the BER application and indicates its status *(RUN | HLT | OFF)*.

This status can be changed after softkey selection (pressing once) by means of the *ON/OFF* key or the *CONT/HALT* key. The status of the measurement is unaffected upon switchover to other menus controlling a *Receiver Quality* measurement, however, a running measurement is restarted.

Remote control
`INITiate:RXQuality:BER`
`ABORt:RXQuality:BER`
`STOP:RXQuality:BER`
`CONTinue:RXQuality:BER`

Measurement configuration

Pressing the measurement control softkey twice opens the popup menu *Receiver Quality Configuration* (see section *Measurement Configurations (Receiver Quality Configuration)* on page 4.158 ff.). Besides, a number of hotkeys defining the scope of the measurement are associated to the measurement control softkey. All settings are explained in detail in section *Measurement Control (Receiver Quality Configuration – Control)* on page 4.158 ff.

Application

The *Application* softkey selects the measurement application. The three alternative applications *BER, BER Average*, and *Neighbor Cells* are displayed in separate measurement menus. When an application is selected, the corresponding measurement menu is called up. The configuration settings for both applications, however, are listed in a common popup-menu (see section *Measurement Control (Receiver Quality Configuration – Control)* on page 4.158 ff.).

BER and *BER Average* (=Continuous) are treated as repetition modes in other measurement groups. The difference in the *Receiver Quality* measurement is that the basic evaluation period is a speech frame instead of a single burst.

BER

The *BER* hotkey activates the single shot *Receiver Quality* measurement. The measurement is stopped after one statistics cycle, i.e. after the number of evaluation periods (frames) set in the configuration menu *Control* (see section *Measurement Control (Receiver Quality Configuration – Control)* on page 4.158) or if a stop condition is met. A measurement that has been stopped is indicated by the status display *HLT* in the associated softkey.

BER should always be used if only a single measurement result is required under fixed conditions.

Remote control
No explicit switchover command. All single shot measurements are identified by the 2nd/3rd level keywords `...RXQuality:BER...`

BER Average

The *BER Average* hotkey activates the continuous Receiver Quality measurement. The measurement runs until it is stopped explicitly, or until the stop condition is met. A continuous average over the selected number of evaluation periods (frames) is calculated. An ongoing measurement is indicated by the status display RUN in the associated softkey.

Remote control
No explicit switchover command. All continuous measurements are identified by the 2nd/3rd level keywords `...RXQuality:BAVerage...`

Neighbor Cells

The *Neighbor Cells* hotkey displays the neighbor cells reported by the mobile. The output contains up to 6 neighbor cells together with the received signal level of signals from these cells (RxLevel, see *Table 4-14* on page 4.155).

The neighbor cell information is not available if the *Enhanced Measurement Reports* are enabled (see *Network* tab of the *Connection Control* menu).

Remote control
`[SENSe:]RREPorts:NCELl?`

BLER

The *BLER* hotkey activates the Block Error Ratio (BLER) measurement on packet data channels. The CMU transmits RLC blocks and can measure the BLER in all receive timeslots of the MS.

Remote control
No explicit switchover command. All single shot measurements are identified by the 2nd/3rd level keywords `...RXQuality:BLER...`

BS Signal

The *BS Signal* softkey determines the level and the data transmitted on the CMU's traffic channel. The following settings are specific to the *Receiver Quality* measurement:

TCH Level BER

The *TCH Level BER* hotkey sets the level of the CMU's traffic channel signal (for applications *BER* and *BER Average*). The settings remain valid while *BER* or *BER Average* is active, see section *Measurement Control (Receiver Quality Configuration – Control)* on page 4.158. They hold for both single slot and multislot mode of the MS under test.

The level in the used timeslot *(used TS)* and the unused timeslots *(unused TS)* can be defined separately. The unused TS level is expressed in units relative to the level in the used timeslot. Note that the receiver quality specifications defined in GSM 05.05 must be met when the two timeslots adjacent to the used timeslot are detecting GSM signals at 20 dB above the used timeslot level. This is why the default value for the unused TS level is higher than the default used TS level.

Remote control
```
CONFigure:RXQuality:BER<nr>|BAVerage:CONTrol[:CSWitched]
  [:TCH]:LEVel:UTIMeslot
CONFigure:RXQuality:BER<nr>|BAVerage:CONTrol[:CSWitched]
  [:TCH]:LEVel:UNTimeslot
```

TCH Level BLER

The *TCH Level BLER* hotkey sets the level of the CMU's traffic channel signal (for application *BLER*) in all timeslots. The levels are defined relative to a reference level. The settings remain valid for the duration of the *BLER* measurement only, see section *Measurement Control (Receiver Quality Configuration – Control)* on page 4.158. They hold for both single slot and multislot mode of the MS under test.

Remote control
```
CONFigure:RXQuality:BLER:CONTrol:PDATa[:TCH]:MSLot:RLEVel
CONFigure:RXQuality:BLER:CONTrol:PDATa[:TCH]:MSLot:LEVel:INDi
vidual
```

Network

The *Network* softkey defines network parameters that the CMU reports to the mobile station; see also section *Network Parameters (Connection Control – Network)* on page 4.192. The following settings are specific to the *Receiver Quality* measurement and not provided in the *Connection Control* menu:

Bit Stream BER

The *Bit Stream BER* hotkey selects the data to be transmitted on the traffic channel. All pseudo random bit sequences (PRBS) provided in the *Network* tab are available (see section *Network Parameters (Connection Control – Network)* on p. 4.192 ff.); however, the *Bit Stream BER* is only valid while a *Receiver Quality* measurement is active.

Remote control
```
CONFigure:RXQuality[:CSWitched]:BITStream
CONFigure:RXQuality:PDATa:BITStream
```

Display

The *Display* softkey is available in the *BLER* application where it defines the display format of the BLER results.

Results

The *Results* hotkey selects whether the BLER results in the measurement menu are displayed as a *Percentage* (the number of blocks received in error divided by the total number of blocks) or as an *Absolute* number of blocks received in error.

Remote control
No command, display configuration only.

Measurement Results

The measurement results depend on the application selected.

a) BER and BER Average

The test settings of the current *Receiver Quality* measurement and the results are displayed in the tables in the center of the menu.

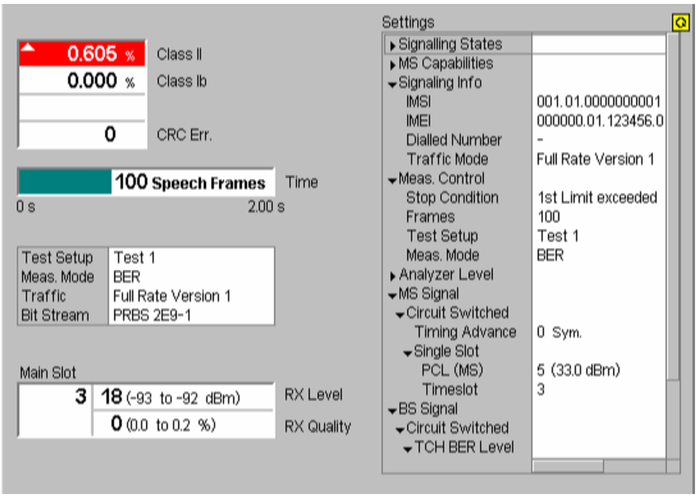


Fig. 4-65 Display of test settings and measurement results (BER)

The measurement results in the left upper table depend on the selected measurement mode (see definitions at the beginning of section *Receiver Quality Measurements* on page 4.133).

RBER/FER When the residual bit error rate *(Meas. Mode = RBER/FER)* is measured the following is displayed:

Class II	Residual bit error rate for class II bits (unprotected bits)
Class Ib	Residual bit error rate for class Ib bits (partly protected bits)
FER	Frame erasure rate: relative number of invalid and therefore erased frames
CRC Error	Result of *cyclic redundancy check.* Number of frames erased on the signal path from the device under test to the CMU

Note: *In some specific measurements, not all results may be available. E.g. the AMR full rate speech codec does not provide any Class II bits; the output field shows invalid results "– – –".*

BER When the bit error rate *(Meas. Mode = BER)* is measured the following is displayed:

Class II	Bit error rate for class II bits (unprotected bits)
Class Ib	Bit error rate for class Ib bits (partly protected bits)
CRC Error	Result of *cyclic redundancy check:* number of frames erased on the signal path from the device under test to the CMU

Burst by Burst In a *Burst by Burst* measurement (Fast BER*, Measurement Mode = Burst by Burst),* the following is displayed:

BER	Bit error rate for all bits (unprotected bits, no other bits are transmitted)
CRC Error	Result of *cyclic redundancy check:* number of frames erased on the signal path from the device under test to the CMU

BER/DBLER In a *Data Block Error Rate* measurement (*Measurement Mode = BER/DBLER),* the following is displayed:

BER	Bit error rate for class II bits (unprotected bits, no other bits are transmitted)
DBLER	Data block error rate: relative number of erroneous blocks; see section *BER Tests of PDTCHs* on p. 4.135 ff
USF BLER	Percentage of assigned USFs received in error, for packet switched data channels ((E)GPRS, with option CMU-K42/-K43) only. In circuit switched mode, the output field shows invalid results.
False USF Det.	Percentage of unassigned USFs received in error, for packet switched data channels ((E)GPRS, with option CMU-K42/-K43) only. In circuit switched mode, the output field shows invalid results. Moreover, the *USF Duty Cycle* (see section *Network Parameters (Connection Control – Network)* on p. 4.227 ff.) must be less than 100% in order to obtain a valid result.
CRC Error	Result of *cyclic redundancy check:* number of frames erased on the signal path from the device under test to the CMU

Some results are not available in all measurement configurations; see Table 4-9 on p. 4.136.

AMR Inband FER The results for the measurement mode *AMR Inband FER* (with option R&S CMU-K45) are described in section *AMR Reference Sensitivity Test* on p. 4.236 ff.

USF BLER only

In a *USF BLER only* measurement (only for packet switched data channels ((E)GPRS), with option CMU-K42/-K43*),* the following is displayed:

USF BLER	Percentage of assigned USFs received in error.
False USF Det.	Percentage of unassigned USFs received in error. The *USF Duty Cycle* (see section *Network Parameters (Connection Control – Network)* on p. 4.227 ff.) must be less than 100% in order to obtain a valid result.
CRC Error	Result of *cyclic redundancy check:* number of frames erased on the signal path from the device under test to the CMU

Some results are not available in all measurement configurations; see Table 4-9 on p. 4.136.

Limit Check

A red output field indicates that the measurement result exceeds the upper limit set in the *Limits* tab of the *Receiver Quality* configuration menu; see p. 4.163 ff.

No independent limit is assigned to the *False USF Det.* result. The limit check is based on the *USF BLER* limit.

Progress Bar

A bar below the table indicates the relative measurement progress:

- In a *single shot* measurement, the ratio between the current measurement time and the total measurement time.
- In a *continuous* measurement, the ratio between the frames (or bursts or RLC data blocks, depending on the *Meas. Mode)* measured and the total number of frames (bursts/RLC data blocks) to be measured.

Remote Control

```
READ[:SCALar]:RXQuality:BER|BAVerage?
FETCh[:SCALar]:RXQuality:BER|BAVerage?
SAMPle[:SCALar]:RXQuality:BER|BAVerage?
CALCulate:RXQuality:BER|BAVerage:LIMit:MATChing?
```

Confidence BER results

If a confidence BER test is performed (i.e. if the stop condition *Confidence Level* is set), an additional output field displays one of the following measurement results:

Running	Measurement still running, no early fail or early pass decision made.
Early Fail	Measurement stopped because an early fail limit was exceeded. The DUT is probably out of tolerance.
Early Pass	Measurement stopped because an early pass limit was exceeded. The DUT is probably within tolerance.
Fail	Measurement terminated with a *Min. Test Time* larger than the tartet test time so that no early pass or early fail decision could be made; bit errors exceed upper limit (see *Fig. 4-62* on p. 4.143).
Pass	Single-limit test: Measurement terminated with a *Min. Test Time* larger than the tartet test time so that no early pass or early fail decision could be made, bit errors below the lower limit. Dual-limit test: Measurement terminated with no upper or lower limit exceeded (see *Fig. 4-63* on p. 4.144).
Too High	Upper limit exceeded in a dual-limit test (*Fig. 4-63* on p. 4.144).
Too Low	Upper limit exceeded in a dual-limit test.

The *Confidence Settings* are described on p. 4.159. For background information and application examples refer to section *Statistical BER Tests* on p. 4.141 ff.

Remote Control

```
CONFigure:RXQuality:BER<nr>:CONTrol:REPetition  CLEVel, NONE
READ[:SCALar]:RXQuality:BER? etc.
```

RF Level Search results

If a level search is performed (i.e. if the stop condition *RF Level Search* is set), an additional output field displays one of the following measurement results:

Search level and BER limit

Search failed because level limit reached

Search failed because max. no. of cycles reached

The *Search Settings* and the search algorithm are described in the *Search Settings* paragraph on p. 4.160.

Remote Control

```
CONFigure:RXQuality:BER<nr>:CONTrol:REPetition  RFLS, NONE
READ[:SCALar]:RXQuality:BER? etc.
```

Test Setup

The table below the measurement results indicates the current test setup together with the *Meas. Mode*, the *Traffic* mode and the *Bit Steam*. The settings are also indicated in the *Settings* table in the left half of the measurement menu.

Settings

The *Settings* table gives an overview of the configuration of the current measurement. This includes the settings made via the softkeys and hotkeys of the *Receiver Quality* menu, and the tolerances set in the *Limits* tab of the *Receiver Quality Configuration* menu, see section *Upper Limits for Bit Error Rate (Receiver Quality Configuration – Limits)* on page 4.163.

The parameters depend on the current application and the measurement mode.
Remote control
See sections *Test Settings* on page 4.145 and *Upper Limits for Bit Error Rate (Receiver Quality Configuration – Limits)* on p. 4.163.

Main Slot – Receiver Reports

The *Main Slot* table in the lower left section of the menu displays the receiver reports provided by the mobile phone. The parameters are different in circuit switched and packet data mode; see section *MS Rcv. Reports – Received Results of the Mobile Phone* on p. 4.154 ff.

b) BLER

The results of the current *Receiver Quality* measurement are displayed in the tables in the center of the menu.

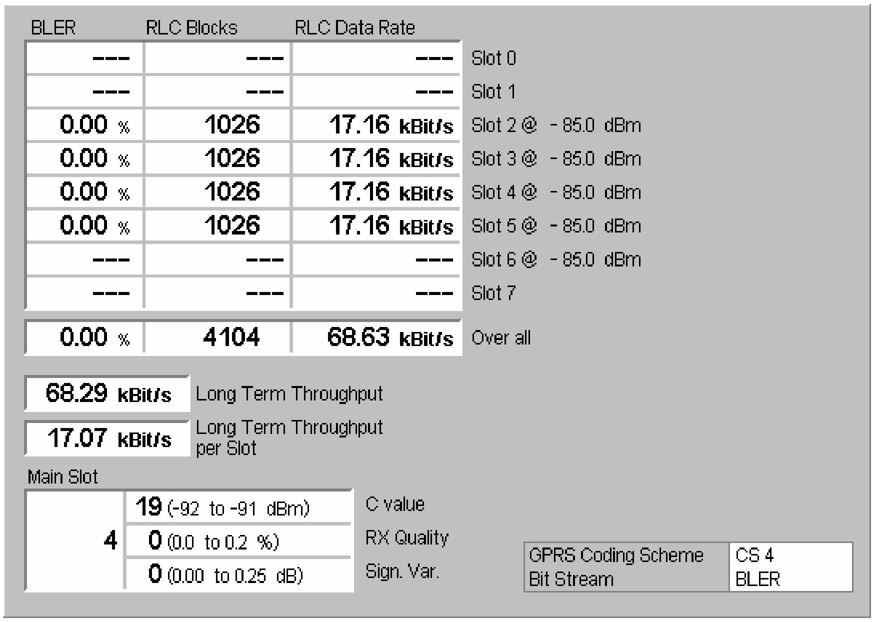


Fig. 4-66 Display of test settings and measurement results (BLER)

The measurement results are defined at the beginning of section *Receiver Quality Measurements* on page 4.133.

BLER / RLC Blocks

The upper table shows the measured Block Error Ratio (BLER) in all timeslots *(Slot 0* to *Slot 7).* The number of transferred *RLC Blocks* in each slot, the *RLC Data Rate* (see below) and the BS signal level used during the BLER measurement *(TCH BER Level,* dBm-values to the right of the table) is indicated in addition. The display format for the BLER can be toggled between *Percentage* and *Average (Display – Results).*

The *TCH BER Level* is not displayed for timeslots that are disabled in the slot editor; see *Slot Configuration Editor* on p. 4.180. Moreover, valid results are available only in timeslots where the MS receives data from the CMU.

Note: *The number of timeslots that can be evaluated simultaneously is limited by the multislot capabilities of the DUT. The CMU can send RLC blocks in up to 4 timeslots provided that the B52 Mode (see p. 4.197) is set to* Multislot Support*. With the setting* BCCH or TCH *(see* Mode *softkey on p. 4.185) all timeslots are available as traffic channels.*

RLC Data Rate

The RLC data transmission rate is displayed in units of kBit/s.

The *RLC Data Rate* corresponds to the net data transmission rate: Only the blocks that are correctly received are counted so that the data rate decreases as the BLER increases. Besides, the data rate depends on the number of bit per block and thus on the coding scheme; see *Table 4-13* on p. 4.141.

Over all results The *Over all* table row shows the following statistical results:

- The BLER averaged over all slots, i.e. the sum of the individual BLER in all enabled slots, weighted with the number of RLC Blocks in each slot and divided by the total number of RLC blocks.
- The total number of RLC blocks transferred, i.e. the sum of all RLC blocks in timeslots 0 to 7.
- The sum of the RLC data rates in all enabled slots.

Long Term Throughput Below the *Over all* results, two output fields show the average overall RLC data rate since the beginning of the measurement and the average overall data rate divided by the number of active slots.

An EGPRS MS operating in Incremental Redundancy RLC mode (see section *Network Parameters (Connection Control – Network)* on p. 4.227 ff.) must achieve a long term throughput of 20 kbps per timeslot.

Measurement Statistics All results are updated every 2 seconds. BLER/RLC blocks and *Long Term Throughput* on one hand and RLC data rate on the other hand are calculated with a different statistics:

- The sum for the *RLC Blocks* and the *BLER* runs over all blocks received since the beginning of the measurement. The same applies to the *Long Term Throughput.*
- The *RLC Data Rate* is averaged over the last 3 update periods. Therefore it is available only after the first three update periods have elapsed, i.e. after 6 seconds. The theoretical data rate per timeslot is 50 data blocks per second for the coding schemes CS1 to CS4 and MCS1 to MCS6 and 100 data blocks for MCS7 to MCS9. The actual data rate is smaller because of the control blocks between the data blocks and due to the fact that the measurement period of the BLER measurement usually will not match exactly the transmit period of the RLC/MAC layer. If the *RLC Block Count* is set to a value that is reached in less than 6 seconds, then no *RLC Data Rate* result is displayed.

Time A bar below the table indicates the total number of RLC data blocks transferred in a single shot measurement and the relative measurement progress. The bar is omitted for continuous measurements. For the coding schemes CS1-CS4 and MCS1-MCS6 an RLC block is transmitted every 20 ms in each used DL timeslot so that the total measurement time amounts to:

Meas. Time = 20 ms x <RLC Block Count> / <Number of used DL slots>

For the coding schemes MCS7 to MCS9 a block is transmitted every 10 ms; so that the measurement time is divided by two.

Remote Control

```
READ[:SCALar]:RXQuality:BLER?
FETCh[:SCALar]:RXQuality:BLER?
SAMPle[:SCALar]:RXQuality:BLER?
```

Test Setup

The table below the measurement results indicates the current GPRS coding scheme and the *Bit Steam*. The settings are also indicated in the *Setup* table on the left side of the measurement menu.

In packet data mode and with an active EGPRS modulation and coding scheme MCS1 to MCS9, the incremental redundancy setting is displayed; see *Incremental Redundancy* on p. 4.228. An additional line contains the puncturing scheme:

- If incremental redundancy is switched on, the *Initial puncturing scheme* for first transmission of the data blocks is indicated.
- If incremental redundancy is switched off, the *Fixed puncturing scheme* is indicated.

Main Slot – Receiver Reports

The *Main Slot* table in the lower left section of the menu displays the receiver reports provided by the mobile phone. The parameters are different in circuit switched and packet data mode; see section *MS Rcv. Reports – Received Results of the Mobile Phone* on p. 4.154 ff.

MS Rcv. Reports – Received Results of the Mobile Phone

GSM mobile phones continuously measure the signal strength and quality of several nearby base stations. The measured values for the active base station (serving cell BTS) are regularly sent to the active base station/CMU in the so-called “measurement reports”. They are automatically provided and do not represent real measured quantities. The time interval between transmission of two consecutive measurement reports is referred to as the *reporting period.*

The quantities characterizing the signal strength and quality of the serving cell (i.e. the CMU's traffic channel signal) are displayed together with the *Main Timeslot* number in a table in the lower left part of the *Receiver Quality* menu. The parameters depend on the *Main Service* and on the selected *Coding Scheme:*

- In circuit switched mode, the *RX Level* and *RX Quality* are displayed. If *Enhanced Meas. Reports* is enabled in the *Network* tab of the *Connection Control* menu, then the *Mean Bit Error Probability (Mean BEP),* the Coefficient of Variation of the BEP *(CV BEP),* and the *Number of Received Blocks* are displayed in addition.
- In GPRS packet data mode (coding schemes CS1 to CS4), the *C value*, *RX Quality* and *Sign. Var.* can be displayed. By default the values are not transmitted; see *Test Mode RF Level Reporting* on p. 4.230.
- In EGPRS packet data mode (coding schemes MCS1 to MCS4 for GMSK modulation, MCS5 to MCS9 for 8PSK modulation), the *C value*, the *Mean Bit Error Probability (Mean BEP)* and the Coefficient of Variation of the BEP *(CV BEP)* can be displayed. By default the values are not transmitted; see *Test Mode RF Level Reporting* on p. 4.230.

RX Level

RX Level denotes the received signal input level determined by the mobile for the signals of the CMU.

Required CMU settings: *Main Service = Circuit Switched*

The level is expressed in terms of dimensionless power levels depending linearly on the absolute measured power. A high power level implies a high received signal input power:

Table 4-14 Definition of RX Level

Value of RX Level	Corresponding signal strength
63	> –48 dBm
62	–49 dBm to –48 dBm
62	–50 dBm to –49 dBm
...	...
2	–109 dBm to –108 dBm
1	–110 dBm to –109 dBm
0	< –110 dBm

Remote control
`[SENSe:]RREPorts:RXLevel?`

RX Quality

RX Quality denotes the received signal quality determined by the mobile for the signals of the CMU.

Required CMU settings: *Main Service = Circuit Switched*

The received signal quality is expressed in terms of dimensionless quality levels (actually “error levels”). A high quality level implies a high bit error rate and thus a **poor** received signal quality:

Table 4-15 Definition of RX Quality

Value of RX Quality	Bit error rate
0	0% to 0.2%
1	0.2% to 0.4%
2	0.4% to 0.8%
3	0.8% to 1.6%
4	1.6% to 3.2%
5	3.2% to 6.4%
6	6.4% to 12.8%
7	12.8% to 100%

Remote control
`[SENSe:]RREPorts:RXQuality?`

C Value

The *C Value* is the normalized received signal level at the MS, averaged over the radio blocks as defined in standard 3GPP TS 45.008. The level is expressed in terms of dimensionless numbers ranging from 0 to 63. The assignment between C Values and absolute received signal levels is equal to the definition of RX Levels, see Table 4-14 above.

Required CMU settings: *Main Service = Packet Data,*
Coding Scheme = CS1 to CS4

The C value is used for GPRS uplink power control; see background information in section *RF Signals of the MS (Connection Control – MS Signal)* on p. 4.223 ff.

Remote control
`[SENSe:]RREPorts:CVALue?`

Sign. Var.

Sign. Var. denotes the variance of the received signal level within the radio blocks, averaged over all blocks within the MS reporting period. The variance is a measure of the difference between the received signal levels of the different bursts within the block; it vanishes if all burst levels are equal.

Required CMU settings: *Main Service = Packet Data,*
Coding Scheme = CS1 to CS4

Sign. Var. is equal to the SIGN_VAR parameter defined in standard 3GPP TS 45.008, see Table 4-16 below.

Remote control
```
[SENSe:]RREPorts:SVARiance?
```

Table 4-16 Definition of Sign. Var.

Value of Sign. Var.	Value range
63 62 62 ... 2 1 0	>15.75 dB^2 >15.50 dB^2 to 15.75 dB^2 >15.25 dB^2 to 15.50 dB^2 ... >0.50 dB^2 to 0.75 dB^2 >0.25 dB^2 to 0.50 dB^2 0 dB^2 to 0.25 dB^2

Mean BEP

Mean BEP denotes the average Bit Error Probability (BEP) of the radio blocks, averaged over all blocks within the MS reporting period. Two independent MEAN_BEP values are reported for GMSK and 8PSK-modulated signals, respectively. A third independent *Mean BEP* value is available for circuit switched connections, provided that the *Enhanced Meas. Reports* are enabled.

Required CMU settings: *Main Service = Packet Data,*
Coding Scheme = MCS1 to MCS4 (GMSK),
MCS5 to MCS9 (8PSK)

or: *Main Service = Circuit Switched,*
Enhanced Meas. Reports = On

Mean BEP is equal to the MEAN_BEP parameters defined in standard 3GPP TS 45.008; see Table 4-17 below.

Remote control
```
[SENSe]:RREPorts:GMBep?
[SENSe]:RREPorts:EMBep?
[SENSe]:RREPorts:MBEP?
```

Table 4-17 Definition of Mean BEP

Value of Mean BEP	Value range of log_{10}(actual BEP), GMSK modulation	Value range of log_{10}(actual BEP), 8PSK modulation
0 1 2 … 29 30 31	> –0.60 –0.70 to –0.60 –0.80 to –0.70 ... –3.50 to –3.40 –3.60 to –3.50 < –3.60	> –0.60 –0.64 to –0.60 –0.68 to –0.64 ... –3.44 to –3.28 –3.60 to –3.44 < –3.60

CV BEP

CV BEP denotes the Coefficient of Variation of the Bit Error Probability (BEP) of the radio blocks, averaged over all blocks within the MS reporting period. The Coefficient of Variation is the standard deviation of the measured BEP of the different bursts within the block; it vanishes if all bursts have equal BEP. Two independent *CV BEP* values are provided for GMSK and 8PSK-modulated signals, respectively. A third independent *CV BEP* value is available for circuit switched connections, provided that the *Enhanced Meas. Reports* are enabled.

Required CMU settings: *Main Service = Packet Data,*
Coding Scheme = MCS1 to MCS4 (GMSK),
MCS5 to MCS9 (8PSK)

or: *Main Service = Circuit Switched,*
Enhanced Meas. Reports = On

CV BEP is equal to the CV_BEP parameters defined in standard 3GPP TS 45.008, see Table 4-18 below.

Remote control
```
[SENSe]:RREPorts:GCBep?
[SENSe]:RREPorts:ECBep?
[SENSe]:RREPorts:CBEP?
```

Table 4-18 Definition of CV BEP

Value of CV BEP	Value range of std(BEP) / Mean BEP
0	>1.75
1	>1.50 to 1.75
2	>1.25 to 1.50
3	>1.00 to 1.25
4	>0.75 to 1.00
5	>0.50 to 0.75
6	>0.25 to 0.50
7	0 to 0.25

Number of Received Blocks

Number of Received Blocks denotes the number of correctly decoded blocks that were completed during the measurement reporting period.

Required CMU settings: *Main Service = Circuit Switched,*
Enhanced Meas. Reports = On

Number of Received Blocks is equal to the NBR_RCVD_BLOCKS parameter defined in standard 3GPP TS 45.008, see Table 4-18 above.

Remote control
```
[SENSe]:RREPorts:NRBlocks?
```

The receiver reports of up to six neighbor cells of the serving cell can be displayed using the *Neighbor Cell* hotkey, see page 4.145.

Measurement Configurations (Receiver Quality Configuration)

The popup menu *Receiver Quality Configuration* contains two tabs to define the parameters for the bit error rate measurement.

The popup menu *Receiver Quality Configuration* is opened by pressing the measurement control softkey *BER/ BER Average/Neighbor Cell/BLER* at the top right in the *Receiver Quality* menu twice. It is possible to change between the tabs by pressing the associated hotkeys.

Measurement Control (Receiver Quality Configuration – Control)

The *Control* tab controls the *Receiver Quality* measurement by determining

- Settling times for the mobile after which the measurement is started *(AGC Holdoff Time)*
- The *Repetition* mode
- The *Stop Condition* for the measurement
- The measured quantity *(Meas. Mode)*
- The levels in the traffic channel *(TCH Level BER)* set during the *Receiver Quality* measurement

With the exception of the holdoff times, all settings can be defined separately for the applications *BER* (with up to ten different test setups), *BER Average* and *BLER.*

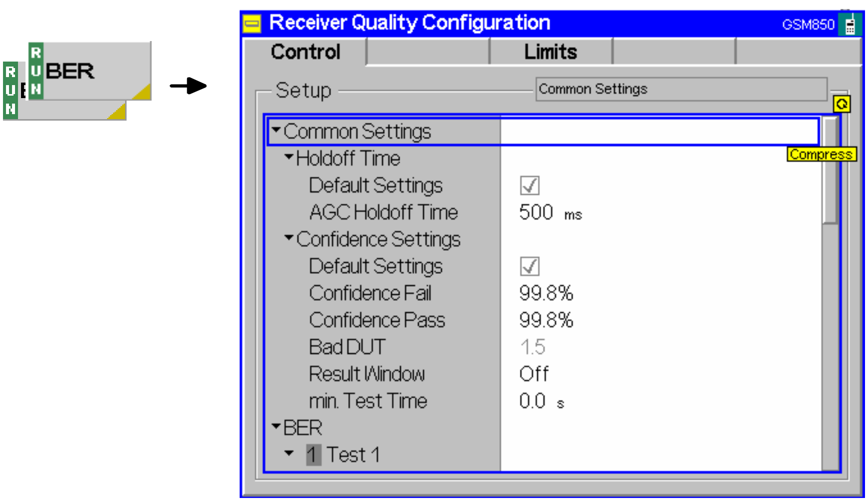


Fig. 4-67 Receiver Quality – Control

Default The first *Default* switch overwrites all settings in the *Control* tab with default values. Besides, there are default switches acting on every individual BER test setup, on the continuous mode and on the *BLER* application.

Remote control
```
CONFigure:RXQuality:CONTrol:DEFault  ON | OFF
CONFigure:RXQuality:BER<nr>:CONTrol:DEFault  ON | OFF
CONFigure:RXQuality:BAVerage:CONTrol:DEFault  ON | OFF
CONFigure:RXQuality:BLER:CONTrol:DEFault  ON | OFF
```

Common Settings The *Common Settings* section specifies a holdoff time that is necessary for the adjustment of the mobile station to the BER measurement.

AGC Holdoff Time Time during which the mobile can adjust itself to the new RF level at the beginning of the Receiver Quality measurement (automatic gain control). The *AGC Holdoff Time* is also applied if the RF level changes during the *Receiver Quality* measurement.

The holdoff time to be set depends on the performance of the mobile station. A reduction of the holdoff time towards the mobile-dependent lower limits can accelerate the measurement.

Remote control
`CONFigure:RXQuality:CONTrol:AGCTime <AGCTime>`

Confidence Settings

The *Confidence Settings* section sets the parameters for statistical BER tests. For background information and application examples refer to section *Statistical BER Tests* on p. 4.141 ff. The settings are available for the *BER* application and valid in the measurement modes *RBER/FER, BER* and *Burst by Burst.*

Note: *In the measurement modes* RBER/FER *and* BER, *the Class II BER provides the pass/fail criteria. In the measurement modes* Burt by Burst *and* BER/DBLER, *the* BER *calculated from all bits is used. No statistical results are provided for AMR full rate tests and for measurement in GPRS test mode A.*

Statistical testing is activated by setting *Stop Condition = Confidence Level;* see below. The results *(Early Fail, Early Pass etc.)* are displayed in the measurement menu. The following confidence settings are provided:

Confidence Fail Confidence level for early fail decisions: After the *Min. Test Time*, the confidence test is stopped with an *"Early Fail"* message as soon as the probability of the DUT to have a BER above the specified upper limit (see section *Upper Limits for Bit Error Rate (Receiver Quality Configuration – Limits)* on p. 4.163 ff.) is larger than the confidence fail value.

Confidence Pass Confidence level for early pass decisions: After the *Min. Test Time*, the confidence test is stopped with an *"Early Pass"* message as soon as the probability of the DUT to have a BER below the specified upper limit **times the *Bad DUT* factor** of 1.5 is larger than the confidence pass value.

Note: *The confidence levels are the complement of the* probabilities of wrong decision F *used in the test specification:*
<Confidence Level> = 1 – F.

Bad DUT Fixed bad DUT factor of 1.5; see section *Statistical BER Tests* on p. 4.141 ff.

Result Window BER range factor for statistical dual-limit BER tests. A factor of n % means that the BER must be within the range [<BER Limit> (1 – n %), <BER Limit> (1 + n %)]. The *OFF* setting corresponds to a single-limit BER test.

Min. Test Time Minimum test time before a check of the early pass and early fail limits can stop the measurement. Minimum test times are necessary in particular if the test conditions introduce some fluctuations that disturb the statistical independence of the single bit error events and must be averaged out (e.g. multipath fading, birth/death propagation, moving propagation).

Remote control
```
CONFigure:RXQuality:BER:CONTrol:CONFidence:FAIL
CONFigure:RXQuality:BER:CONTrol:CONFidence:PASS
CONFigure:RXQuality:BER:CONTrol:CONFidence:RWINdow
CONFigure:RXQuality:BER:CONTrol:CONFidence:MTTIme
```

Search Settings

The *Search Settings* section sets the stop conditions for an *RF Level Search*.

The search iteration starts at the TCH BER levels defined for each test setup. It is stopped with an error message and a red output field in the *Receiver Quality* menu if one of the two conditions is met:

- The maximum number of iteration steps/cycles (single BER measurements at a specific level) has been reached, i.e. the convergence is too slow (error message *Max cycles reached)*.
- An RF level to be measured gets outside a specified level range, i.e. the target BER is likely to be too irregular as a function of the RF level (error message *Level limit reached)*.

The search is considered to be successful and stopped (with no error message but the level result in the output field; see section *BER and BER Average* on p. 4.148 ff.) if convergence has been reached, i.e. if the levels in consecutive cycles are close enough to each other.

The search settings are available for the *BER* application and valid in the measurement modes *RBER/FER, BER*, *Burst by Burst,* and *BER/DBLER:*

Max. Cycles	Maximum number of single measurements.
Upper Level Limit	Maximum allowed RF level during the search procedure.
Lower Level Limit	Minimum allowed RF level during the search procedure.

Remote control
```
CONFigure:RXQuality:CONTrol:SEARch:MCYCles
CONFigure:RXQuality:CONTrol:SEARch:LLIMit
CONFigure:RXQuality:CONTrol:SEARch:ULIMit
```

BER Test Setups

The *BER* table section defines up to 10 user-specific configuration files for single shot *Receiver Quality* measurements (application *BER).* The test setups are numbered from 1 to 10 and can be called up via the *Test Setup* hotkey associated to the *BER* softkey. They differ from each other in the default settings for the signal power of the CMU and the criteria for analysis.

Remote control
The application number is denoted by a numeric suffix in the RXQuality commands `(...RXQuality:BER<nr>:...)`.

Test Name

The *Test Name* option assigns a name to each of the 10 test setups. In the *Test Setup* hotkey, the individual test setups are referenced with their *Test Names*.

Remote control
A numeric suffix in the RXQuality commands `(...RXQuality:BER<nr>:...)` denotes the application number.

Stop Condition

The *Stop Condition* parameter defines a stop condition for the measurement:

None	Continue measurement even in case of error
1st Limit exceeded	Stop measurement on first error (tolerance exceeded)
All Limits exceeded	Stop measurement if all tolerances are exceeded
Confidence Level	Stop measurement as soon as the BER confidence level exceeds the values set in the *Confidence Settings* section described on p. 4.159.
RF Level Search	Repeated single-shot measurement at varying signal level until a certain target bit error rate *(Class II Bits)* is found or a

stop condition is met. The target bit error rates are defined in the *Limits* tab of the configuration menu. A different target value can be set for each test setup. The *Class II Bits* limits represent the limits for unprotected bits in the meas. modes *BER, RBER/FER, Burst by Burst,* or *BER/DBLER* (see *Meas. Mode* on p. 4.161). In the meas. mode *AMR Inband FER,* no RF Level Search is possible.

The search iteration is confined to a level interval and is stopped after a maximum number of measurement cycles; see paragraph on *Search Settings* on p. 4.160.

Remote control

```
CONFigure:RXQuality:BER<nr>:CONTrol:REPetition
  ALIMits | FLIMit | CLEVel | RFLS NONE,<StepMode>
CONFigure:RXQuality:BAVerage:CONTrol:REPetition
  ALIMits | FLIMit | NONE, <StepMode>
```

Frames

The parameter *Frames* defines the statistic count (= the number of speech or data frames to be sent in a *BER* measurement). A low value permits to limit the scope and accelerate the measurement.

The meaning of a frame and its bit content depends on the service, the frame type and the channel coding; see section *Frame Structure for Speech and Data Channels* on p. 4.139 ff.

Remote control

```
CONFigure:RXQuality:BER<nr>:CONTrol <Mode>,<FramesToSend>
```

Meas. Mode

Meas. Mode selects the quantities to be measured. For a list of measurement modes and corresponding measurement results see also section *Measurement Results* on page 4.148 ff.

The following measurement modes are available in circuit switched mode (see *Main Service* on p. 4.107):

BER	Bit error rate (separately for class II and class Ib bits)
RBER / FER	Residual bit error rate (separately for class II and class Ib bits) and frame erasure rate
Burst by Burst	Accelerated measurement, only class II bits are transmitted
BER / DBLER	Bit error rate and data block error rate
AMR Inband FER	Frame Error Rate (FER) for AMR inband signalling codewords. The results for the measurement mode *AMR Inband FER* (with option R&S CMU-K45) are described in section *AMR Reference Sensitivity Test* on p. 4.236 ff.

The following measurement modes are available in packet data mode (GPRS or EGPRS, with option CMU-K42 or CMU-K43; see *Main Service* on p. 4.107):

BER / DBLER	Bit error rate, data block error rate, USF BLER, and *False USF Detection* (test mode B; see section *BER Tests of PDTCHs* on p. 4.135 ff.)
USF BLER only	USF BLER and *False USF Detection,* but no BER and no DBLER. For test mode A, *USF BLER only* and *BER / DBLER* are equivalent; see section *BER Tests of PDTCHs* on p. 4.135 ff. *USF BLER only* is particularly suitable for measuring the *USF BLER* at low downlink signal levels. Usually the BER and DBLER results are much larger than the *USF BLER* (especially for the higher modulation and coding schemes where the error

protection for the data bits is poor while the USF is still error protected). As the downlink signal power decreases the *Receiver Quality* measurement is stopped before a *USF BLER* different from zero can be obtained. *USF BLER only* circumvents this problem.

All measured quantities are defined at the beginning of section *Receiver Quality Measurements* on page 4.133 ff.

Remote control
```
CONFigure:RXQuality:<Application>:CONTrol[:CSWitched]
      RFER | BER | BBB | BDBL,<FramesToSend>
CONFigure:RXQuality:<Application>:CONTrol:PDATa
      BDBL | UBONly,<FramesToSend>
```
Where `<Application> = BER<nr> | BAVerage`

Average The parameter *Average* defines the number of frames to be averaged in a *BER Average* measurement. The meaning of a frame and its bit content depends on the service, the frame type and the channel coding; see section *Frame Structure for Speech and Data Channels* on p. 4.139 ff.

Remote control
```
CONFigure:RXQuality:BAVerage:CONTrol <Mode>,<FramesToAverage>
```

The following statistical settings are relevant for *BLER* measurements only:

Repetition Selects the repetition mode for the *BLER* measurement (single shot or continuous BLER measurement).

Remote control
```
CONFigure:RXQuality:BLER:CONTrol:REPetition SING | CONT
```

RLC Block Count *RLC Block Count* sets the number of RLC blocks to be sent and evaluated per single-shot BLER measurement. The hotkey is available in the *BLER* application and if the *Repetition* mode is set to *Single Shot.*

An RLC block is transmitted every 20 ms in each used DL timeslot so that the total measurement time amounts to:

Meas. Time = 20 ms x <RLC Block Count> / <Number of used DL slots>

The bit content of a frame and its depends on the service, the frame type and the channel coding; see section *Frame Structure for Speech and Data Channels* on p. 4.139 ff.

Remote control
```
CONFigure:RXQuality:BLER:CONTrol:RLBCount
```

DL Resources in Use *DL Resources in Use* selects the percentage of DL RLC blocks assigned to the MS under test and used for the BLER calculation. 100% corresponds to an assigned block rate of 1 block per 20 ms in each timeslot. The assigned block rate can be reduced by a factor of n/12 where n = 1 to 11; the remaining (12 – n)/12 blocks are dummy blocks.

The settings can be used to test a possible dependence of the BLER on the block rate. A lower percentage of DL resources in use reduces the stress on the MS receiver but increases the measurement time for the BLER measurement.

Remote control
```
CONFigure:RXQuality:BLER:CONTrol:DLDCycle RB1 | … | RB12
```

The following level settings for the BS traffic channel are valid during the *Receiver Quality* measurement only; they don't supersede the downlink levels defined in the *Slot Configuration Editor* described in section *Softkey-oriented Version: MS Multislot Mode* on p. 4.179 ff.

In circuit switched mode, two alternative ways of defining the TCH levels are provided: Depending on the *Level Mode* setting in the *Slot Configuration Editor,* either the *TCH Level BER* or the *Individual Levels BER* is used. For packet data channels only the *Individual* level mode is provided.

TCH Level BER

The *TCH Level BER* section defines the traffic channel level in the *Used/Unused* level mode (see *Level Mode* softkey in section *Softkey-oriented Version: MS Multislot Mode* on p. 4.179 ff.).

used Timeslot — Absolute level in all active (used) timeslots

unused Timeslot — Level in the unused timeslots of the traffic channel relative to the level in the used timeslots.

The level in the used timeslot(s) is specified in dBm. The allowed level range depends on the selected RF output of the CMU and the external attenuation set.

The level in the unused timeslots is specified relative to the level in the used timeslot(s) in dB. The actual level in the unused timeslots must also lie within the permissible range for the RF outputs. This condition may place an additional restriction on the permissible level range for the unused timeslots.

Remote control

```
CONFigure:RXQuality:BER<nr>:CONTrol[:CSWitched][:TCH]
         :LEVel:UTIMeslot
CONFigure:RXQuality:BER<nr>:CONTrol[:CSWitched][:TCH]
         :LEVel:UNTimeslot
```

Individual Levels BER

The *Individual Levels BER* section defines the traffic channel level in the *Individual* level mode (see *Level Mode* softkey in section *Softkey-oriented Version: MS Multislot Mode* on p. 4.179 ff.). This section is provided for circuit-switched as well as for packet data channels.

Reference Level — Absolute reference level for the individual downlink (BS) signal levels.

Slot 0 to 7 — Level in the individual timeslots in dB, relative to the reference level.

The allowed level range depends on the selected RF output of the CMU and the external attenuation set.

Remote control

```
Configure:RXQuality:<Applic>:CONTrol:<Main_Service>[:TCH]
         :MSLot:RLEVel
CONFigure:RXQuality:<Applic>:CONTrol:<Main_Service>[:TCH]
         :MSLot:LEVel:INDividual etc.
CONFigure:RXQuality:BER<nr>:CONTrol:<Main_Service>[:TCH]
         :MSLot:LEVel[:SLOT]:ZERO etc.
```

Where <Main_Service> = [CSWitched] | PDATa

Upper Limits for Bit Error Rate (Receiver Quality Configuration – Limits)

The *Limits* tab defines the upper limits for the individual measured quantities in the Receiver Quality menu. All settings can be defined separately for the two applications *BER* (with up to ten different test setups) and *BER Average.* Which of the configured quantities are actually measured depends on the measurement mode set *(BER, RBER/FER*, or *Burst by Burst*, see section *Measurement Results* on page 4.148).

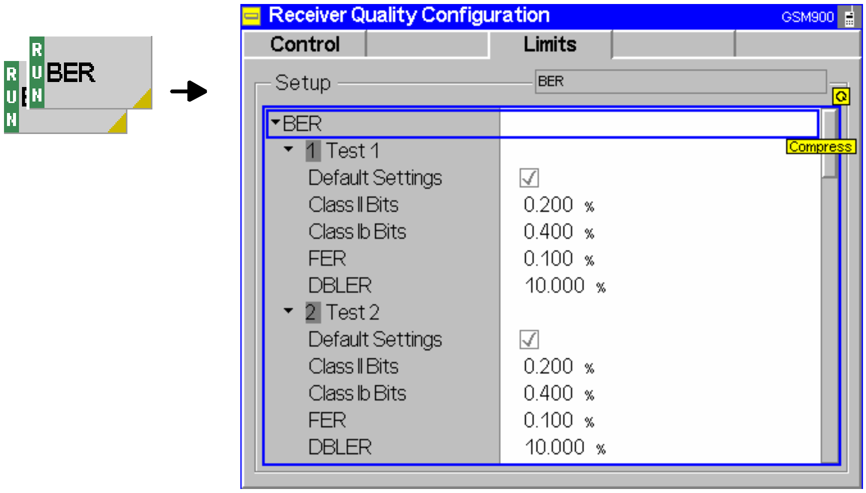


Fig. 4-68 Receiver Quality Configuration – Limits

Default Settings

The *Default* switches overwrite the settings belonging to an individual BER test setup or to the BER Average mode.

Remote control
```
CONFigure:RXQuality:BER<nr>:LIMit:DEFault  ON | OFF
CONFigure:RXQuality:BAVerage:LIMit:DEFault  ON | OFF
```

Class II Bits

Upper limit of the bit error rate (or residual bit error rate or burst by burst bit error rate, depending on the mode) for class II bits (unprotected bits) in the value range 0% to 100%.

Remote control
```
CONFigure:RXQuality:BER<nr>|BAVerage:LIMit:CLII <ClassIIBER>
```

Class Ib Bits

Upper limit of the bit error rate (or residual bit error rate, depending on the mode) for class Ib bits (partly protected bits) in the value range 0% to 100%.

Remote control
```
CONFigure:RXQuality:BER<nr>|BAVerage:LIMit:CLIB <ClassIbBer>
```

FER

Upper limit for frame error rate (frame erasure rate), relative number of invalid and therefore erased frames in the value range 0% to 100% (only measured in measurement mode *RBER/FER)*.

The default settings for the three upper limits reflect the importance of the three measured quantities for evaluation of the transmission and received-signal quality (in the case of unprotected bits, a higher error rate is expected and accepted than in the case of protected bits, etc.).

Remote control
```
CONFigure:RXQuality:BER<nr>|BAVerage:LIMit:FERRors
         <Frame_Errors>
```

DBLER Upper limit of the Data Block Error Rate in the value range 0% to 100% (only measured in measurement mode *BER/DBLER)*.

Remote control
`CONFigure:RXQuality:BER:LIMit:DBLer`

USF BLER Upper limit of the USF Block Error Rate in the value range 0% to 100%. Only measured in measurement mode *BER/DBLER* and on packet switched data channels (GPRS, option CMU-K42).

The USF BLER limit is also used as a limit for the *False USF Detection* result.

Remote control
`CONFigure:RXQuality:BER:LIMit:USFBler`

Connection Control

The menu group *Connection Control* controls the signalling procedures (call setup and release, services, signalling parameters) and determines the inputs and outputs with the external attenuation values and the reference frequency.

The purpose of the *Signalling* test mode is to perform transmitter and receiver tests with an existing call (or data transfer) connection between the CMU and the mobile. Therefore the menus for setting up a connection (*Connection Control – Connection)* appear immediately after the function group and mode *GSM400/GT800/850/900/1800/1900-MS Signalling* is activated. Besides, all the tabs in the *Connection Control* menu can be called up by pressing the *Connect. Control* softkey at the top right in every measurement menu. They are linked with each other via the hotkey bar at the lower edge of the screen. Pressing the *Escape* key closes the active *Connection Control* menu and re-activates the underlying measurement menu.

The tabs *Connection Control – Connection* displayed during synchronization are described at the beginning of section *GSM Measurements with Signalling* on p. 4.104 ff. The remaining *Connection Control – Connection* tabs are described below.

Connection Control in the Synchronized State

In addition to the parameter overview described in section *Connection Control with Call Established* on p. 4.169 ff., the *Network Support* and *Main Service* softkeys, and the wideband power measurement described in section *Signalling Control without Signal (State Signal Off)* on p. 4.105 ff., the *Connection (Synchronized)* tab contains the following softkeys which lead to other signalling states:

- Deactivation of the control channel signal for synchronization *(Signal Off)*
- Establishing a call to the mobile station (*Connect Mobile* -> state *Alerting)*
- Short message service *(Send SMS* -> return to state *Synchronized).*

The popup menu *Connection (Synchronized)* is opened when a successful call (in which case a location update is considered as being already performed) is released *(Disconnect Mobile* softkey in the *Alerting* or in the *Call Established* state, MS call release, loss of radio link) or when a location update is initiated by the mobile phone. It is replaced by the *Connection (Alerting)* menu if the CMU initiates a call to the mobile phone (Softkey *Connect Mobile),* or by the *Connection (Call Established)* menu if the mobile phone initiates a call to the CMU, see *Fig. 4-45* on page 4.105.

Note: *If the synchronization is lost during operation (because of a low signal level etc.) the warning Synchronization Lost ! will appear.*

At the same time, bit 2 is set in the STATus:OPERation register. To continue, confirm that you received the message by pressing the Accept button.

Connect. Control →

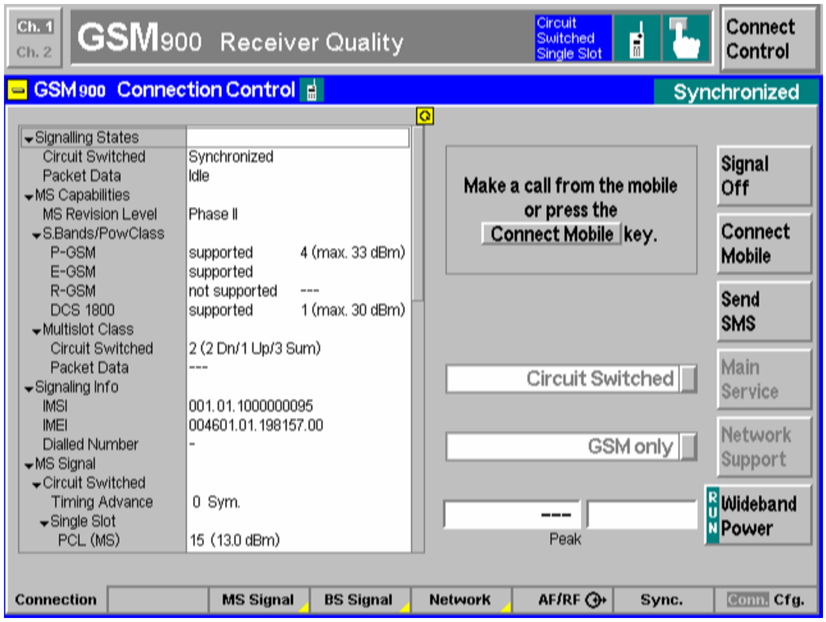


Fig. 4-69 Connection Control – Connection (Synchronized)

The function of the *Power* softkey is described in the section *Signalling Control without Signal (State Signal Off)* on page 4.105, the softkeys *Signal Off* and *Send SMS* in the section *Connection Control with Signal (State Signal On)* on page 4.108.

The parameter overview in the left half of the menu is also indicated in the other *Connection* tabs and is described in section *Connection Control with Call Established* on p. 4.169 ff. Some parameters are not always available, depending on the current and previous signalling states and settings. In this case the table shows invalid or unavailable settings ("---").

Header Message A Header Message (here: *Make a call from the mobile or press the "Connect Mobile" key)* displayed on top of each *Connection* tab informs on the current instrument state or indicates how to proceed to get to other signalling states.

Connect Mobile

The softkey *Connect Mobile* establishes a call to the mobile station.

A user prompt below the header indicates the function of this softkey. After it is pressed the two successive header messages *Paging in progress ... Call to mobile in progress* are displayed. As soon as the mobile responds (rings), the CMU changes to the signalling state *Alerting.* As soon as the call is accepted at the mobile, the CMU changes to the signalling state *Call Established*.

If the mobile does not respond to the CMU's paging messages within a fixed period of time, the notice message *Call to mobile was no successful* is displayed and bit no. 6 of the STATus:OPERation:CMU:SUM1|2:CMU<nr> sub-register, *Paging Failed,* is set.

Remote control
`PROCedure:SIGNalling[:CSWitched]:ACTion MTC`

Connection Control in the Alerting State

In addition to the parameter overview described in section *Connection Control with Call Established* on p. 4.169 ff., the *Network Support* and *Main Service* softkeys, and the wideband power measurement described in section *Signalling Control without Signal (State Signal Off)* on p. 4.105 ff., the *Connection (Alerting)* tab contains the following softkeys which lead to other signalling states:

- Deactivation of the control channel signal for synchronization and call release *(Signal Off)*
- *Disconnect Mobile* while keeping the control channel signal switched on (-> state *Synchronized)*

The popup menu *Connection (Alerting)* is opened while the mobile phone is ringing during a call setup *(Connect Mobile* softkey in the *Signal On* or in the *Synchronized* state). It is replaced by the *Connection (Call Established)* menu when the mobile phone accepts the call (is picked up*)*, or by the *Connection (Synchronized)* menu if the call is released *(Disconnect Mobile* softkey, MS call release, alert timeout, loss of radio link), see *Fig. 4-45*.

Connect. Control →

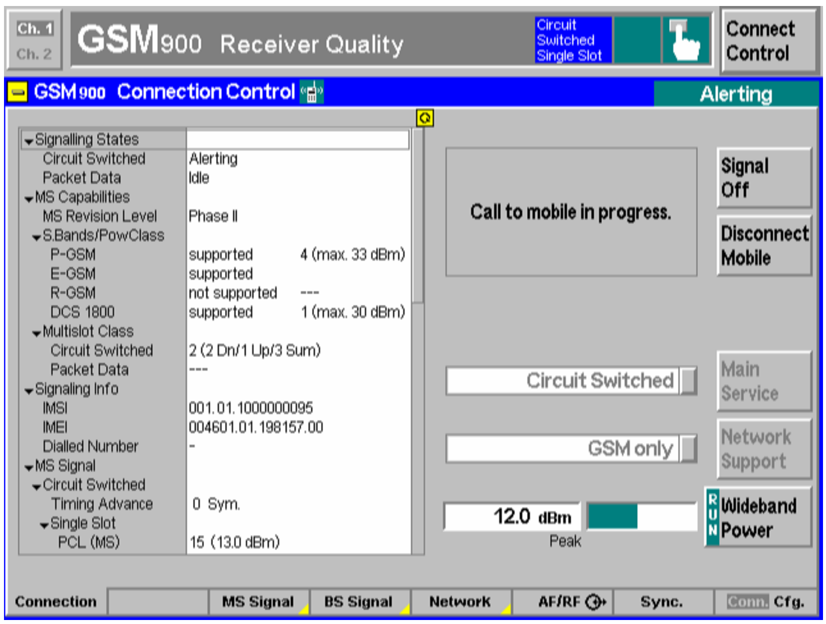


Fig. 4-70 Connection Control – Connection (Alerting)

The function of the *Wideband Power* softkey is described in the section *Signalling Control without Signal (State Signal Off)* on page 4.105, the softkey *Signal Off* softkey in section *Connection Control with Signal (State Signal On)* on page 4.108.

The parameter overview in the left half of the menu is also indicated in the other *Connection* tabs and is described in section *Connection Control with Call Established* on p. 4.169 ff. Some parameters are not always available, depending on the current and previous signalling states and settings. In this case the table shows invalid or unavailable settings ("---").

Header Message A Header Message displayed on top of each *Connection* tab informs on the current instrument state or indicates how to proceed to get to other signalling states.

Disconnect Mobile

The *Disconnect Mobile* softkey releases the call to the mobile station. The CMU changes to the signalling state *Synchronized*.

Remote control
`PROCedure:SIGNalling[CSWitched]:ACTion CRELease`

Connection Control with Call Established (State Call Established)

In addition to the parameter overview described in section *Connection Control with Call Established* on p. 4.169 ff., the *Network Support* and *Main Service* softkeys, and the wideband power measurement described in section *Signalling Control without Signal (State Signal Off)* on p. 4.105 ff., the *Connection (Call Established)* tab contains the following softkeys which lead to other signalling states:

- Deactivation of the signal for synchronization and call release to the mobile station *(Signal Off)*
- Call release to mobile station (*Disconnect Mobile* -> state *Synchronized)*
- Short message service *(Send SMS* -> return to state *Call Established)*

The popup menu *Connection (Call Established)* can be opened after a call from the CMU *(Call to MS* softkey in the *Signal On* or in the *Synchronized* state) is accepted at the mobile or after a successful call from the mobile. It is replaced by the *Connection (Synchronized)* menu if the call is released *(Disconnect Mobile* softkey, MS call release, alert timeout, loss of radio link), or by the *Connection (Signal On)* menu if the mobile is switched off, see *Fig. 4-45*.

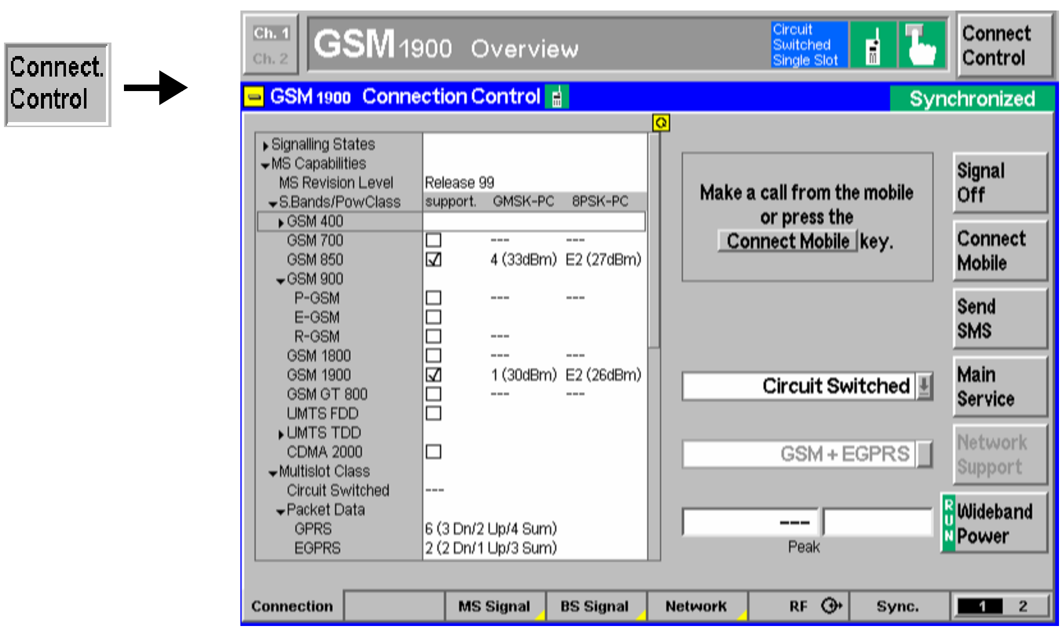


Fig. 4-71 Connection Control – Connection (Call Established)

The function of the softkeys *Signal Off* and *Wideband Power* is described in section *Signalling Control without Signal (State Signal Off)* on page 4.105, the *Send SMS* softkey in section *Connection Control with Signal (State Signal On)* on page 4.108, the *Disconnect Mobile* softkey in section *Connection Control in the Alerting State* on page 4.167.

The parameter overview in the left half of the menu is also indicated in the other *Connection* tabs. Some parameters are not always available, depending on the current and previous signalling states and settings. In this case the table shows invalid or unavailable settings ("---").

Header Message A Header Message displayed on top of each *Connection* tab informs on the current instrument state or indicates how to proceed to get to other signalling states.

Signalling States The *Signalling States* section indicates the current signalling states of the CMU in GSM *(Circuit Switched,* see *Fig. 4-45* on p. 4.105*)* and GPRS *(Packet Data)* mode. GSM and GPRS states are independent from each other. The GPRS signalling scheme is described in section *GPRS Signalling* on p. 4.213 ff.

The signalling states of the CMU are changed by means of the right softkeys in the *Connection* tabs of the *Connection Control* menu; see below.

Remote control
```
[SENSe]:SIGNalling[:CSWitched]:STATe?
[SENSe]:SIGNalling:PDATa:STATe?
```

MS Capabilities The *MS Capabilities* section indicates the characteristics of the mobile station under test. Valid parameter values are available as soon as the CMU has reached the GSM *Synchronized* or in the GPRS *Attached* signalling states. The *Dialed Number* is shown after a *Call from MS*.

Note: *In the* Network *tab of the* Connection Control *menu, it is possible to disable the request of various information elements from the MS in order to speed up the location update or connection; see* Requested Mobile Data *on p.* 4.200*.*

MS Revision Lev. GSM phase (Phase 1, Phase 2 or Phase 2+) of the mobile station.

S. Bands/PowClass
Supported GSM band(s), power class and nominal maximum output power in dBm of the mobile station. The power classes for GMSK and 8PSK modulation *(GMSK-PC, 8PSK-PC)* are displayed in separate columns. For GSM900 mobile stations, the R-GSM, E-GSM, and P-GSM subbands are also indicated, e.g. *E-GSM / 1 (max. 39 dBm).* For mobiles supporting several GSM bands or subbands, several lines are filled with valid results.

Multislot Class Multislot class of mobile station in GSM *(Circuit Switched)* mode, in (E)GPRS *(Packet Data)* mode, and in Dual Transfer Mode (DTM). The multislot class is displayed in the format *<Multislot Class> (<max. no. of downlink slots> Dn/<max. no. of uplink slots> Up/<Sum> Sum)*, e.g. 4 (2 Dn/2 Up/3 Sum). A mobile station may indicate different multislot classes for circuit-switched services and for (E)GPRS (see GSM 04.08). The MS multislot classes are defined in 3GPP TS 05.02 and listed in *Table 4-19 below*.

Remote control
```
[SENSe:]MSSinfo:POWer:CLASs[:GMSK]?
[SENSe:]MSSinfo:POWer:CLASs:EPSK?
[SENSe:]MSSinfo:REVision?
[SENSe:]MSSinfo:BANDs?
[SENSe:]MSSinfo:SBANds?
[SENSe]:MSSinfo:MSCLass:CSWitched?
[SENSe:]MSSinfo:MSCLass:PDATa[:GPRS]?
[SENSe:]MSSinfo:MSCLass:PDATa:EGPRs?
[SENSe]:MSSinfo:MSCLass:DTM[:GPRS]?
[SENSe]:MSSinfo:MSCLass:DTM:EGPRs?
```

Table 4-19: MS multislot classes

Multislot class	**Maximum number of slots**		
	Downlink (MS RX)	**Uplink (MS TX)**	**Sum**
1	1	1	2
2	2	1	3
3	2	2	3

Multislot class	Maximum number of slots Downlink (MS RX)	Uplink (MS TX)	Sum
4	3	1	4
5	2	2	4
6	3	2	4
7	3	3	4
8	4	1	5
9	3	2	5
10	4	2	5
11	4	3	5
12	4	4	5
13	3	3	not applicable
14	4	4	not applicable
15	5	5	not applicable
16	6	6	not applicable
17	7	7	not applicable
18	8	8	not applicable
19	6	2	not applicable
20	6	3	not applicable
21	6	4	not applicable
22	6	4	not applicable
23	6	6	not applicable
24	8	2	not applicable
25	8	3	not applicable
26	8	4	not applicable
27	8	4	not applicable
28	8	6	not applicable
29	8	8	not applicable

RX describes the maximum number of receive timeslots that the MS can use per TDMA frame. TX describes the maximum number of transmit timeslots that the MS can use per TDMA frame. The MS must be able to support all integer values of receive timeslots from 0 to RX and all integer values of transmit timeslots from 0 to TX (depending on the services supported by the MS).

Sum is the total number of uplink and downlink TS that can actually be used by the MS per TDMA frame. The MS must be able to support all combinations of integer values of RX and TX timeslots where $1 \leq RX + TX \leq Sum$ (depending on the services supported by the MS). Sum is not applicable to all classes.

MS Capabilities – Signalling Info

The *Signalling Info* section indicates the code numbers identifying the mobile station under test and the dialed number.

IMSI International mobile subscriber identity in the format MCC.MNC.MSIN

MCC 3-digit mobile country code

MNC 2- or 3-digit mobile network code

MSIN 10- or 9-digit mobile subscriber ID

IMEI international mobile station equipment identity in the format TAC.FAC.SNR.SVN

TAC 6-digit type approval code

FAC 2-digit final assembly code

SNR 6-digit serial no.

SVN 1- or 2-digit software version number

Dialed Number Number dialed at the mobile station *(Call from MS)*

Remote control

```
[SENSe:]MSSinfo:IMSI:MCC?
[SENSe:]MSSinfo:IMSI:MNC?
[SENSe:]MSSinfo:IMSI:MSIN?
[SENSe:]MSSinfo:IMEI:TAC?
```

```
[SENSe:]MSSinfo:IMEI:FAC?
[SENSe:]MSSinfo:IMEI:SNR?
[SENSe:]MSSinfo:IMEI:SVN?
[SENSe]:MSSinfo:DNUMber
```

MS Signal The *MS Signal* section indicates important parameters describing the signals that the MS is to transmit. These parameters are set in the *MS Signal* tab and explained in greater detail there (see section *RF Signals of the MS (Connection Control – MS Signal)* on page 4.176 ff.).

Remote control
`CONFigure:MSSignal...`

BS Signal The *BS Signal* section indicates important parameters describing the signals that the CMU transmits in the state *Signal On*. These parameters can be set in the *BS Signal* tab and are explained there in more detail (see section *RF Signals of the CMU (Connection Control – BS Signal)* on page 4.184 f.).

Remote control
`CONFigure:BSSignal...`

Network The *Network* section indicates the most important network parameters currently used by the CMU. These parameters can be set in the *Network* tab and are explained there in more detail (see section *Network Parameters (Connection Control – Network)* on page *4.192*).

Remote control
`CONFigure:NETWork...`

AF/RF The table *AF/RF* indicates the RF connectors and external attenuation settings. These parameters are set in the tab AF/*RF* and are explained in greater detail there (see section *RF Connectors (Connection Control – RF Input/Output.)* on page *4.95* ff.).

Remote control
`[SENSe:]CORRection:LOSS...?`

Handover to another Network (Connection Control – Handover)

The *Handover* tab initiates a handover of the GSM connection to a different GSM network or to an UTRAN cell (WCDMA FDD InterCell). It is therefore available in the signaling states *Call Established* (circuit switched main service, see section *Signalling Control without Signal (State Signal Off)* on p. 4.105 ff.) or *TBF Established* (packet data main service, (E)GPRS mode, for a GSM dual band handover only). Handover includes:

1. Selection of the target GSM network or of a GSM to WCDMA handover *(Destination Selection).*
2. GSM or WCDMA prepare session with configuration of the essential target network parameters *(Destination Parameter).*
3. Start of the handover procedure *(Handover).* The target UTRAN cell for a GSM to WCDMA handover is created during the handover procedure; the mobile doesn't have to measure the cell while it is still connected to the GSM network (blind handover).

Note: *The CMU also supports reverse handover from a WCDMA to a GSM connection. For more information refer to the operating manual for WCDMA UE tests (CMU-K65/…/-K69), stock no. 1115.4962.12.*

The following GSM functions are only relevant for WCDMA to GSM handovers and therefore described in the WCDMA manual:

Cell Synchronization:	*Finely Synchronized or Non-synchronized*
Alerting:	*None or With GSM Setup Message*

The remote control commands belong to the GSM function groups and are described in Chapter 6 of the present GSM manual; refer to:

`CONFigure:HANDover:ALERting; CONFigure:HANDover:CSYNc`

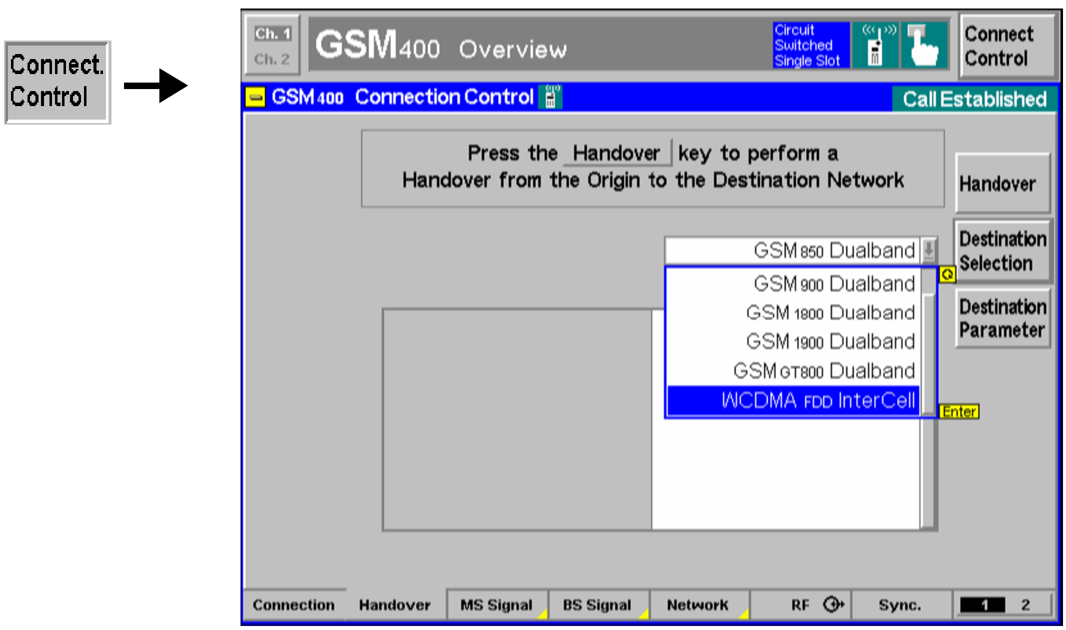


Fig. 4-72 Connection Control – Handover (destination selection)

Destination Selection

The softkey *Destination Selection* selects the target network for handover.

Dual-band handover between all enabled GSM bands is supported. Once the selection is confirmed via *Enter,* the CMU changes to the *Call Pending* signalling state. In this state, the entire *Connection Control* menu is mapped onto the target function group, so it is possible to edit the *Destination Parameters* (see below), the *BS Signal*, and the *Network* parameters of the target network.

Remote control

```
STATus:HANDover:TARGet:LIST?
CONFigure:HANDover:TARGet <Target>
```

Note: Call Pending *is an intermediate signalling state that only occurs in the context of a handover process. For a complete overview of signalling states see Fig. 6.1 in chapter 6 of this manual.*

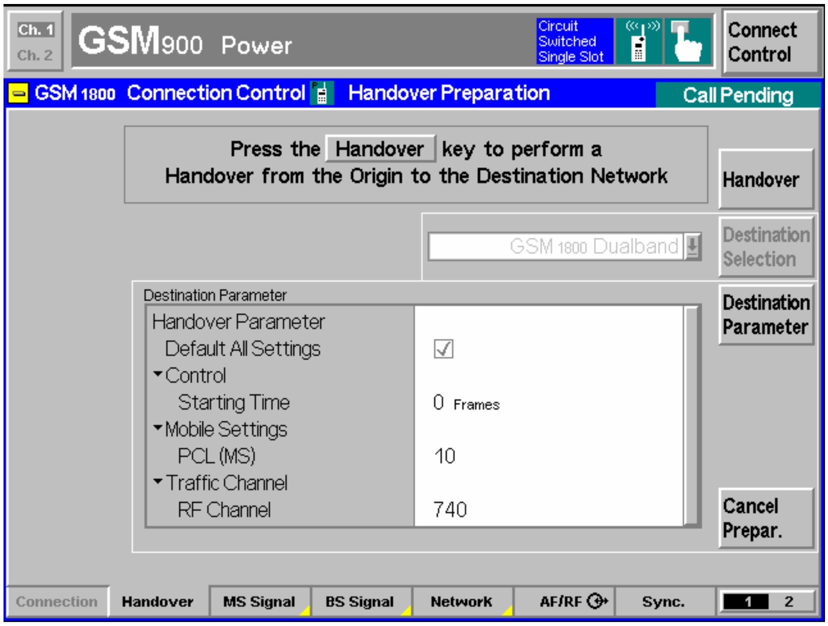


Fig. 4-73 Connection Control – Handover (Call Pending, GSM dual band handover)

Destination Parameter

(GSM dual band)

The *Destination Parameter* softkey sets important target network parameters that come into effect as soon as the call is handed over.

If the target network is a GSM network, the following destination parameters can be set:

Default All Sett. Sets all *Destination Parameters* to default values.

RF Channel Traffic channel number used for the connection in the target network.

Note: *The channel numbers in GSM1800 and GSM1900 are ambiguous. To ensure that the RF Channel is correctly interpreted check the setting of the* Band Indicator *(see p. 4.202). For a handover between GSM1800 and GSM1900 the* Band Indicator *should be changed before the handover is initiated.*

The following additional parameters can be set if circuit switched main service is active (see section *Signalling Control without Signal (State Signal Off)* on p. 4.105 ff.):

Starting Time Time interval (in frames) after which the mobile station performs a new registration with the base station after a channel, timeslot, and fast power change.

PCL (MS) Power control level used by the mobile station to call and perform a location update in the target network.

The following additional parameters can be set if packet data main service is active (see section *Signalling Control without Signal (State Signal Off)* on p. 4.105 ff.):

Coding Scheme GPRS coding schemes for traffic data channels, CS1 to CS4; modulation and coding schemes MCS1 to MCS9 for EGPRS

See also section *Network Parameters (Connection Control – Network)* on page 4.192 ff.

Remote control

```
CONFigure:NETWork[:CSWitched]:SMODe:STIMe DEF
CONFigure:MSSignal[:CSWitched][:TCH][:SSLot]MS:PCL DEF
CONFigure:BSSignal[:CSWitched][:TCH]:CHANnel DEF
CONFigure:NETWork[:CSWitched]:SMODe:STIMe <Frames>
```

```
CONFigure:MSSignal[:CSWitched][:TCH][:SSLot]MS:PCL <PCL>
CONFigure:BSSignal[:CSWitched][:TCH]:CHANnel <TCH>
CONFigure:NETWork:OBANd OPPB1 | OPB2 | OPB3 …
```

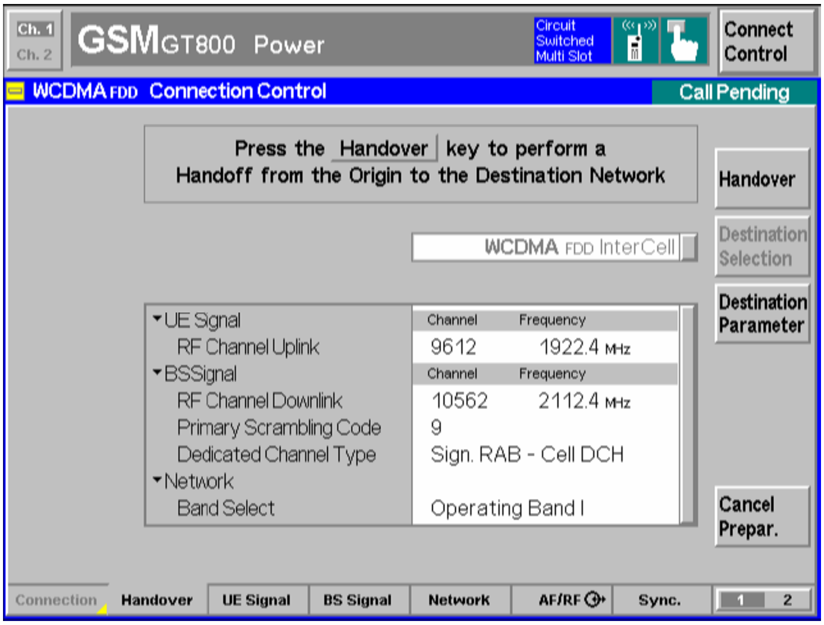


Fig. 4-74 Connection Control – Handover (Call Pending, WCDMA FDD InterCell handover)

Destination Parameter

WCDMA FDD InterCell

The destination parameters for a **WCDMA FDD InterCell handover** are set in the WCDMA destination network; they are described in detail in the operating manual for software options CMU-K65/…/69 *(WCDMA UE Tests, Generator, Signalling),* stock no. 1115.4962.12. The following destination parameters can be set:

RF Channel Uplink — Carrier frequency and channel number (UARFCN, UTRA Absolute Radio Frequency Channel Number) of the WCDMA signal that the UE transmits in the uplink.

RF Channel Downlink — Carrier frequency and channel number of the downlink WCDMA signal *(BS Signal)* generated by the CMU.

The assignment between channel numbers *N* and carrier frequencies *F* is defined in the 3GPP specification (TS 34.121). The following relation holds for both the uplink and downlink channels:

$$N = 5 \cdot (F / MHz), \quad 0.0\ MHz \le F \le 3276.6\ MHz$$

The following additional BS Signal and band parameters can be set:

PrimaryScrambling Code — Number of the primary scrambling code in the range 0 to 1FF (hex), corresponding to 0 to 511 decimal.

Dedicated Channel Type — Dedicated channel to be allocated between the CMU/UTRAN and the UE. The dedicated channel must be a *Voice, RMC,* or a *Sign. RAB - Cell DCH* channel.

Operating Band — One of the operating bands I to VI supported by the CMU. This parameter simplifies the RF channel selection because the default RF channel settings and the allowed ranges are adjusted according to the operating band.

Remote control

```
UNIT:RFANalyzer:FREQuency <Unit>
[SENSe:]RFANalyzer:FREQuency <Frequency>
UNIT:RFGenerator:FREQuency <Unit>
SOURce:RFGenerator:FREQuency <Frequency>
```

```
SOURce:RFGenerator:SCODe:PRIMary
CONFigure:BSSignal:DCH:TYPE  RMC | VOIC | SRAB
CONFigure:NETWork:OBANd OPPB1 | OPB2 | OPB3 …
```

Handover

The *Handover* softkey initiates a handover to the GSM or WCDMA target network.

GSM dual-band handover

After a GSM dual band handover the BS Signal tab no longer shows the current control channel settings (in particular, the *BCCH Mode, BCCH Level* and *BCCH Channel)* but displays "from other network", indicating that the values of the origin network have been left unchanged. Display of the current values is restored by returning to the target network or setting up the connection again.

WCDMA FDD InterCell handover

The mobile receives a handover request with the destination parameters while it is still GSM-connected. The target UTRAN cell is created during the handover procedure and replaces the GSM cell (blind handover). After a handover, the mobile is in the WCDMA *Connected* state where all WCDMA measurements can be performed. However, the mobile is not registered in the WCDMA network so that the CMU enters the *Signal On* state after the connection is released *(Disconnect UE)*.

The WCDMA FDD inter cell handover procedure switches off the Aux TX signal. If desired (e.g. in order to re-activate a GSM BCCH superimposed to the UTRAN cell and initiate a second handover back to GSM), the Aux TX signal can be switched on in the WCDMA handover prepare session. For details refer to the WCDMA UE operating manual.

PMAX for dual-band handover

After a dual-band handover to another GSM band, PMAX is also valid in the destination network. Due to the band-specific PCL scales (see Table 4-8 on 4.127), the actual maximum MS output power can change; see description of *PMAX* on p. 4.183.

Remote control
`PROCedure:SIGNalling[:CSWitched]:ACTion HANDover`

Cancel Prepar.

The *Cancel Prepar.* softkey cancels the *Handover* procedure and resets the CMU to the *Call Established* or *TBF Established* signalling state.

The destination parameters defined in the *Call Pending* state are maintained. To cancel the *Handover* procedure and return to the measurement mode, press the *ESCAPE* key or the *Connection Control* softkey.

Remote control
–

RF Signals of the MS (Connection Control – MS Signal)

The *MS Signal* tab configures the operating mode and the RF traffic channel signal of the MS under test. Some functions of the menu depend on the *Main Service (Circuit Switched* or *Packet Data (GPRS)* operating mode) and the *Slot Mode (Single Slot* or *Multislot* operation) of the mobile as well as on the signalling state of the CMU *(Call Established* or other states). As a consequence, settings may be disabled or even hidden in some operating modes of the CMU/MS test system. Exact information is provided in the command description in chapter 6 of this manual.

The present chapter describes the parameters related to circuit switched operation of the mobile phone. Tests in *Packet Data (GPRS)* mode require option CMU-K42. They are described in section *RF Signals of the MS (Connection Control – MS Signal)* on p. 4.223 ff.

The CMU provides a softkey-oriented version of the *MS Signal* tab and a table-oriented version with extended functionality. The *MS Signal* hotkey toggles between the two versions if it is pressed repeatedly.

Softkey-oriented Version: MS Single Slot Mode

The *Slot Mode* of the mobile can be set by means of the *Slot Mode* softkey before a call is established. While *Single Slot* mode is selected, the softkey-oriented version of the *MS Signal* tab determines

- The transmitter output power *(PCL)*, and *Timing Advance* of the MS
- The routing of the speech data *(DAI)* and the *Loop* for *Receiver Quality* tests.

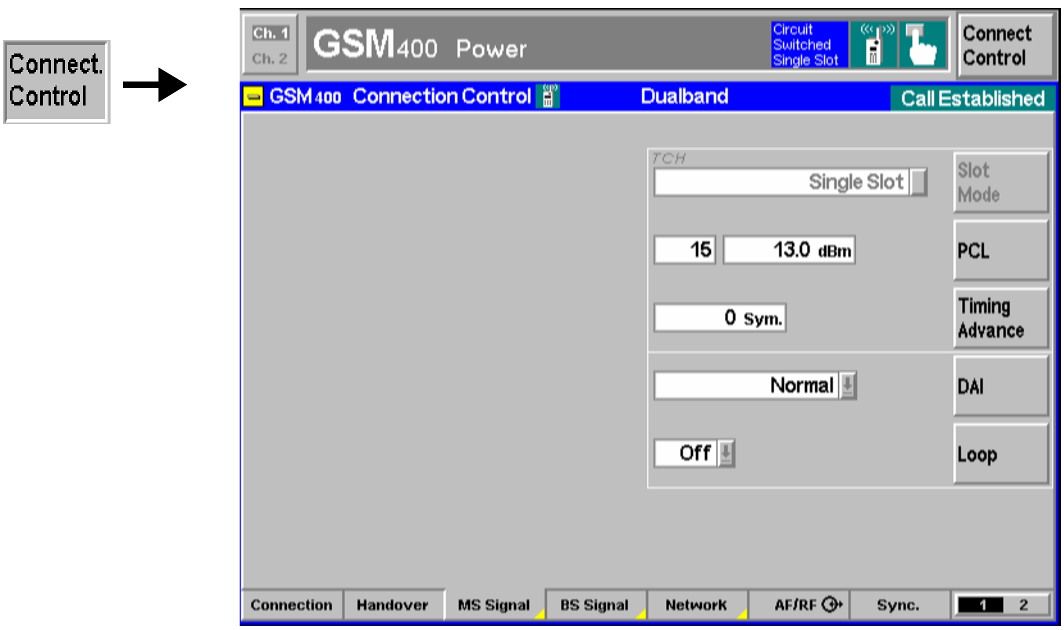


Fig. 4-75 Connection Control – MS Signal (panel, single slot)

Slot Mode

The *Slot Mode* softkey set the mobile station under test to either *Single Slot* or *Multislot* operation. As soon as a call is established the slot mode can no longer be changed and the softkey is disabled (grayed). The *Multislot* setting changes the other softkeys in the *MS Signal* tab (see section *Softkey-oriented Version: MS Multislot* on p. 4.179). It will come into effect only if the MS under test is capable of multislot operation (i.e. if it supports HSCSD or GPRS).

Remote control

```
CONFigure:SIGNalling[:CSWitched][:TCH]:SMODe SSL | MSL
```

PCL

The *PCL* softkey sets (signalling states < *Call Established)* or changes (signalling states *Call Established)* the MS output power during the connection. The softkey is identical to the *PCL (MS)* parameter in the table-oriented version of the MS Signal tab.

The MS transmitter output power can be selected in PCL (Power Control Level) units or as a corresponding absolute power value (in dBm with a 2 dBm spacing); see section *Limit Values for Average Burst Power (Power Configuration – Limits)* on page *4.127*.

Note: Power *measurements on normal bursts are performed at the MS output power set via* PCL *or the corresponding parameters for multislot or packet data mode. In contrast, the access burst is transmitted before a call is set up. The* P/t Access Burst *measurement is performed at the maximum power for the cell* PMAX *(see* PMAX *parameter on p.* 4.183*).*

Caution: If very small MS powers are specified, the mobile station, depending on its power class or GSM phase (phase 1 or 2, may actually transmit at a higher power so that the CMU may be overdriven.

Example (GSM900): The minimum level of phase 2 mobile phones is 5 dBm (PCL 19), the minimum level of phase 1 is 13 dBm (PCL 15). If PCL 19 is set but a phase 1 mobile station is used, this mobile will transmit at 13 dBm (PCL 15).

Remote control
```
CONFigure:MSSignal[:CSWitched][:TCH][:SSLot]:MS:PCL
PROCedure:SIGNalling[:CSWitched][:TCH][:SSLot]:MS:PCL
```

Timing Advance

The *Timing Advance* softkey sets a (positive) delay time (in symbol periods) correcting the timing of the mobile. In the network, timing advance is to compensate for the propagation time of the signal from the BTS to the mobile and back.

This setting is valid for both circuit switched and packet data connections.

Remote control
```
PROCedure:SIGNalling[:TCH]:TADVance
CONFigure:MSSignal[:TCH]:TADVance
```

DAI
Acoustic Dev.

The *DAI Acoustic Dev.* determines the routing of the speech data (Digital Audio Interface (DAI) of the mobile or internal, i.e. normal mode) and which device is being tested (speech transcoder/DTX functions or A/D & D/A):

The DAI can be set to one of the following modes:

Normal	Normal operation of the mobile; default setting during a call setup
Decoder	Test of speech decoder / DTX functions (downlink)
Encoder	Test of speech encoder / DTX functions (uplink)
Acoustic Devices	Test of acoustic devices and A/D & D/A

When entering the *Call Established* state, the DAI setting is always *Normal*. The other options must be set explicitly after each call setup.

Remote control
```
PROCedure:SIGNalling[:CSWitched]:DAI <Interface>
```

Loop

The *Loop* softkey sets the test loop at the MS. *Receiver Quality* measurements use their own test loops so the loop defined here is valid as long as no *Receiver Quality* measurement is active. All test loops are defined in standard 3GPP TS 44.014.

The following loops are available in single slot mode:

Off	No test loop activated
A	TCH loop including signalling of erased frames (full signalling)
B	Speech TCH loop without signalling of erased frames (residual bit error rate)
C	TCH burst-by-burst loop
I	TCH loop without signalling of erased frames for in-band channel error rate

To activate a loop, the *Loop Command* function in the *Network* tab must be set to *Disable* or *Sensitivity;* see p. 4.199.

Remote control
```
PROCedure:SIGNalling[:CSWitched][:SSLot]:LOOP
CONFigure:MSSignal[:CSWitched][:SSLot]:LOOP
```

Softkey-oriented Version: MS Multislot Mode

The *Slot Mode* of the mobile can be set by means of the *Slot Mode* softkey (see p. 4.177) before a call is established. While *Multislot* mode is selected, the softkey-oriented version of the *MS Signal* tab determines

- The transmitter output power in the main timeslot *(Main Slot PCL)*, the *Main Timeslot* number
- The *Timing Advance* of the MS; see section *Softkey-oriented Version: MS Single Slot Mode* on p. 4.177 f.
- The levels in all uplink and downlink timeslots *(Slot Config.)*
- The *Loop* for *Receiver Quality* tests.

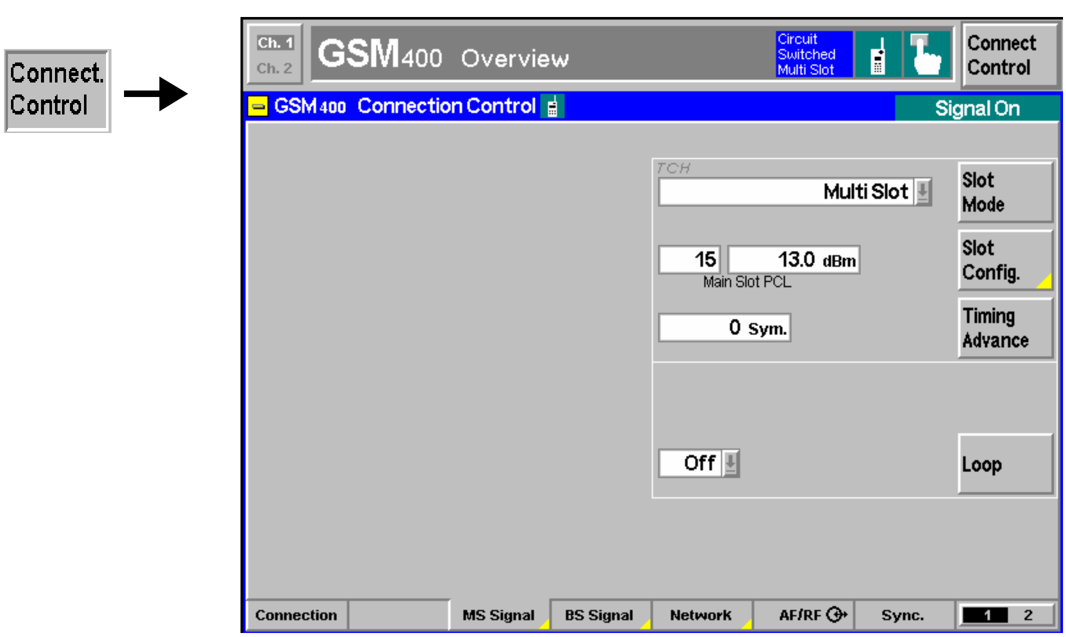
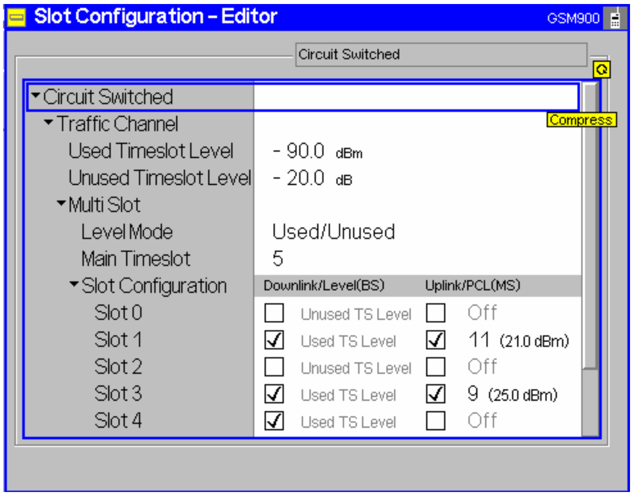


Fig. 4-76 Connection Control – MS Signal (panel, multislot)

Slot Config.

The *Slot Config.* softkey sets the output power of the mobile station transmitter and the main timeslot number (see below). The output power can be selected in PCL (Power Control Level) units or as a corresponding absolute power value (in dBm with a 2 dBm spacing); see section *Limit Values for Average Burst Power (Power Configuration – Limits)* on page *4.127*.

Pressing the *Slot Config.* softkey twice opens the *Slot Configuration Editor:*



The *Slot Configuration Editor* determines the levels in all uplink and downlink timeslots.

Note: *All settings in the* Slot Configuration Editor *except the* Level Mode *can be changed irrespective of the signalling state of the CMU. With an established connection (i.e. in the* Call Established *or* TBF Established *state), all settings made only take effect when the editor is closed.*

Circuit Switched – Traffic Channel

The *Circuit Switched – Traffic Channel* section provides general uplink and downlink level settings. They are available only if the *Level Mode* is set to *Used/Unused* (see below).

Used Timeslot Level Absolute level (in dBm) in all active (used) timeslots of the downlink traffic channel signal (BS signal parameter)

Unused Timeslot Level Level in all inactive (unused) timeslots of the downlink traffic channel signal (BS signal parameter) relative to the *Used Timeslot Level* (in dB)

The value range for both levels depends on the RF output selected and of the external attenuation set, see section *Control of Input and Output Signals (Non Signalling)* on page *4.82.*

Remote control
```
CONFigure:BSSignal[:CSWitched][:TCH]:LEVel:UTIMeslot
PROCedure:BSSignal[:CSWitched][:TCH]:LEVel:UTIMeslot
CONFigure:BSSignal[:CSWitched][:TCH]:LEVel:UNTimeslot
PROCedure:BSSignal[:CSWitched][:TCH]:LEVel:UNTimeslot
```

Multi Slot

The *Multi Slot* section determines the main timeslot and the way the levels are defined.

Level Mode — *Individual* levels in all downlink channels or distinction between *Used/Unused* timeslots. If *Used/Unused* is selected the *Used Timeslot Level* and the *Unused Timeslot Level* can be defined in the *Traffic Channel* section. *Individual* levels are defined relative to the *Reference Level* defined below.

Reference Level — Reference value for the individual downlink (BS) signal levels. The reference level is available only if the *Level Mode* is set to *Individual* (see above).

Main Timeslot — Timeslot used for signalling. The main timeslot can not be switched off in both the downlink and uplink; see *Slot Configuration* below.

Remote control

```
CONFigure:BSSignal[:CSWitched][:TCH]:MSLot:LMODe
CONFigure:BSSignal[:CSWitched][:TCH]:MSLot:RLEVel
PROCedure:BSSignal[:CSWitched][:TCH]:MSLot:RLEVel
CONFigure:BSSignal[:CSWitched][:TCH]:MSLot:MTIMeslot
PROCedure:SIGNalling[:CSWitched][:TCH]:MSLot:SCONfig
```

Slot Configuration

Table of all used and unused timeslots (GSM timeslots 0 to 7) in the downlink and the uplink. The *Main Timeslot* is always active (enabled) in both the downlink and uplink direction. The boxes enable (if checked) or disable the other timeslots.

Important Note: *The CMU can transmit signals in enabled as well as in disabled downlink timeslots. Enabling a downlink timeslot means that the MS is instructed to listen to a signal in this timeslot.*

To ensure that the UE signalling messages can be decoded properly, the main TS level must be sufficient compared to the levels in the other slots. In case of high level differences between the UL TSs (approx. > 10 dB), it is recommended to use the TS with the highest level as the main timeslot.

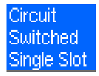
Downlink Level (BS) — RF levels in all downlink timeslots (RF signal transmitted by the BS/CMU). If the *Level Mode* is set to *Used/Unused,* the *Used Timeslot Level* and the *Unused Timeslot Level* from the *Traffic Channel* section are entered and the downlink levels in the *Slot Configuration* table can not be edited. If the *Level Mode* is set to *Individual,* all downlink levels are defined relative to the *Reference Level*.

If the *BCCH and TCH* mode is active (see *Mode* softkey on p. 4.185), slot 0 of the downlink signal is reserved for the BCCH and slots 1 and 7 are not available for the traffic channel. *BCCH* is indicated instead of the level and the enable switches for slots 0, 1 and 7 are grayed.

Uplink PCL (MS) — Transmitter output power of the MS in all active (enabled) uplink timeslots. The MS transmitter output power is selected in PCL (Power Control Level) units; the corresponding absolute power value is also indicated; see section *Limit Values for Average Burst Power (Power Configuration – Limits)* on page *4.127*. If a timeslot is disabled, the corresponding output power is automatically switched *Off*.

Note: *The number of downlink and uplink channels must be compatible with the multislot class of the MS under test; see Table 4-19 on p. 4.170.*

The *Slot Mode* and the *Slot Configuration* (for multislot mode) is shown in the configuration icon in the menu title bar, e.g.:



Remote control
```
CONFigure:BSSignal[:CSWitched][:TCH]:MSLot:SCONfig:UUNused
CONFigure:BSSignal[:CSWitched][:TCH]:MSLot:SCONfig:INDividual
CONFigure:MSSignal[:CSWitched][:TCH]:MSLot:SCONfig
PROCedure:SIGNalling[:CSWitched][:TCH]:MSLot:SCONfig
```

Loop

The *Loop* softkey sets the test loop at the MS. *Receiver Quality* measurements use their own test loops so the loop defined here is valid as long as no *Receiver Quality* measurement is active. All test loops are defined in standard 3GPP TS 44.014.

The following loops are available in multislot mode:

Off	No test loop set
G	Multi-slot TCH burst-by-burst loop
H	Multi-slot TCH loop including signalling of erased frames

To activate a loop, the *Loop Command* function in the *Network* tab must be set to *Disable* or *Sensitivity;* see p. 4.199.

Remote control
```
PROCedure:SIGNalling[:CSWitched]:MSLot:LOOP
CONFigure:MSSignal[:CSWitched]:MSLot:LOOP
```

Table-oriented Version

The table-oriented version of the *MS Signal* tab contains all MS signal settings of the softkey-oriented version (see sections *Softkey-oriented Version: MS Single Slot Mode* on p. 4.177 and *Softkey-oriented Version: MS Multislot Mode* on p. 4.179 ff.). Besides it defines:

- The maximum MS transmitter output power allowed in the cell *(PMAX)*
- The Discontinuous Transmission *(DTX)* mode of the mobile station

The active *Main Service (Circuit Switched* or *Packet Data)* is underlined in the *BS Signal* tab. In the following, general parameters and parameters for circuit switched mode are described. For a description of packet data parameters refer to section *RF Signals of the MS (Connection Control – MS Signal)* on p. 4.223 ff.

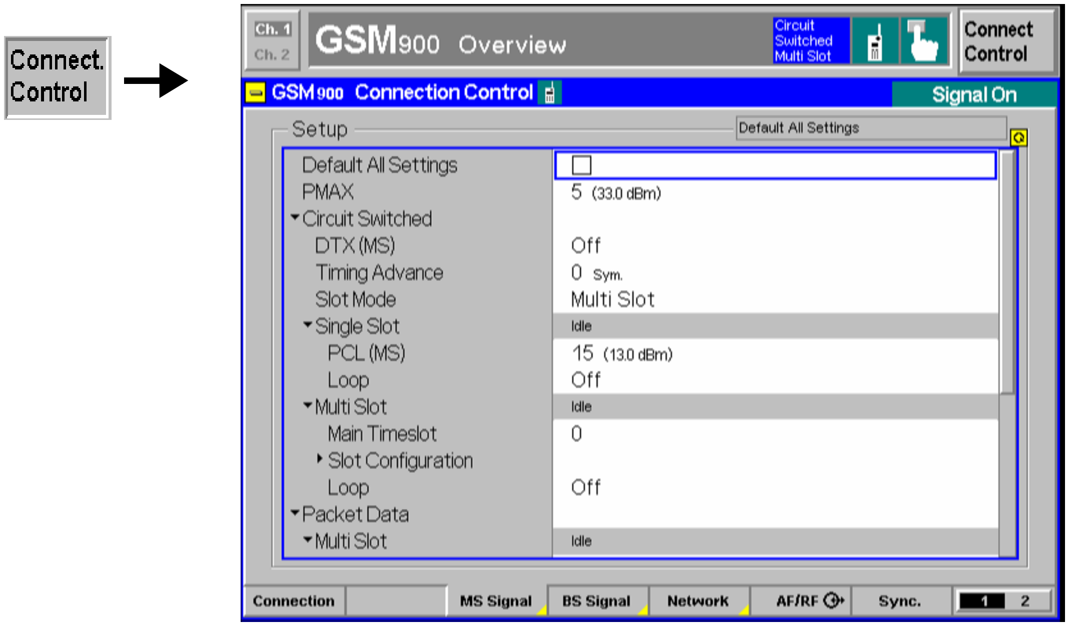


Fig. 4-77 Connection Control – MS Signal (table)

The following settings are not provided in the softkey-oriented versions of the *MS Signal* tab (see sections *Softkey-oriented Version: MS Single Slot Mode* on p. 4.177 and *Softkey-oriented Version: MS Multislot Mode* on p. 4.179 ff.).

Default Settings

The *Default All Settings* switch assigns default values to all settings in the *MS Signal* tab (the default values are quoted in the command description in chapter 6 of this manual).

Remote control
–

PMAX

The *PMAX* parameter sets the maximum MS transmitter output power allowed in the cell. The value corresponds to the output power at which the mobile station performs a location update to synchronize to the CMU. It is valid both for circuit switched and for packet data mode.

The maximum MS transmitter output power can be selected in PCL (Power Control Level) units or as a corresponding absolute power value (in dBm with a 2 dBm spacing); see section *Limit Values for Average Burst Power (Power Configuration – Limits)* on page *4.127*.

Note: *PMAX defines the MS output power for access burst measurements (application* P/t Access Burst*). The other* Power *measurements are performed at the MS output power set* via PCL (MS) *(see* PCL *softkey on p.* 4.178*) or the corresponding parameters for multislot or packet data mode.*

After a dual-band handover to another GSM band, PMAX is also valid in the destination network. Due to the band-specific PCL scales (see Table 4-8 on 4.127), the actual maximum MS output power changes if one of the bands GSM1800/GSM1900 and a lower-frequency band is involved.

Example: *PMAX = 5, handover from GSM900 to GSM1800.*

In the original network, PCL 5 corresponds to a maximum output power of 33 dBm, in the destination network, to 20 dBm. In order to reach the maximum output power of 30 dBm for GSM1800, PMAX must be set to 0.

Remote control
`CONFigure:MSSignal:CCH:PMAX`

Circuit Switched – DTX (MS)

The *DTX (MS)* parameter decides whether or not the mobile station may use the operating mode *Discontinuous Transmission*.

In the operating mode DTX *(discontinuous transmission mode)* the *voice activity detection* of the mobile station analyzes the language elements and the intervals and decides whether a transmission is required. As a result of this, only useful information is transferred; if nothing is spoken, the mobile station will not transmit anything. The DTX method permits to reduce radio interference, the power as well as the current consumption of the mobile stations.

Note: *Since the mobile station only transmits from time to time in DTX mode, the RF measurement can only sporadically be performed by the CMU. Therefore, the DTX mode is switched* Off *in the default setting.*

Remote control
```
CONFigure:MSSignal[:CSWitched]:DTX  ON | OFF
[SENSe:]RREPorts:DTX?
```

RF Signals of the CMU (Connection Control – BS Signal)

The *BS Signal* tab configures the operating mode and the RF control and traffic channel signals that the CMU transmits to communicate with the MS under test. Some functions of the menu depend on the *Main Service (Circuit Switched* or *Packet Data (GPRS)* operating mode) and the *Slot Mode (Single Slot* or *Multislot* operation) of the mobile as well as on the signalling state of the CMU *(Call Established* or other states). As a consequence, settings may be disabled or even hidden in some operating modes of the CMU/MS test system. Exact information is provided in the command description in chapter 6 of this manual.

The present chapter describes the parameters related to circuit switched operation of the mobile phone. Tests in *Packet Data (GPRS)* mode require option CMU-K42. They are described in section *RF Signals of the CMU (Connection Control – BS Signal)* on p. 4.223 ff.

The CMU provides a softkey-oriented version of the *BS Signal* tab and a table-oriented version with extended functionality. The *BS Signal* hotkey toggles between the two versions if it is pressed repeatedly.

Softkey-oriented Version: Single Slot Mode

The *Slot Mode* of the mobile can be set by means of the *Slot Mode* softkey before a call is established. While *Single Slot* mode is selected, the *Level Mode* softkey is inactive. The softkey-oriented version of the *BS Signal* tab determines

- A *Frequency Offset* by which the RF frequency of the BS traffic and control channel (BCCH) signal is modified
- The transmission *Mode*, *BCCH Level* and GSM channel number *(RF Channel)* of the CMU's Broadcast Control Channel (BCCH)

- The level *(TCH Level)*, GSM channel number *(RF Channel)*, *Hopping* sequence and *Timeslot* of the CMU's traffic channel (TCH)

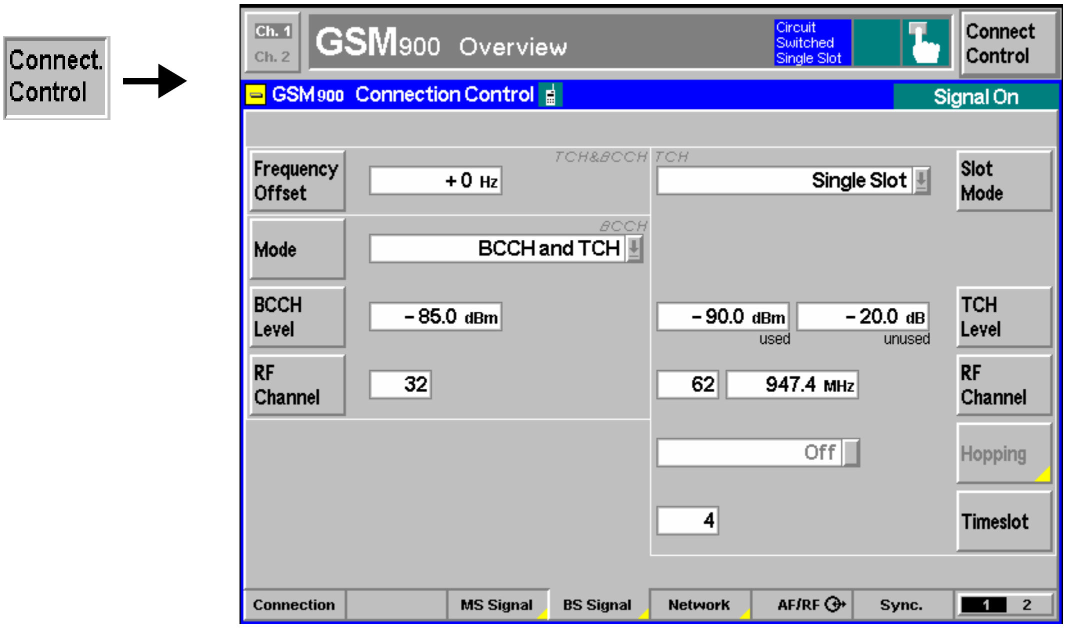


Fig. 4-78 Connection Control – BS Signal (panel, single slot)

The left half of the BS Signal tab contains the following BCCH settings:

Frequency Offset

The *Frequency Offset* softkey determines the frequency offset of the CMU signals from the value defined under *RF Channel*. This enables fine tuning of the signal generated by the CMU, for example for simulating a Doppler shift (due to a relative movement between mobile and CMU) or de-tuning of the base station or the MS receiver. The value range of the frequency offset is – 100 kHz to +100 kHz (covering the entire GSM channel width) such that the CMU is able to transmit on any frequency within the selected GMS band.

For special applications it is possible to multiply the frequency offset with a random sign; see *Enabling the Random Frequency Offset* on p. 4.190.

Remote control
`CONFigure:BSSignal:FM:DEViation <Frequency>`

Mode

The *Mode* softkey defines the BS Signal configuration after a connection has been set up:

BCCH or TCH Switch off BCCH after the connection has been established. This means that in the *Call Established* and *TBF Established* states, all timeslots are available for the TCH. This is particularly useful for BER tests on packet data channels; see section *BER Tests of PDTCHs: BLER and DBLER* on p. 4.135 ff.

BCCH and TCH Maintain BCCH after the connection has been established. The BCCH occupies timeslot 0 but also blocks the two adjacent timeslots (no. 7 and 1) for TCHs: Only timeslots 2 to 6 are available for BS signal traffic channels.

Note: *If one of the options R&S CMU-B95 or R&S CMU-B96, Additional RF Channel, is fitted, the Aux TX signal can be used for the BCCH (see 4.190). With this signal configuration all timeslots are available for the TCH, even though the BCCH can be maintained to ensure a stable connection. The Mode softkey is hidden.*

Remote control
`CONFigure:BSSignal:CCH:MODE BATC | BOTC`

The following BCCH settings are provided by the Main TX generator or the Aux TX generator (with Option R&S CMU-B95/B96), depending on the settings in the table-oriented *BS Signal* tab (see Aux TX section on p. 4.190).

BCCH Level

The *BCCH Level* softkey sets the absolute level (in dBm) of the BCCH control channel used for synchronization of the mobile. The value range for *Level* depends on the RF output selected and of the external attenuation set.

Remote control
`CONFigure:BSSignal:CCH:LEVel:ABSolute  <Level>`

RF Channel

The *RF Channel* softkey selects the GSM channel number of the BCCH control channel. For an overview of GSM channels see section *Control of Input and Output Signals* on page *4.82*. In GSM900 the CMU can use all three sub-bands (P-GSM, E-GSM, R-GSM), so care must be taken that the MS supports the selected *RF Channel.*

Remote control
`CONFigure:BSSignal:CCH:CHANnel <CCHChannel>`

Note: *After a handover the BS Signal tab no longer shows the current* Mode, BCCH Level *and* RF Channel *but displays "from other network", indicating that the values of the origin network have been left unchanged. Display of the current values is restored by returning to the target network or setting up the connection again.*

The right half of the BS Signal tab contains the following TCH settings:

Slot Mode

The *Slot Mode* softkey set the mobile station under test to either *Single Slot* or *Multislot* operation. As soon as a call is established the slot mode can no longer be changed and the softkey is disabled (grayed). The *Multislot* setting changes some of the other softkeys in the *BS Signal* tab (see section *Softkey-oriented Version: MS Multislot* on p. 4.179). It will come into effect only if the BS under test is capable of multislot operation (i.e. if it supports HSCSD or GPRS).
Remote control
No separate switchover command. The slot modes are selected implicitly by the keywords `[:SSLot]` or `:MSLot` in the command header.

TCH Level

The *TCH Level* softkey sets the absolute level (in dBm) in the used timeslot and the relative level in all unused timeslots of the BS signal. The unused timeslot level is defined relative to the level in the used timeslot (in dB).

The value range for both levels depends on the RF output selected and of the external attenuation set, see section *Control of Input and Output Signals (Non Signalling)* on page *4.82.*

Remote control
`CONFigure:BSSignal[:CSWitched][:TCH]:LEVel:UTIMeslot`
`PROCedure:BSSignal[:CSWitched][:TCH]:LEVel:UTIMeslot`

```
CONFigure:BSSignal[:CSWitched][:TCH]:LEVel:UNTimeslot
PROCedure:BSSignal[:CSWitched][:TCH]:LEVel:UNTimeslot
```

RF Channel

The *RF Channel* softkey selects the GSM channel number of the traffic channel allocated to the connection. For an overview of GSM channels see section *Control of Input and Output Signals* on page *4.82* ff. In GSM900 the CMU can use all three sub-bands (P-GSM, E-GSM, R-GSM), so care must be taken that the MS supports the selected *RF Channel.*

Remote control

```
CONFigure:BSSignal[:CSWitched][:TCH]:CHANnel  <Channel>
```

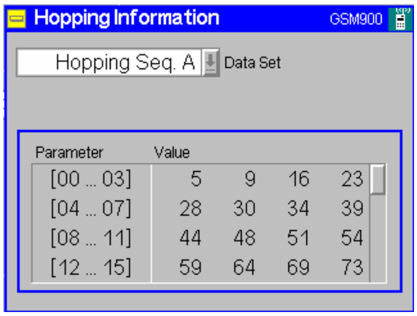
Hopping

The *Hopping* softkey selects a frequency hopping sequence.

Off Switch off frequency hopping

A, B, C, D Selection of the hopping sequence referred to as A (or B or C or D)

Pressing the *Hopping* softkey twice opens the *Hopping Information* dialog:



This dialog displays the current hopping sequences A to D. The four sequences can be selected in the *Data Set* list.

Note: *The hopping sequence can be (re)defined in the table-oriented version of the BS Signal tab while the CMU is in the signalling states Signal Off, Signal On, or Synchronized. See section Table-oriented Version on p. 4.189 ff.*

Remote control

```
PROCedure:SIGNalling[:CSWitched][:TCH][:SSLot]:
                                          FHOPping:SEQuence
CONFigure:BSSignal[:CSWitched][:TCH][:SSLot]:FHOPping:A
CONFigure:BSSignal[:CSWitched][:TCH][:SSLot]:FHOPping:B
CONFigure:BSSignal[:CSWitched][:TCH][:SSLot]:FHOPping:C
CONFigure:BSSignal[:CSWitched][:TCH][:SSLot]:FHOPping:D
```

Timeslot

The *Timeslot* softkey determines the traffic channel timeslot number for the single slot circuit switched connection.

Remote control

```
PROCedure:SIGNalling[:CSWitched][:TCH][:SSLot]:TIMeslot
CONFigure:BSSignal[:CSWitched][:TCH][:SSLot]:TIMeslot
```

Softkey-oriented Version: Multislot Mode

The *Slot Mode* of the mobile can be set by means of the *Slot Mode* softkey before a call is established. While *Multislot* mode is selected, frequency *Hopping* is set to *Off* and the softkey-oriented version of the *BS Signal* tab determines

- A *Frequency Offset* by which the RF frequency of the BS traffic and control channel (BCCH) signal is modified
- The transmission *Mode*, *BCCH Level* and GSM channel number *(RF Channel)* of the CMU's Broadcast Control Channel (BCCH)
- The definition of the BS signal levels in all timeslots *(Slot Config.)* and the way they are defined *(Level Mode)*
- The GSM channel number *(RF Channel)* of the CMU's traffic channel (TCH)
- The *Main Timeslot* used for signalling and its GSM channel number *(Main Timeslot)*

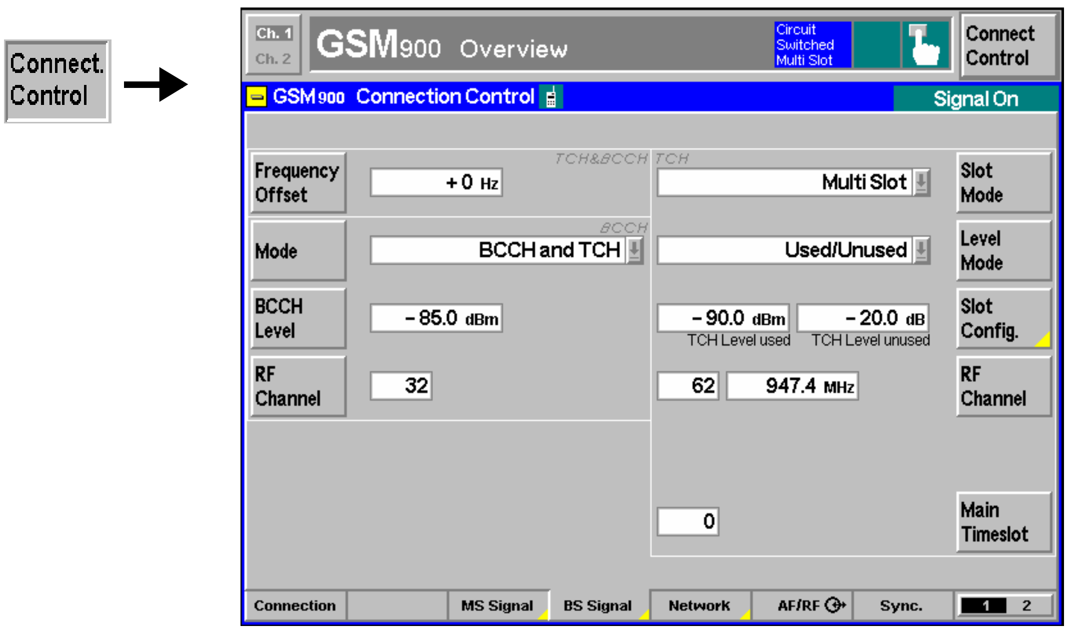


Fig. 4-79 Connection Control – BS Signal (panel, multislot)

The left half of the BS Signal tab contains the BCCH settings described in section *Softkey-oriented Version: Single Slot Mode* on p. 4.184 ff. The right half of the BS Signal tab contains the following TCH settings that are not described in section *Softkey-oriented Version: Single Slot Mode* on p. 4.184 ff.:

Level Mode

The *Level Mode* softkey determines how the downlink TCH levels are defined if the mobile is in *Multislot* mode:

Used/Unused — All active (used) timeslots are at the same level and all inactive (unused) timeslots are at the same level. The *Used Timeslot Level* and the *Unused Timeslot Level* can be defined by means of the *Slot Config.* softkey or in the table-oriented version of the *BS Signal* or of the *MS Signal* tab; see also *Slot Configuration Editor* on p. 4.180.

Individual — All active (used) timeslots can be set individually and all inactive (unused) timeslots are off (at zero level). The levels of the used timeslots can be defined in the table-oriented version of the *BS Signal* or of the *MS Signal* tab; see also *Slot Configuration Editor* on p. 4.180. They are expressed relative to a *Reference Level* which is defined by means of the *Slot Config.* softkey or in the table-oriented version of the *BS Signal* or of the *MS Signal* tab.

Remote control
`CONFigure:BSSignal[:CSWitched][:TCH]:MSLot:LMODe UUN | IND`

Slot Config.

The function of the *Slot Config.* softkey depends on the *Level Mode* setting:

- In the *Used/Unused* level mode, the softkey defines the *Used Timeslot Level* and the *Unused Timeslot Level.*
- In the *Individual* level mode, the softkey sets the *Reference Level* for the individual timeslots.

Pressing the *Slot Config.* softkey twice opens the *Slot Configuration Editor* described on p. 4.180. The *Slot Configuration Editor* determines the levels in all uplink and downlink timeslots.

Remote control
`CONFigure:BSSignal[:CSWitched][:TCH]:MSLot:SCONfig:UUNused`
`CONFigure:BSSignal[:CSWitched][:TCH]:MSLot:SCONfig:INDividual`

RF Channel

The *RF Channel* softkey selects the GSM channel number of the main timeslot. For an overview of GSM channels see section *Control of Input and Output Signals* on page *4.82* ff.

Remote control
`CONFigure:BSSignal[:CSWitched][:TCH]:CHANnel`

Main Timeslot

The *Main Timeslot* softkey determines the timeslot that the MS and the BS/CMU use for signalling. The main timeslot can not be switched off in both the downlink and uplink; see *Slot Configuration Editor above*.

Remote control
`PROCedure:SIGNalling[:CSWitched][:TCH]:MSLot:MTIMeslot`
`CONFigure:BSSignal[:CSWitched][:TCH]:MSLot:MTIMeslot`

Table-oriented Version

The table-oriented version of the *BS Signal* tab contains all BS signal settings of the softkey-oriented version (see sections *Softkey-oriented Version: Single Slot Mode* on p. 4.184 and *Softkey-oriented Version: Multislot Mode* on p. 4.188). Besides it defines:

- A *Random Frequency Offset* that can change its sign after each GSM frame.
- The additional RF channel *Aux TX.*
- The four *Hopping* sequences A, B, C, and D. The hopping sequences can be defined in the signalling states *Signal On, Signal Off* and *Synchronized*. They are valid if the mobile is in *Single Slot* mode only.

The active *Main Service (Circuit Switched* or *Packet Data)* is underlined in the *BS Signal* tab. In the following, general parameters and parameters for circuit switched mode are described. For a description of packet data parameters refer to section *RF Signals of the CMU (Connection Control – BS Signal)* on p. 4.225 ff.

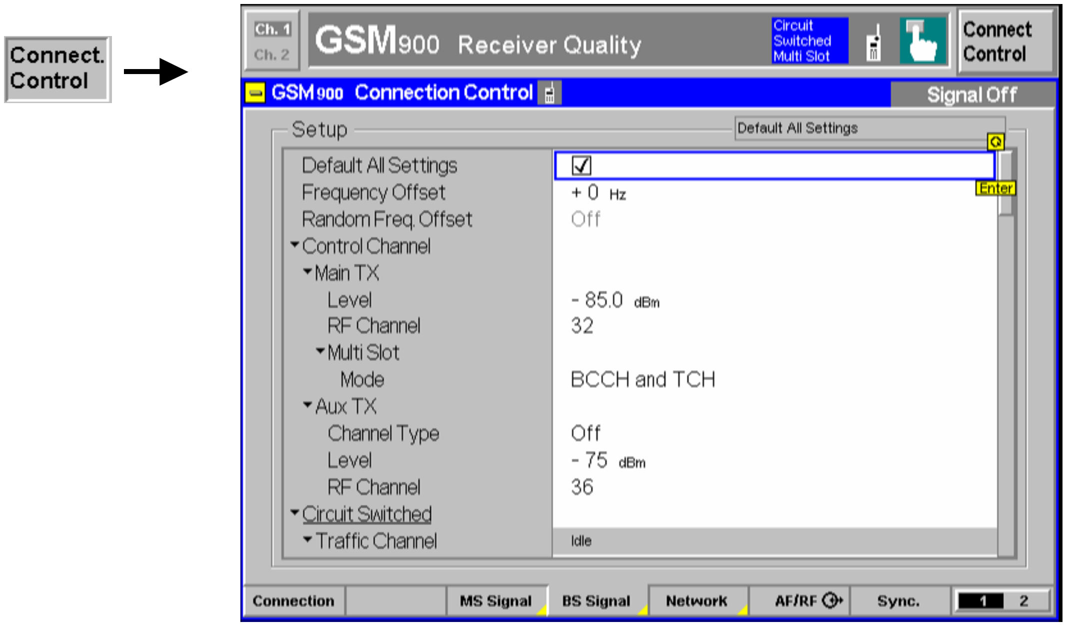


Fig. 4-80 Connection Control – BS Signal (table)

The following settings are not provided in the softkey-oriented versions of the *BS Signal* tab (see sections *Softkey-oriented Version: Single Slot Mode* on p. 4.184 and *Softkey-oriented Version: Multislot Mode* on p. 4.188 ff.).

Default Settings

The *Default All Settings* switch assigns default values to all settings in the *BS Signal* tab (the default values are quoted in the command description in chapter 6 of this manual).

Remote control
–

Random Freq. Offset

Enabling the *Random Frequency Offset* causes the (static) frequency offset (see p. 4.185) to randomly change its sign after each frame. More specifically, the probability of a sign change of the frequency offset between two consecutive frames is 50%. The random frequency offset has no effect if the static frequency offset is 0 Hz.

The random frequency offset must be set in the *CEST* (circuit switched main service) or *TEST* (packet data main service) signalling states. It is automatically reset (switched off) each time that the connection is released.

A test case using the random frequency offset for determining the EGPRS usable receiver input level range is described in standard 3GPP TS 51.010-1.

Remote control
`PROCedure:BSSignal:FM:DEViation:RANDom:ENABle ON | OFF`

Aux TX

If one of the options R&S CMU-B95 or R&S CMU-B96, *Additional RF Generator,* is fitted, the CMU provides a second RF signal Aux TX that can be used for the BCCH (circuit switched main service) or for the *BCCH* + *PBCCH* (packet data main service) to set up and maintain a connection. The following Aux TX signal parameters can be set:

Channel Type Switch the Aux TX signal *Off* or use it for the BCCH (circuit switched main service) or for the *BCCH* + *PBCCH* (packet data main service). If Aux TX is switched *Off*, the *Main TX* generator provides both the TCH and the BCCH/PBCCH.

If *BCCH + PBCCH* is set the R&S CMU uses a fixed slot configuration where the BCCH occupies slot 0 (GSM standard) and the PBCCH occupies slot 4.

If the PBCCH is not transmitted on the Aux TX signal, then the signalling information for packet data connections is transferred in System Information type 13 blocks.

Level Aux TX signal level. This defines the *BCCH Level* of the softkey-oriented *BS Signal* tab if Aux TX is used for the BCCH. The Aux TX level is independent of the *Main TX* level.

RF Channel Aux TX channel number. This defines the *BCCH Channel* of the softkey-oriented *BS Signal* tab if Aux TX is used for the BCCH. The Aux TX channel must be different from the TCH channel.

Channel Conflict Check

The Aux TX signal is transmitted continuously (in all timeslots) so that the BCCH/PBCCH is superimposed to the TCH as long as the Aux TX signal is switched on. To avoid interferences that might impair the connection, the minimum channel difference between the Main TX (TCH) and the Aux TX channel is 4 (setting *Channel Conflict Check: On)*. The Aux TX can be set to arbitrary frequencies if the channel conflict check is switched *Off.*

Note 1: Handover

After a handover the BS Signal tab no longer shows the current Aux TX settings but displays "from other network", indicating that the values of the origin network have been left unchanged. Display of the current values is restored by returning to the target network or setting up the connection again.

Note 2: Dual Transfer Mode

The Dual Transfer Mode (with option R&S CMU-K44), requires an Aux TX Channel Type BCCH or PBCCH. Refer to Chaper 9 of this manual for detailed information.

Remote control
```
CONFigure:BSSignal:CCH:AUXTx:CHANnel
CONFigure:BSSignal:CCH:AUXTx:CHTYpe OFF | BCCH | BPBC
CONFigure:BSSignal:CCH:AUXTx:LEVel[:ABSolute]
CONFigure:BSSignal:CCH:AUXTx:CCCHeck
```

Tips for using the Aux TX signal:

The main purpose of the Aux TX signal is to ensure a stable connection (continuous BCCH), while the Main TX signal provides a TCH in all 8 timeslots. This is particularly useful for packet data channels. The following hardware-related restrictions should be kept in mind:

- The RF output connector RF 3 OUT is available for the Aux TX signal only with option R&S CMU-B96. Compared to RF 1 and RF 2, RF 3 OUT provides much higher Aux TX output levels.
- The Aux TX channel must be different from the TCH channel. If a conflicting frequency is set, the CMU displays a notice box indicating that the setting will be auto-corrected. Conflicting frequency settings may occur in the *BS Signal* tab (TCH Channel, BCCH Channel, RF Channel, Hopping sequence Lists) but also indirectly when a connection is set up *(Signal On, Main Service)* or a *Power/PCL* measurement is performed.

If equal TCH and BCCH channel numbers are needed for a particular test, it is still possible to select the multislot mode *TCH or BCCH* (see p. 4.185) in order to obtain a TCH in all 8 timeslots.

Hopping sequence List ...

The table section *Hopping Sequence List...* configures the four frequency hopping sequences A, B, C, and D. Configured hopping sequences can be selected via the *Hopping* softkey in the signalling state *Call Established* (see section *Softkey-oriented Version: Single Slot Mode* on page 4.184).

In GSM networks, frequency hopping is primarily used for error protection in the radio transmission path. It consists of periodically switching over the transmission channels (except BCCH) to other carrier frequencies. The frequency changes after each radio frame so that the dwell time on each carrier frequency is 4.615 ms ("slow" frequency hopping).

Frequency hopping is controlled by the network: The BTS transfers a hopping sequence (hopping list) to the mobile station. From this list, the mobile station calculates the radio frequency channel for each TDMA frame number according to an algorithm described in GSM 05.02.

Four standard hopping lists *A, B, C,* and *D* are defined as default sequences, see command description in chapter 6. All four lists can be modified by entering up to 64 channel numbers. If a shorter list is desired, *Off* can be entered for the unused channel numbers.

Remote control

```
PROCedure:SIGNalling[:CSWitched][:TCH][:SSLot]:
                                          FHOPping:SEQuence
CONFigure:BSSignal[:CSWitched][:TCH][:SSLot]:FHOPping:A
CONFigure:BSSignal[:CSWitched][:TCH][:SSLot]:FHOPping:B
CONFigure:BSSignal[:CSWitched][:TCH][:SSLot]:FHOPping:C
CONFigure:BSSignal[:CSWitched][:TCH][:SSLot]:FHOPping:D
```

Network Parameters (Connection Control – Network)

The *Network* tab defines various parameters of the network that the CMU reports to the mobile station. Some functions of the menu depend on the *Main Service (Circuit Switched* or *Packet Data (GPRS)* operating mode) and most parameters can no longer be set after the *Call Established* signalling state is reached. As a consequence, settings may be disabled or even hidden in some operating modes of the CMU/MS test system. Exact information is provided in the command description in chapter 6 of this manual.

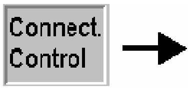
The present chapter describes the parameters related to circuit switched operation of the mobile phone. Tests in *Packet Data (GPRS)* mode require option CMU-K42. They are described in section *Network Parameters (Connection Control – Network)* on p. 4.225 ff.

The CMU provides a softkey-oriented version of the *Network* tab and a table-oriented version with extended functionality. The *Network* hotkey toggles between the two versions if it is pressed repeatedly.

Softkey-oriented Version

The softkey-oriented version of the *Network* tab selects the following traffic channel parameters:

- The channel coding and transmission rate *(Traffic Mode)*
- The bit pattern that the CMU transmits to the MS *(Bit Stream)*



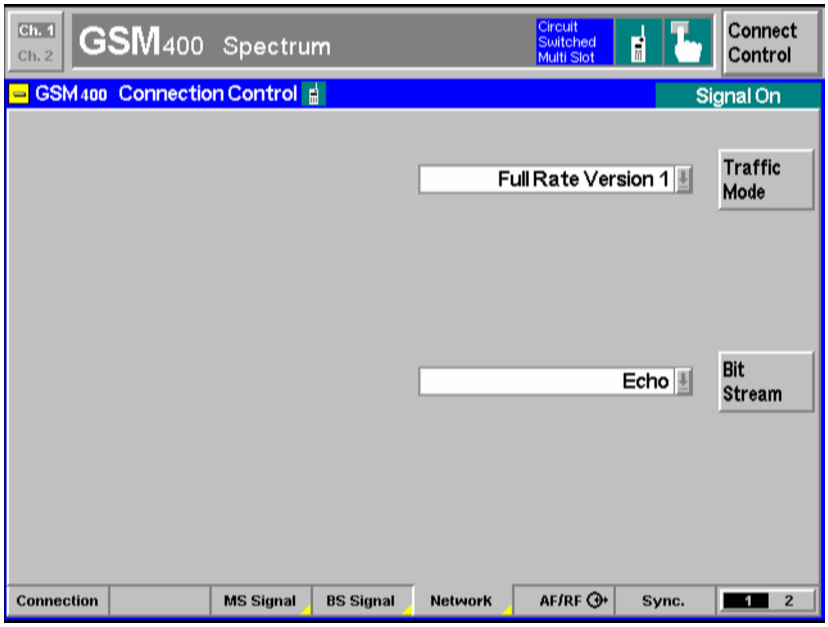


Fig. 4-81 Connection Control – Network parameters (panel)

Traffic Mode

The *Traffic Mode* softkey determines the speech or data channel coding and the transmission rate in the traffic channels:

Full Rate Version 1	Use of standard full-rate speech coding
Full Rate Version 2	Enhanced full rate speech coding
Half Rate Version 1	Half-rate speech coding
Full Rate Data 4800	*Full-rate coding with fixed transmission rate in baud*
Full Rate Data 9600	
Full Rate Data 14400	
Half Rate Data 2400	*Half-rate coding with fixed transmission rate in baud*
Half Rate Data 4800	

Note: *A transmission mode can only be selected if the connected mobile station is equipped with the appropriate speech coder. If this is not the case, the CMU automatically sets the default speech coder (Full Rate Version 1).*

The subchannel for half rate coding can be selected in the table-oriented version of the Network *tab.*

The following GPRS/EGPRS traffic modes are compatible with reduced signalling mode only: If one of the modes is selected, the *Signalling Channel* is automatically set to *NONE* (see p. 4.199). The *Signalling Channel* can not be changed while one of the (E)GPRS traffic modes is active.

The (EGPRS) modes can be used to perform *Receiver Quality* tests specific to packet-data channels and to measure the Data Block Error Rate (DBLER). GPRS with full signalling and EGPRS requires options CMU-K42/-K43 (see section *GPRS Signalling and EGPRS* on p. 4.213 ff.).

CS1 Test Mode	Coding according to coding scheme 1 *(CS1)* specified for GPRS.
...	
CS4 Test Mode	Coding scheme 4 *(CS4)* specified for GPRS.
MCS1 Test Mode	Modulation and coding scheme 1 *(MCS1)* specified for EGPRS.

...

MCS9 Test Mode Modulation and coding scheme 9 *(MCS9)* specified for EGPRS.

The four coding schemes CS1 to CS4 are defined for the GPRS packet-data traffic channels (PDTCH). For most packet control channels, coding scheme CS1 is used. All coding schemes CS1 to CS4 are mandatory for MSs supporting GPRS.

The nine modulation and coding schemes MCS1 to MCS9 are defined for the EGPRS packet data traffic channels. For all EGPRS packet control channels the corresponding GPRS control channel coding is used. Mobiles supporting EGPRS shall support MCS1 to MCS9 in downlink and MCS1 to MCS4 in uplink.

The following traffic modes are used for tests on mobile phones equipped with an AMR (Adaptive Multi-Rate) codec, available with option CMU-K45, *AMR GSM for R&S CMU 200*:

AMR full rate Test of full rate AMR codec (FR_AMR) with 8 modes and a data rate up to 12.2 kbit/s

AMR half rate Test of half rate AMR codec (HR_AMR) with 6 modes and a data rate up to 7.95 kbit/s

The speech codecs must be supported by the MS under test. Selecting one of the AMR traffic modes opens an extended version of the *Network* tab with further AMR settings; see section *Adaptive Multi-Rate (AMR) Speech Codec* on p. 4.232 ff.

Remote control
`CONFigure:NETWork[:CSWitched]:SMODe:TRAFfic`
`PROCedure:NETWork[:CSWitched]:SMODe:TRAFfic`

Bit Stream

The *Bit Stream* softkey determines the data transmitted on the traffic channel and the signal path.

PSR 2E9-1 Transmission of the pseudo random sequence to CCITT O.153

PSR 2E11-1 Transmission of the pseudo random sequence to CCITT O.153

PSR 2E15-1 Transmission of the pseudo random sequence to CCITT O.151

PSR 2E16-1 Transmission of a pseudo random sequence (Polynomial: $x^{16} + x^5 + x^3 + x^2 + 1$)

Loopback Loop-back with minimum delay: The CMU sends back all data received on the TCH after 1 speech frame.

Echo Loop-back with delay. The CMU sends back all data received on the TCH after 50 speech frames (Echo) without invoking the speech codec. If the CMU does not receive speech data in this operating mode, it automatically transmits a bit pattern, producing “silence” in the receiver of the mobile station.

Handset The CMU sends and receives speech frames that are routed to the internal speech codec (option CMU-B52). Analog signals are provided via the *SPEECH* connector at the front panel of the instrument. The analog input signal at connector *SPEECH* is amplified by 22.5 dB.

Handset Low The CMU sends and receives speech frames that are routed to the internal speech codec (option CMU-B52). Analog signals are provided via the *SPEECH* connector at the front panel of the instrument. The analog input signal at connector *SPEECH* is not amplified.

Decoder Cal The speech codec (option CMU-B52) provides a 1 kHz sinewave signal at its analog output. This signal is used for external calibration of the analog output paths.

Encoder Cal The speech codec (option CMU-B52) loops the input signal after digital/analog conversion directly to the analog output. This signal is used for external calibration of the analog input paths.

Codec Cal The CMU sends and receives speech frames that are routed to the internal speech codec (option CMU-B52). Analog signals are provided via the *SPEECH* connector at the front panel of the instrument. The analog input signal at connector *SPEECH* is not amplified. The CMU sends a close loop message to the mobile station to activate an internal test loop.

Receiver Quality measurements require a pseudo random bit sequence to be transmitted on the traffic channel. This sequence can be set independently as *Bit Stream BER(*see p. 4.147); the bit stream set in the *Network* tab is not valid for *Receiver Quality* measurements.

Note: *Some Bit Stream settings require a particular configuration of the instrument. In particular, all settings after Echo (i.e. Handset, Handset Low, Decoder Cal., Encoder Cal, Codec Cal.) are not available if one of the following conditions is true:*

- *The speech codec (option CMU-B52) is not installed.*
- *One of the AMR traffic modes and DTX (MS) mode is active simultaneously.*
- *One of the full or half rate data traffic modes is active.*
- *The* B52 Mode *(see p. 4.197) is set to* Multislot Support.

Remote control

```
CONFigure:NETWork[:CSWitched]:SMODe:BITStream
PROCedure:NETWork[:CSWitched]:SMODe:BITStream
```

Table-oriented Version

The table-oriented version of the *Network* tab contains all *Network* settings of the softkey-oriented version (see section *Softkey-oriented Version* on p. 4.192). Besides it defines:

- The *Network Support* of the CMU simulating a BS station and the *Main Service*. These network parameters can also be defined in the *Connection* tab; see section *Signalling Control without Signal (State Signal Off)* on p. 4.105.
- The function of the speech coder *(B52 mode)*
- The code numbers defining the *Network Identity*
- Configuration parameters for signalling *(Starting Time, Location Update, Default IMSI, Power Change, Signalling Channel, Loop Command)*
- The definition of the parameters of the mobile station that are requested by the CMU during *location update* or when a call is setup *(Requested Mobile Data)*
- *Timeouts*
- Parameters for calculation of the *Advice of Charge*
- *System Parameters*
- The used channels in the neighbor cells *(BA List)*

The active *Main Service (Circuit Switched* or *Packet Data)* is underlined in the *Network* tab. In the following, general parameters and parameters for circuit switched mode are described. For a description of packet data parameters refer to section *Network Parameters (Connection Control – Network)* on p. 4.227 ff.

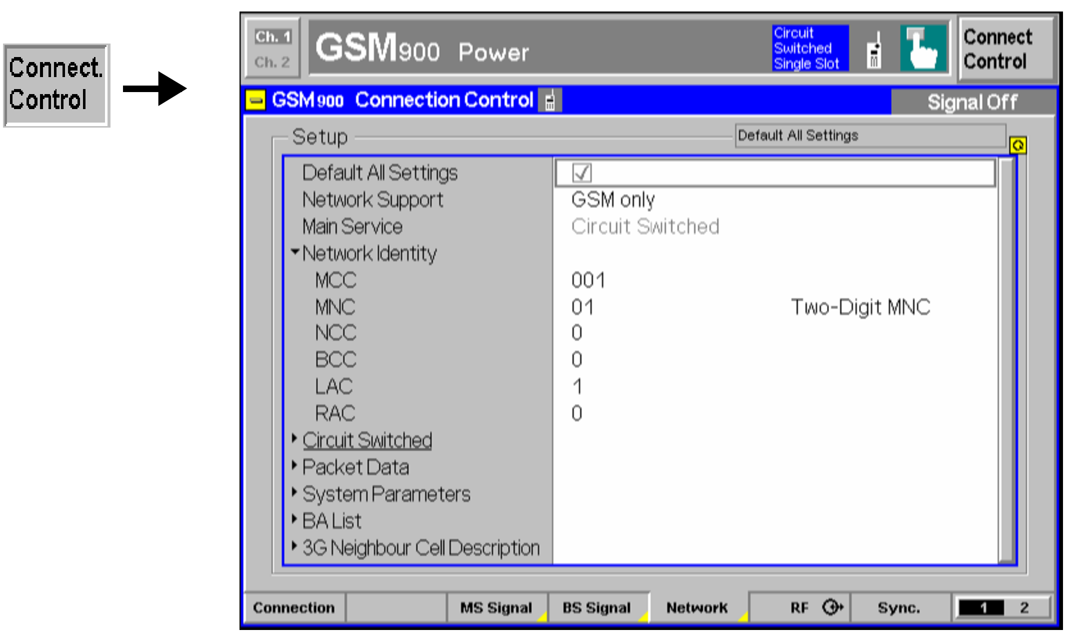


Fig. 4-82 Connection Control – Network parameters (table)

The following settings are not provided in the softkey-oriented version of the *Network* tab (see section *Softkey-oriented Version* on p. 4.192 ff.) or in the *Connection* tab.

B52 Mode

B52 Mode qualifies whether the speech codec (option CMU-B52) is reserved for audio measurements or for the BLER measurement:

Speech Coder The speech codec is reserved for audio measurements (see also section *AF/RF Connectors (Connection Control – AF/RF)* on p. 4.203 ff.). The Block Error Rate (BLER) measurement (see section *Receiver Quality Measurements* on p. 4.133 ff.) can be performed on one timeslot only.

Multislot Support The speech codec is used for the BLER measurement so that a result can be obtained in up to 4 timeslots. The speech codec is not available for audio tests, however, direct tests on audio signals are still possible with option CMU-B41, *Audio Generator and Analyzer* (see CMU 200/300 manual).

Switchover of the *B52 Mode* takes some seconds. This function is not available unless option CMU-B52 is fitted.

Remote control

```
CONFigure:NETWork:B52Mode  SCOD | MSUP
```

Network Identity

The field *Network Identity* contains parameters characterizing the radio network that the CMU mimics:

MCC	3-digit Mobile Country Code, set to 001,
MNC	2- or 3-digit Mobile Network Code, set to (0)10 for GSM850 and GSM1900, and set to (0)01 for the other GSM bands. The number of digits can be selected in the adjacent field *(Two-Digit MNC* or *Three-Digit MNC),* irrespective of the GSM band.
NCC	Network Color Code, set to 0
BCC	Base transceiver station Color Code, set to 0
Loc. Area (LAI)	Location Area Code, set to 1
RAC	Routing Area Code, set to 0

Remote control

```
CONFigure:NETWork:IDENtity:MCC  <MCC>
CONFigure:NETWork:IDENtity:MNC  <MNC>
CONFigure:NETWork:IDENtity:MNC:DIGits 2 | 3
CONFigure:NETWork:IDENtity:NCC  <NCC>
CONFigure:NETWork:IDENtity:BCC  <BCC>
CONFigure:NETWork:IDENtity:LAC  <LAC>
CONFigure:NETWork:IDENtity:RAC  <RAC>
```

Signalling Modes

The *Signalling Modes* table section determines signalling parameters that the CMU conveys to the mobile station to influence its function (the parameters for CMU signals, on the other hand, are set in the BS-Signal tab, see section *RF Signals of the CMU (Connection Control – BS Signal)* on p. 4.184 ff.). The parameters refer to:

- *Traffic Mode* and *Bit Stream;* see section *Softkey-oriented Version* on p. 4.192 ff.
- The subchannel for half rate speech coding *(Half Rate Subchannel)*.
- Definition of a *Starting Time* for the channel change and the handover.
- *Location Update*
- Input of a mobile subscriber identity used for the location update *(Default IMSI)*
- *Power Change* mode
- *Signalling Channel*
- Condition for closing the loop in the mobile station *(Loop Command)*

Half Rate Subchannel

Half Rate Subchannel defines the subchannel to be used if half rate speech, data, or AMR channels are allocated (see *Traffic Mode* softkey on p. 4.193). With half rate coding, only half of the TDMA frames are used for a connection so that two subchannels numbered 0 and 1 are available.

The physical channel characteristics of the half rate channels and the TDMA frame mapping is described in standard 3GPP TS 45.002, Clause 7, Table 1. See also the TCH/H channel description in standard 3GPP TS 44.018.

Remote control
```
CONFigure:NETWork[:CSWitched]:SMODe:TRAFfic:HRSubchannel
                         SC0 | SC1
```

Starting Time

Starting Time determines a time interval after which the mobile station performs a new registration to the network after a channel, timeslot and fast power change (see *Power Change*). This parameter is also used for handover procedures from WCDMA to a GSM network. The value 0 frames means that no starting time is used.

Remote control
```
CONFigure:NETWork[:CSWitched]:SMODe:STIMe  <Frames>
```

Location Update

Location Update determines in which cases the mobile performs a location update:

Always	Each time the mobile station is switched on
Auto	Only if required, see background information below

A location update is normally used to signal to the base stations that the mobile station has changed its position. In this case, it is used to report to the CMU that the mobile station is switched on and ready for a call. After a location update of the mobile station, the signalling state *Synchronized* is reached. The parameter *Auto* implies that the attach bit is cleared. The mobile station will then only perform a location update if it does not seem to be registered. This may happen when the SIM card is changed or when the network parameters (e.g. *location area*) are changed in the CMU.

Remote control
```
CONFigure:NETWork[:CSWitched]:SMODe:LOCupdate  ALWays | AUTO
```

Default IMSI

The *Default IMSI* section defines an international mobile subscriber identity (IMSI) which is used to set up the call to the mobile. It consists of:

MCC	3-digit mobile country code
MNC	2- or 3-digit mobile network code, depending on the setting in the *Network Identity* secton. By default, a 3-digit MNC is used for GSM850 and GSM1900, a 2-digit MNC is used for the other GSM bands.
MSIN	10- or 9- digit mobile subscriber ID. A 10-digit MSIN is used together with a 2-digit MNC; a 9-digit MSIN is used together with a 3-digit MNC.

The IMSI of the mobile phone must be known before the call can be established. If the IMSI is known and reported to the tester as *Default IMSI,* it doesn't have to be determined during the location update; the call procedure will be faster. For this purpose, the international mobile subscriber identity request must be switched off *(IMSI Request = Off).*

Otherwise, the *Default IMSI* is overwritten by the respective parameters of the mobile station as soon as these are requested and transferred. For this purpose, the international mobile subscriber identity request must be switched on *(IMSI Request = On).*

The default setting for the *Default IMSI* is MCC = 001, MNC = (0)01, MSIN = 1(0)00000095 (Phase-2 mobile phones). For GSM850 and GSM1900, MNC = (0)10, MSIN = 1(0)00000095.

Remote control

```
CONFigure:NETWork[:CSWitched]:SMODe:IMSI:MCC  <code>
CONFigure:NETWork[:CSWitched]:SMODe:IMSI:MNC  <code>
CONFigure:NETWork[:CSWitched]:SMODe:IMSI:MSIN <code>
```

Power Change Mode

The *Power Change Mode* controls the power change of the mobile station:

Slow Slow power change, controlled via SACCH *(slow associated control channel),*

Fast fast power change, controlled via FACCH *(fast associated control channel).*

Note: *The CMU does not check whether the new power has already been achieved at the end of the command (be careful with remote-control programs).*

Remote control

```
CONFigure:NETWork[:CSWitched]:SMODe:PCHange  FAST | SLOW
```

Signalling Channel

Signalling Channel determines which channel is used for signalling:

SDCCH Signalling via *stand-alone dedicated channel:* Call setup to traffic channel with an extra signalling channel (normal mode in the network), duration 4 s to 6 s

FACCH Signalling via *fast associated control channel:* Fast call setup with signalling on traffic channel, duration 1 s to 2 s

NONE No automatic connection setup: The mobile must be controlled by means of an external test interface so that the CMU can immediately reach the *Call Established* state without exchanging signalling messages. The connection is faster and is also possible if the DUT does not provide any higher layers (module tests).

This mode is analogous to *Reduced Signalling* in packet data mode; see *Service Selection* softkey on p. 4.217. It is automatically activated if one of the (E)GPRS traffic modes is selected *(see Traffic Mode softkey on p.* 4.193*).*

Remote control

```
CONFigure:NETWork[:CSWitched]:SMODe:SCHannel
```

Loop Command

Loop Command determines in which cases the close loop command (CLOSE_TCH_LOOP_CMD) is sent to the mobile station. Closing the loop causes the mobile station to return all received bits to the CMU. In the case of an open loop, the mobile station does not send back anything. Most but not all mobiles require a test SIM card to enter the loopback mode.

Enable If the test set sends a pseudo-random sequence (PSR2E9-1, PSR2E11-1, PSR2E15-1, PSR2E16-1, e.g. for *Receiver Quality* measurement), the loop is closed. If no pseudo-random sequence is sent *(Bit Stream = ECHO, Loopback, Handset;* see p. 4.194*)*, the loop is left open. The loop type defined via *Loop* (see p. 4.179) is used.

Disable The CMU sends no close loop command (not even if a *Receiver Quality* measurement is active). Exception: See below.

Sensitivity The loop is closed only for *Receiver Quality* measurements. The loop type defined via *Loop* (see p. 4.179) is used.

Note: *If a data connection with pseudo-random data is active* (see *Traffic Mode* softkey on p. 4.193)*, then the loop command is always closed.*

A closed loop is a prerequisite for a receiver quality test (bit-error-rate measurement). However, it can be useful for transmitter measurements as well, since it permits to obtain a pseudo-random-modulated transmit signal from the mobile in an easy way. If the CMU transmits a pseudo-random modulation, the close loop command also causes a pseudo-random modulation of the signal to be returned by the mobile station.

Remote control
```
CONFigure:NETWork[:CSWitched]:SMODe:LCOMmand
```

Requested Mobile Data

Requested Mobile Data determines which parameters of the mobile station are requested during location update, MOC, or MTC. The requested information is displayed in the *Connection* tab of the *Connection Control* menu; see section *Connection Control with Call Established* on p. 4.169 ff.

IMSI Request Request of the international mobile subscriber identity *(On)* or no request *(Off)*.

IMEI Request Request of the international mobile station equipment identity *(On)* or no request *(Off)*.

Authentication R. Request of the mobiles authentication capability *(On)* or no request *(Off)*.

Handover R. Request to determine whether the mobile station can hand over to another GSM radio network (e.g. GSM1800, GSM1900) *(On)* or not *(Off)*. Dual band handover is always possible.

Classmark 3 R. Request of the classmark 3 information element (3GPP TS 05.14). This element specifies the supported bands and multislot classes of the mobile.

The IMSI request can be switched off if the IMSI of the mobile phone is known and reported to the tester as *Default IMSI* (see above). This speeds up the call setup procedure.

NOTE

The IMSI Request *and* IMEI Request *settings are valid for both circuit switched and packet data connections.*

Remote control
```
CONFigure:NETWork:REQuest:IMSI  ON | OFF
CONFigure:NETWork:REQuest:IMEI  ON | OFF
CONFigure:NETWork[:CSWitched]:REQuest:AUTHenticate  ON | OFF
CONFigure:NETWork[:CSWitched]:REQuest:HANDover  ON | OFF
CONFigure:NETWork[:CSWitched]:REQuest:CTHRee  ON | OFF
```

Adaptive Multi-Rate (AMR)

Adaptive Multi-Rate (AMR) comprises the settings for the AMR codec. In addition to the settings provided in the softkey-oriented *Network* tab (see section *Adaptive Multi-Rate (AMR) Speech Codec* on p. 4.232 ff.) the following settings are provided:

Noise Suppression Switch noise suppression at the AMR codec of the mobile station on or off.

Remote control
```
CONFigure:NETWork[:CSWitched]:AMR:NSUPpression  ON | OFF
```

Timeouts

The *Timeouts* field determines timeouts after which an interrupted radio link or an unsuccessful call to the mobile station is aborted:

Radiolink Timeout Mobile	Time period after which a previously established but interrupted connection is dropped by the mobile station – number of missing SACCH blocks in the value range 4, 8, 12, ... 24, ... 64
Radiolink Timeout Testset	Time period after which an existing, but interrupted connection is aborted by the CMU – number of missing SACCH blocks in the value range 4, 5, 6, ... 24, ... 64. In the setting Off, the CMU does not abort the connection; this corresponds to an infinite timeout period
MTC Timeout	Maximum time period in seconds during which the phone is ringing in the case of call to mobile (mobile terminated call). If the mobile is not picked up, the CMU returns to the *Synchronized* state. Values from 0 s to 10 s to 60 s can be set. In the Off setting, the number of the mobile station is dialed for an unlimited period of time; this corresponds to an infinite timeout

Timeouts are of particular importance in remote-control mode. For example, the remote-control program will not be able to continue if the keyboard of the mobile station is defective and the call can therefore not be answered by the mobile station.

Remote control
```
CONFigure:NETWork[:CSWitched]:TIMeout:RLINk[:MOBile]  <Time>
CONFigure:NETWork[:CSWitched]:TIMeout:RLINk:TESTset  <Time>
CONFigure:NETWork[:CSWitched]:TIMeout:MTC  <Time>
```

Advice of Charge

Advice of Charge comprises the settings for the advice of charge on the mobile station:

Enable	CMU sends (*On*) or does not send *(Off)* data for the advice of charge to the mobile station,
E1 ... E7	Formulas for calculation of the advice of charge according to GSM specification. Numerical input in the value range 0 to 8191.

Remote control
```
CONFigure:NETWork[:CSWitched]:AOCharge:ENABle  ON | OFF
CONFigure:NETWork[:CSWitched]:AOCharge <Value1>, .. ,<Value7>
```

Slot Offset

Slot Offset defines the DL timeslot that the mobile is to loopback to the uplink main timeslot. The slot offset is counted from the main timeslot number n_{MTS}: A slot offset SO ($-7 \leq SO \leq +7$) means that the selected DL timeslot no. equals to (n_{MTS} + SO). Moreover, the periodicity of timeslots in the GSM TDMA frame scheme implies that *Slot Offset* settings differing by 8 are equivalent.

The DL timeslot no. (n_{MTS} + SO) is equal to the timeslot number *(TN)* parameter in the CLOSE_Multi-slot_LOOP_CMD (GSM04.14).

Remote control
```
CONFigure:NETWork[:CSWitched]:SOFFset  <Slots>
```

Enhanced Meas. Reports

If *Enhanced Meas. Reports* is switched *On,* the R&S CMU requests the MS to provide enhanced measurement reports as defined in standard 3GPP TS 05.08, section 8.4.8. This means that, for circuit switched connections *(Main Service: Circuit Switched),* the *Receiver Quality* menus display not only the *RX Level* and the *RX Quality,* but also the *Mean BEP,* the *CV BEP,* and the *Number of Received Blocks*. On the other hand the *Neighbor Cell* reports *(Receiver Quality – Application – Neighbor Cells)* are not evaluated.

If *Enhanced Meas. Reports* is switched *Off,* the *Mean BEP* and the *CV BEP* are only requested for packet data connections.

Remote control

```
CONFigure:NETWork[:CSWitched]:SOFFset  <Slots>
```

System Parameters

System Parameters determines system parameters for the radio link:

Band Indicator	Indication of the band GSM1800 or GSM1900 that the MS under test can use. If the MS supports this parameter and operates in either one of the GSM1800 or GSM1900 bands, all GSM channels are interpreted according to the *Bandwidth Indicator.* The information on the band is essential because the two bands partially use the same channel numbers for different frequencies.
BS-AG-BLKS-RES	Number of data blocks (access grant channel) reserved for the AGCH access (basic services access grant blocks reserved) in the value range 0 to 7
BS-PA-MFRMS	Interval between two paging requests of the CMU in multiframes (basic service paging blocks available per multiframes) and in the value range 2 to 9
Paging Reorganisation	If this parameter is *On,* the mobile listens to all paging groups. If it is *Off,* the mobile only listens to its own paging group; the receiver is idle/deactivated in other paging groups. To measure the spurious emissions of a mobile according to GSM 51.010, *Paging Reorganisation* must be *On* .
T3212	Value of the timer T3212 of the periodic location updating procedure in decihours. In the *Off* setting, no periodic location update is performed.
Cell Access	Enabling (Not Barred) or disabling (Barred) a radio cell for mobile stations

Barring a radio cell means that the mobile station cannot synchronize to it and cannot perform a location update.

Remote control

```
CONFigure:NETWork:SYSTem:BINDicator  G18 | G19
CONFigure:NETWork:SYSTem:BSAGblkres  <Blocks>
CONFigure:NETWork:SYSTem:BSPamfrms  <Frames>
CONFigure:NETWork:SYSTem:BSPReorganis  ON | OFF
CONFigure:NETWork:SYSTem:PLUPdate <Value>
CONFigure:NETWork:SYSTem:CACCess  BARRed | NBARred
```

BA List

BA List configures the list of used channels in the neighbor cells *(BA list, BCCH allocation list)*. The BA list is of significance for selecting the radio cells of the mobile station. Up to 16 entries are possible in the list (i.e. 16 used channels in 16 neighbor cells).

00 ... 15	Current number of adjacent cell. It is possible to enter either no channel *(Off)* or one of the GSM channels 0 to 1023.

List Sorted The channel numbers of the BA list are output in increasing order *(On)* or in arbitrary order *(Off).*

Note: *Irrespective of the current GSM band, channel numbers in the range 0 to 1023 can be used to configure the BA list. Each entry is interpreted to denote a GSM channel of the current GSM band corresponding to the active function group.*

Remote control
`CONFigure:NETWork:BAList <Channel1>{, ... ,<Channel15>}`

3G Neighbor Cell Description *3G Neighbor Cell Description* defines the 3G (UMTS) neighbor cell description information that can be transferred to the MS in System Information 2ter. The description informs the MS about the existence and about the essential properties of a neighbor cell, e.g. to prepare a handover. The following settings are provided:

Enable If the setting is *On* the 3G neighbor cell description including the selected UARFCN and primary SC is transferred on the BCCH.

FDD ARFCN Band 1 UTRAN Radio Frequency Channel number of the 3G neighbor cell.

Primary Scrambling Code Primary SC characterizing the 3G neighbor cell.

Remote control

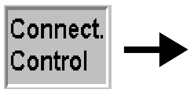
```
CONFigure:NETWork:SI2Quater:NC3G:ENABle
CONFigure:NETWork:SI2Quater:NC3G:FDD:ARFCn
CONFigure:NETWork:SI2Quater:NC3G:FDD:PSCode
```

AF/RF Connectors (Connection Control – AF/RF)

The *AF/RF* tab selects the connectors for RF and AF signals. This includes the setting of

- The RF input and output at the CMU *(RF Output, RF Input)*
- An external attenuation at the connectors *(Ext. Att. Output, Ext. Att. Input)*
- The input source of the CMU speech encoder and the output destination of its speech decoder

If the *Audio Generator and Analyzer* (option CMU-B41) is not fitted, the speech codec (option CMU-B52) is connected to the 9-pole *SPEECH* (handset) connector on the CMU front panel, see chapter 8 of the CMU operating manual. The *Speech Encoder* and *Speech Decoder* settings are not available.



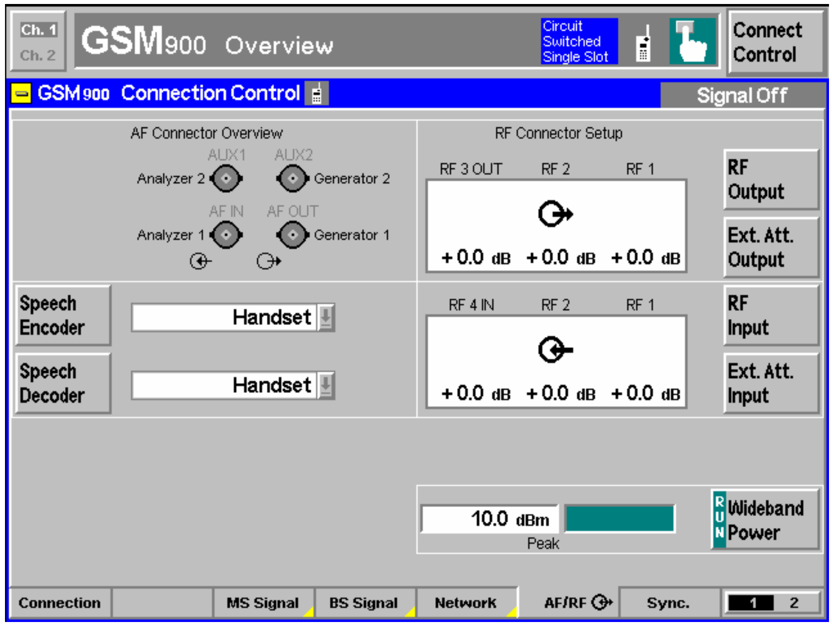


Fig. 4-83 Connection Control – AF/RF connectors

With the exception of the *Speech Encoder* and *Speech Decoder* routing, all functions of this menu are described in section *GSM400/GT800/850/900/1800/1900-MS Non Signalling* on page *4.95*.

Speech Encoder

The *Speech Encoder* softkey selects the input source for the CMU speech encoder (option CMU-B52). The following two input sources are available:

Generator Use the audio generator signal which is also fed to the *AF OUT* connector on the CMU front panel

Handset Use the signal of the 9-pole *SPEECH* (handset) connector on the CMU front panel

Remote control
`ROUTe:SPENcoder[:INPut] HANDset | GENerator`

Speech Decoder

The *Speech Decoder* softkey selects the output destination for the CMU speech decoder (option CMU-B52). The following output destinations are available:

Handset Route speech decoder output to the 9-pole *SPEECH* (handset) connector on the CMU front panel

Analyzer Route speech decoder output to audio analyzer. The standard analyzer input socket *AF IN* is disabled *(Off).*

Analyzer 2 Route speech decoder output to secondary audio analyzer. The standard secondary analyzer input socket *AUX 1* is disabled *(Off).*

Analyzer Both Route speech decoder output to primary audio analyzer. The standard primary and secondary analyzer input sockets *AF IN* and *AUX 1* are disabled *(Off).*

The primary and secondary audio circuits are described in detail in chapter 4 and 6 of the CMU200/300 operating manual.

Remote control
`ROUTe:SPDecoder[:OUTPut] HANDset | ANALyzer | ANA2 | ABOTh`

AF Connector Overview

The *AF Connector Overview* shows the destination of the input signals fed in via AF IN and AUX 1 and the signal sources for the two audio output connectors AF OUT and AUX 2. The routing of input and output signals does not depend on the *Speech Encoder* settings but is a function of the *Speech Decoder* output destination. In the default configuration *(Speech Decoder = Handset),* the connectors AF IN and AF OUT are used as input and output for the primary audio circuit (Analyzer 1, Generator 1). AUX 1 and AUX 2 are used as input and output for the secondary audio circuit (Analyzer 2, Generator 2). If the *Speech Decoder* output is routed to one of the Analyzers, it replaces the external audio input signal. The corresponding input connector is disabled *(Off)*.

Reference Frequency (Connection Control – Sync.)

The *Sync.* tab determines the reference signal for synchronization. This includes

- The selection of internal or external reference frequency
- The output mode for the reference frequency *(F REF OUT 2)*

The functions of this menu are described in the section *GSM400/GT800/850/900/1800/1900-MS Non Signalling* on page *4.98* ff.

Trigger (Connection Control – Trigger)

The *Trigger* tab is part of the second group of tabs in the *Connection Control* menu. It is accessible after pressing the *1 / 2* toggle hotkey once. Pressing *1 / 2* again switches back to the first group of tabs described above.

The *Trigger* tab defines the trigger condition for the measurement and the routing of trigger signals.

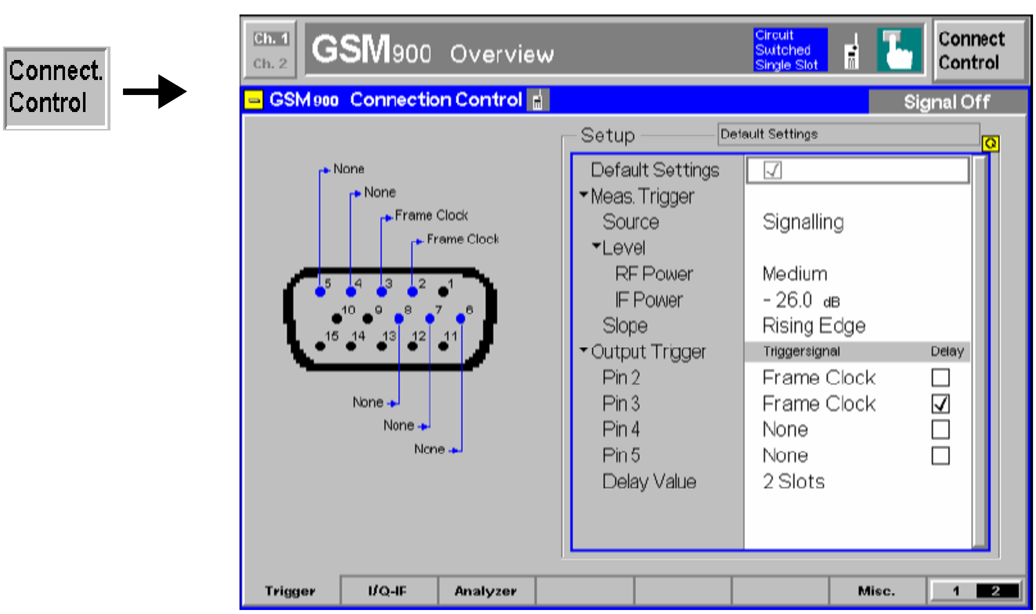


Fig. 4-84 Connection Control – Trigger

Default Settings The *Default Settings* checkbox assigns the default setting to all functions in the *Trigger* tab (the default values are quoted in the command description in chapter 6 of this manual).

Remote control `TRIGger[:SEQuence]:DEFault ON | OFF`

Trigger – Source

Source selects a signal to trigger the measurements:

Free Run Trigger by the GSM input signal: The CMU detects the burst; the exact timing is given by the training sequence. This setting may slow down the measurements. *P/t Multislot, Power/Slot*, and *Power/Frame* measurements can not be performed in *Free Run* trigger mode.

Note: *In* Spectrum *measurements, Free Run trigger mode means that the measurement is not correlated with the burst timing. The* Switching *spectrum must be measured with another trigger source, e.g.* IF Power *trigger.*

RF Power The measurement is triggered by the level of the incoming burst (rising or falling edge; see *Slope* setting below), the trigger level is specified via the *Level* parameters. Wideband power trigger on the RF Front End.

IF Power The measurement is triggered by the level of the IF signal (rising or falling edge; see *Slope* setting below), the trigger level is specified via the *Level* parameters. Narrow-band IF power trigger.

Signalling Triggering by the signalling unit of the instrument, according to the expected frame timing of the RF signal re-transmitted by the MS under test (uplink frame trigger). The uplink frame trigger is always available while the *Signalling* test mode is active and the CMU transmits an RF signal (i.e. except in the signalling state *Signal Off)*.

The uplink frame trigger signal can also be fed to pins 2 to 5 of the AUX 3 connector at the front of the instrument where is can be tapped off to synchronize external devices; see *Output Trigger* below. It consists of a high-pulse TTL signal with its rising edge at the beginning of timeslot 0 of each MS TDMA frame and with a length of exactly 1 timeslot (577 µs). In idle frames and (4-frame) radio blocks carrying CTRL_ACK information elements (in EGPRS mode only), where the MS can transmit irregular burst types, the frame trigger is suspended, and *Ctrl. Acks* trigger events are generated instead (see background information below).

For the *Free Run, RF Power* and *IF Power* settings the input signal must be a burst signal. Triggering via an external signal is only possible in the *Non Signalling* mode. In contrast, *Signalling* measurements must be triggered by the signal from the signalling unit or from the mobile phone.

RF Power trigger signals have a small dynamic range which may not be sufficient for triggering. It is recommended to trigger by the *IF Power* instead.

Some measurements require a particular trigger source. E.g., the *Timing Advance Error* in the *Modulation* menu can be measured with *Signalling* trigger mode only.

Remote control

```
TRIGger[:SEQuence]:SOURce
  SIGNalling | FRUN | RFPower | IFPower
```

Level The *Level* section defines the trigger thresholds if the measurement is triggered by the *RF Power* or *IF Power* (see *Source* function above) respectively. Both thresholds are defined relative to the maximum input level set in the *Analyzer* tab (see section *Input Path (Connection Control – Analyzer)* on p. 4.209 ff.). The *Level* settings have no influence on *Free Run* or *External* trigger measurements.

Note: *The trigger levels are always relative to the* ***current*** *maximum input level. If* Max. Level *is set manually* (RF Mode = Manual)*, the current input level is constant and equal to the setting value. In autoranging mode* (RF Mode = Auto)*, the current maximum input level is dynamically adapted to the measured RF input level; the trigger levels change accordingly.*

The ***RF Power*** trigger threshold is the RF input signal level *(Wideband Power*, see p. 4.107) beyond which the trigger condition is satisfied and a measurement is initiated.

Low	Low trigger threshold, equal to approx. the *RF Max. Level* –26 dB
Medium	Medium trigger threshold, equal to approx. the *RF Max. Level* –16 dB
High	High trigger threshold, equal to approx. the *RF Max. Level* –6 dB

The ***IF Power*** trigger threshold is the IF trigger signal level beyond which the trigger condition is satisfied and a measurement is initiated. The *IF Power* input value defines the trigger threshold relative to the maximum input level:

IF power trigger threshold = <RF Max. Level> + <IF Power>

Remote control
```
TRIGger[:SEQuence]:THReshold:RFPower LOW | MEDium | HIGH
TRIGger[:SEQuence]:THReshold:IFPower <Power>
```

Slope *Slope* qualifies whether the trigger event occurs on the *Rising Edge* or on the *Falling Edge* of the trigger signal. The setting has no influence on *Free Run* measurements.

Due to the polarity and the length of the uplink frame trigger signal (see *Source = Signalling* above), changing the slope from *Rising Edge* to *Falling Edge* corresponds to the introduction of a 1-slot delay of the measurements.

Remote control
```
TRIGger[:SEQuence]:SLOPe POSitive | NEGative
```

Output Trigger *Output Trigger* assigns an output trigger signal (or no signal) to the AUX 3 connector and defines a delay time. The settings are only valid for *Signalling* trigger source; see above.

Pin 2/3/4/5	The frame trigger, hopping trigger, Ctrl. Ack. trigger (see background information below), or onle of the multiframe trigger signals can be assigned to any of the pins no. 2 to 5 of the AUX3 connector. Multiple assignments are allowed. The setting *None* means that no output signal is applied to a pin. If the *Delay* box is checked, the trigger signal at one pin is delayed by an integer number of slots.
Delay	Sets a delay time (integer number of 0 to 7 slots) for the trigger signal. The undelayed frame, Ctrl. Ack. or multislot trigger signal coincides with the beginning of timeslot 0 of the UL (MS) signal, so *Delay* can be used to generate a trigger signal with its rising edge at the beginning of any UL TDMA timeslot.

Remote control

```
TRIGger:OUTPut:PIN<nr>:SIGNal
TRIGger:OUTPut:PIN<nr>:DELay:ENABle
TRIGger:OUTPut:DELay:VALue
```

Hopping Trigger

The hopping trigger signal is a trigger signal with a periodicity of 1 TDMA frame that is generated while the following two conditions are met:

- The mobile under test is connected (signalling states *Call Established* or *TBF Established)*.
- Frequency hopping of the CMU is enabled *(Connection Control – BS Signal – Hopping: ON)* and the CMU has encountered the first channel in the hopping list.

The CMU performs cyclic hopping according to standard 3GPP TS 05.02 using one of the hopping sequences defined in the *BS Signal* tab. The frequency of the BS signal is changed after each TDMA frame. To ensure proper mapping between the TDMA frame numbers and the RF channels, hopping does not necessarily start from the beginning of the sequence. The first hopping trigger pulse occurs when the first channel in the sequence (MAI = 0) is used for the first time.

The hopping trigger signal is analogous to the frame trigger signal: It is a high-pulse TTL signal with its rising edge at the beginning of timeslot 0 of each **DL** TDMA frame (**including** the idle frames) and with a length of exactly 1 timeslot (577 µs). A trigger *Delay* is taken into account. The trigger signal can be used to monitor the hopping sequence or trigger external devices. An application example involving an external R&S signal generator is reported in Chapter 2, section *Frequency Hopping Trigger.*

Multiframe trigger

The 26, 52, and 104 multiframe triggers are analogous to the frame trigger signal and aligned to the beginning of timeslot 0 of each n^{th} uplink frame (n = 26, 52, 104), plus a possible *Delay*. The multiframe trigger signals can be used to synchronize a mobile (or another external device) to the full GSM frame timing of the R&S CMU200, e.g. in order to perform a Bit Error Rate test without previous BCCH synchronization (reduced signalling mode).

Ctrl. Acks trigger

The Ctrl. Acks triggers are also analogous to the frame trigger signal and aligned to the beginning of timeslot 0, plus a possible *Delay*. The trigger events occur at the beginning of each EGPRS UL radio block carrying CTRL_ACK information elements, where the frame trigger signal is suspended. Each radio block comprises 4 TDMA frames so that a single Ctrl Ack trigger event replaces 4 frame trigger events. The CTRL_ACK blocks are generated with a periodicity of approx. 1 s.

- The *Ctrl. Acks (Main Slot)* trigger events occur at the beginning of each CTRL_ACK block transferred in the main timeslot.
- If an UL multislot configuration is active the *Ctrl. Acks (Other Slots)* trigger events occur at the beginning of each CTRL_ACK block transferred in any other timeslot. The R&S CMU requests CTRL_ACK blocks in the other timeslots with a delay of 1 radio block (4 TDMA frames) relative to the main timeslot.

In contrast to the other EGPRS blocks, CTRL_ACK blocks are transferred on either GMSK-modulated normal bursts or on access bursts (see *Control ACK Type* on p. 4.229). The Ctrl. Acks triggers can be used to select a particular burst type for the *Spectrum* measurement (see *Trigger Mode* on p. 4.132). Due to the delay between the main slot and the other slots, it is also possible to observe different slot types in a single *P/t Multislot* menu.

I/Q-IF Interface (Connection Control – I/Q-IF)

The *I/Q-IF* tab is part of the second group of tabs in the *Connection Control* menu. It is accessible after pressing the *1 / 2* toggle hotkey once. Pressing *1 / 2* again switches back to the first group of tabs described above.

The *I/Q-IF* tab configures the signal paths for I/Q and IF signals. With option CMU-B17, *I/Q and IF Interfaces,* I/Q and IF signals can be used in the framework of *RF* measurements and in many network tests. The functions of this menu are described in the section *GSM400/GT800/850/900/1800/1900-MS Non Signalling* on page *4.102* ff.

Input Path (Connection Control – Analyzer)

The *Analyzer* tab is part of the second group of tabs in the *Connection Control* menu. It is accessible after pressing the *1 / 2* toggle hotkey once. Pressing *1 / 2* again switches back to the first group of tabs described above.

The*Analyzer* tab configures the RF input path by defining:

- The maximum level that the CMU can measure *(RF Max. Level)* and the way it is defined *(RF Mode)*
- An attenuation or gain factor *(RF Attenuation)*
- The timeslot that is measured in all multislot configurations *(Meas. Slot)*

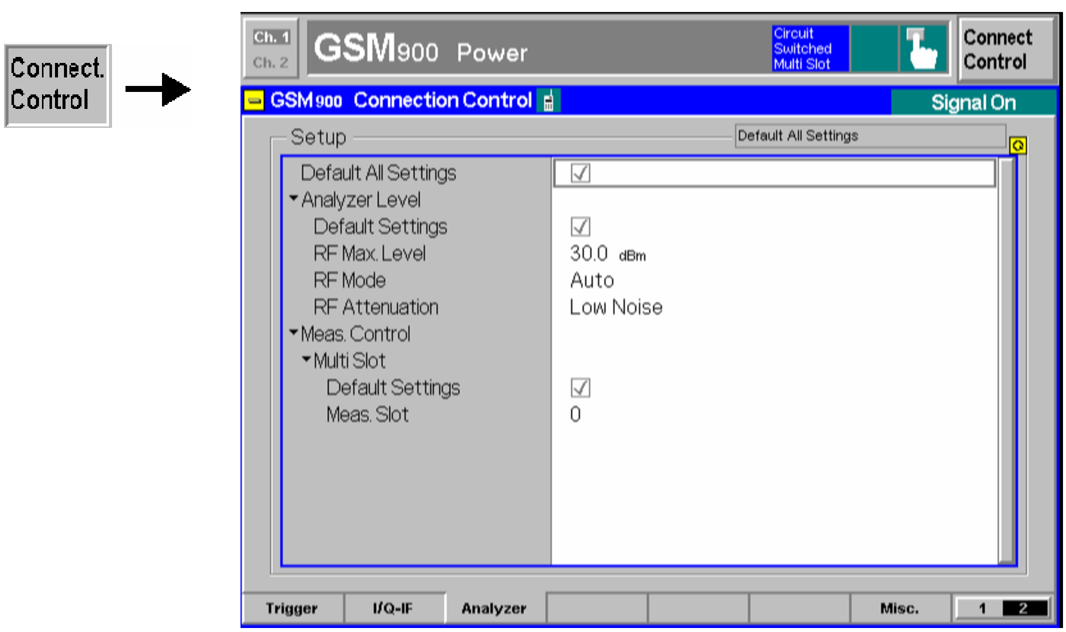


Fig. 4-85 Connection Control – Input level

Default Settings The Default Settings switch overwrites all settings in the *Input Level* tab with their default values. See command description in chapter 6.

Remote control
`[SENSe:]LEVel:DEFault`
`MCONTrol:DEFault`

Analyzer Level

The *Analyzer Level* section configures the RF input path of the CMU. The functions are described in section *GSM400/GT800/850/900/1800/1900-MS Non Signalling*. In contrast to the *Non Signalling* mode, the *Signalling* input level can be set corresponding to the PCL of the connected mobile phone.

Analyzer Level – RF Mode

The *RF Mode* field qualifies how the maximum input level that can be measured *(RF Max. Level)* is defined. *RF Max. Level* is displayed in the parameter lines above the graphical measurement menus.

Manual	Manual input of maximum input level
PCL	Input level corresponding to the power control level of the mobile station.
Auto	Automatic setting of maximum input level *(autoranging)* according to average burst power of applied signal.

Remote control
`[SENSe:]LEVel:MODE MANual | PCL | AUTOmatic`

Multi Slot Meas. Slot

The *Multi Slot – Meas. Slot* parameter defines in which GSM timeslots MS tests are performed. The *Meas. Slot* setting only affects the measurements performed on the CMU. It can be changed any time without any further impact on the MS under test and the connection.

- If *Slot Count* is equal to 1, then the measurement extends over the *Meas. Slot* plus an appropriate display margin.
- If *Slot Count* is equal to 2, then the timeslot preceding the *Meas. Slot (Meas. Slot –1)* and the *Meas. Slot* are measured.
- If *Slot Count* is equal to 3 (4), then *Meas. Slot – 1, Meas. Slot* and the next timeslot (the two next timeslots, *Meas. Slot + 1* and *Meas. Slot + 2)* are measured.

The beginning of the *Meas. Slot* defines the origin (symbol no. 0) of the time axis. The *Meas. Slot* is also the reference for the *Timing* measurement; it must be active to obtain valid measurement results.

The relation between the *Meas. Slot*, the *Slot Count* and the measured time range for a signal with three active timeslots is shown in Fig. 4-86 *below*.

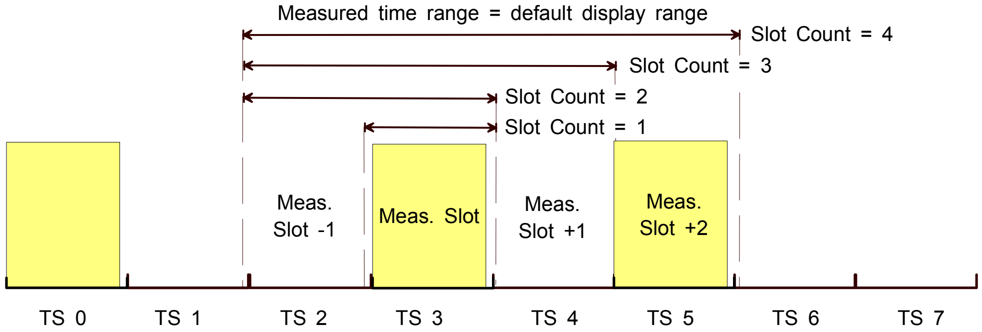


Fig. 4-86 Meas. slot and slot count (for Meas. Slot = 3)

The display range is adapted to the Slot Count and Meas. Slot settings by default but can be modified by means of the *Display Marker – Time Scale* and *Display Marker – Default Scale* hotkeys.

Note: *To ensure that the CMU generally measures an occupied timeslot, the* Meas. Slot. *is set equal to the* Main Timeslot *(see p. 4.181) upon a reset or whenever a connection is set up. In the Call Established and TBF Established states, the main timeslot and* Meas. Slot *can be changed independently. In a dual-band handover, the slot configuration of the target network is activated so that the* Meas. Slot *is set equal to the main timeslot of the target network.*

Remote control
`CONFigure:MCONtrol:MSLot:MESLot`

Display Control (Connection Control – Misc.)

The *Misc.* tab is part of the second group of tabs in the *Connection Control* menu. It is accessible after pressing the *1 / 2* toggle hotkey once. Pressing *1 / 2* again switches back to the first group of tabs described above.

The *Misc.* tab defines in what instances the *Connection Control* popup menu is automatically opened or closed *(Connect. Control Guidance)* and enables automatic menu selection for (E)GPRS tests.

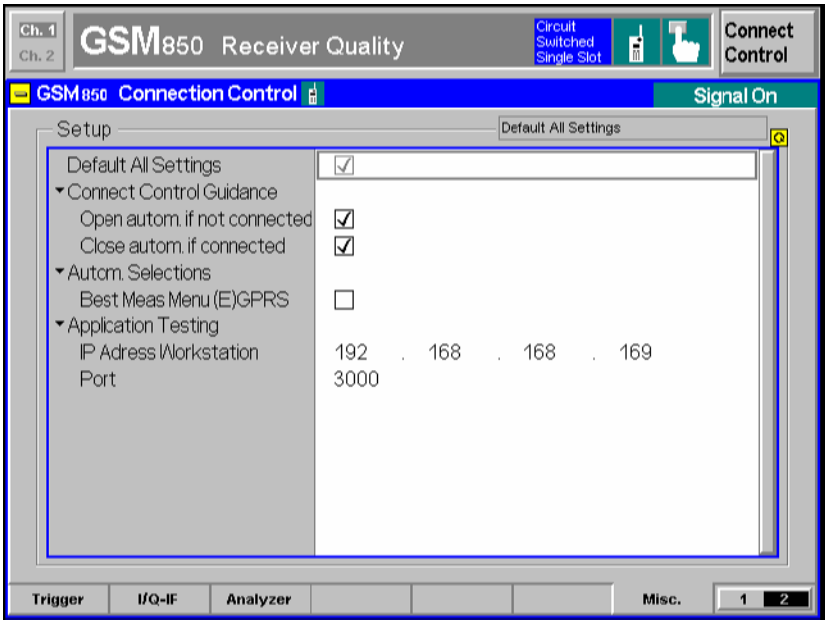


Fig. 4-87 Connection Control – Misc.

Default Settings The *Default All Settings* switch sets all parameters of the *Misc* tab to their default values (see command description in chapter 6).

Remote control No command; screen configuration only.

Connect. Control Guidance Defines in what instances the *Connection Control* popup menu is automatically opened or closed:

Open autom. if not connected

In the *Open automatically* mode, the *Connection Control* menu is automatically opened each time the GSM function group is accessed in *Signalling* test mode, each time a measurement menu is opened while the DUT is not connected and each time a connection is lost. Otherwise the menu must be opened manually.

Close autom. if connected

In the *Close automatically* mode, the *Connection Control* menu is automatically closed as soon as the CMU reaches the *Connected/Call Established* state. Otherwise the menu must be closed manually.

Remote control No command; screen configuration only.

Autom. Selections

Best Meas. Menu (E)GPRS enables or disables automatic menu selection according to the current *Service Selection* defined in the *Connection* tab (see p. 4.217). If this function is enabled, the measurement menus are selected according to Table 4-20 below.

The function is available with option R&S CMU-K42/-43; see section *GPRS Signalling and EGPRS* on p. 4.213 ff. It is also used by the measurement wizard described in Chapter 2.

Remote control No command; screen configuration only.

Table 4-20 Best meas. menus for GPRS and EGPRS

Service Selection	**Selected Menu**	**Selected Applications**
Test Mode A	Power	Power : Multislot
Receiver Quality : BER Average		
Test Mode B	Receiver Quality	Receiver Quality : BER Average
EGPRS Loopb. sym.	Receiver Quality	Receiver Quality : BER Average
EGPRS Loopb. asym.	Receiver Quality	Receiver Quality : BER Average
Red. Sig. Mode A	Power	Power : Multislot on switchover to Receiver Quality: Receiver Quality : BER Average
Red. Sig. Mode B	Receiver Quality	Receiver Quality : BER Average
Red. Sig. EGPRS sym.	Receiver Quality	Receiver Quality : BER Average
Red. Sig. EGPRS asym.	Receiver Quality	Receiver Quality : BER Average
Downlink only	Receiver Quality	Receiver Quality : BLER
BLER	Receiver Quality	Receiver Quality : BLER

Application Testing

Contains IP address information for *(E)GPRS Application Tests* (with option R&S CMU-K92).

IP Address Workstation IP address of the PC used to control option R&S CMU-K92.

Port Port number assigned to a particular application test.

For more information refer to the manual for option R&S CMU-K92, stock no. 1157.4148.12.

Remote control

```
CONFigure:ATESt:WSIPaddress <IP1>, <IP2>, <IP3>, <IP4>
CONFigure:ATESt:WSPort <port_no>
```

Options and Extensions

The features described in this section require the installation of additional software options; for a complete list of deliverable options refer to the data sheet.

GPRS Signalling and EGPRS (Options CMU-K42/K43)

General Packet Radio Service (GPRS) is one of the extensions of GSM Phase 2+ that are aimed to increase the obtainable data transfer rate. To reach this objective, GPRS relies upon the following key features:

1. Data transfer is packet oriented. In addition, transmission takes place only when there are actually data packets to be transmitted (Temporary Block Flow, TBF): The radio resources for each subscriber are dynamically allocated. Compared to circuit switched data transfer where a fixed physical radio channel is continuously occupied by one call, the radio resources can be used more efficiently.
2. GPRS is a multislot solution: Up to 8 timeslots per TDMA frame can be allocated to a single subscriber.
3. Redundant data transmission required for error protection can be minimized by using different channel coding schemes CS1 to CS4.
4. GPRS can be combined with 8PSK-modulated traffic channels to form Extended GPRS (EGPRS). In EGPRS nine different modulation and coding schemes MCS1 to MCS9 are specified.
5. As a GSM extension, GPRS always works in combination with the existing circuit switched network and does not change or replace any of the existing GSM features. GPRS and GSM services can be used alternately.

The characteristics of the GPRS technology outlined above determine the test requirements for GPRS mobile phones and the GPRS-specific test functionality of the CMU:

1. A GPRS-specific test mode for transmitter tests and a loopback test mode for BER tests has been defined, see *Service Selection* softkey on p. 4.217. The CMU is capable of performing *Receiver Quality* measurements on packet switched data traffic channels (PDTCHs) and evaluates the Block Error Ratio (BLER) and the Data Block Error Rate (DBLER). For background information refer to section *BER Tests of PDTCHs* on p. 4.135.
2. The CMU is able to measure a mobile station that operates in multislot mode (see *Slot Mode* softkey on p. 4.177). In particular, the tester measures and displays the power versus time and performs a limit check in up to 4 consecutive timeslots (see section *P/t Multislot* on p. 4.122 ff.). In contrast to circuit switched operation, no single-slot packet data mode is available.
3. The channel coding schemes CS1 to CS4 that a GPRS mobile station under test will use and the modulation and coding scheme MCS1 to MCS9 for an EGPRS mobile station can be set in the *Network* tab of the *Connection Contol* menu *(Coding Scheme;* see section *Network Parameters (Connection Control – Network)* on p. 4.227).
4. The GPRS signalling states and the procedures for setting up a data connection are analogous to the corresponding circuit switched functionality. GPRS is an additional mode of the mobile phone so that the circuit switched GSM and the GPRS signalling schemes are largely independent from each other. Any time before a call or a TBF connection is established, the CMU is able to switch over between circuit switched GSM and GPRS mode (see *Fig. 4-88* on p. 4.215).

Tip: *The Measurement Wizard (see Chapter 2) provides predefined settings for typical GPRS and EGPRS test scenarios. For many applications, selecting a predefined setting is the simplest and fastest way of configuring the instrument.*

Setup of a Connection (Popup Menu Connection Control – Connection)

The menu group *Connection Control* controls signalling (setup and release of a connection, services, signalling parameters) and configures the inputs and outputs with the external attenuation values and the reference frequency.

The term signalling denotes all procedures that are necessary for setting up and releasing a connection and for controlling the connection in the mobile radio network. In the case of a GSM mobile phone supporting GPRS, both a circuit switched GSM call connection and an (E)GPRS connection for data transfer can be set up. In addition a special GPRS test mode has been defined for production tests of GPRS mobile phones. The five GSM signalling states *Signal Off, Signal On, Synchronized, Alerting, Call Established* of the CMU are therefore complemented by the following GPRS signalling states:

Signal Off	CMU transmits no signal.
Idle	CMU transmits a GSM control channel signal. A GPRS mobile station can detect this signal, synchronize to its timing and frequency and then read the system information. In particular, the MS learns whether the CMU (representing the current cell in a real network) supports GPRS services and can initiate a GPRS attach.
Attach in Progress	Transitory state: GPRS attach is being performed. This step is always initiated by the mobile station under test. The MS identifies itself with its GSM identity (IMSI, Temporary Link Level Identity, TLLI) and indicates its presence to the CMU for the purpose of using GPRS Point to Point (PTP) services. This can be done any time while the CMU is in the *Idle* state. If the mobile supports combined attach, the (circuit switched) *Synchronized* state is reached together with the (packet data) *Attached* state; the location update is performed together with the GPRS attach.
Detach in Progress	Transitory state: GPRS detach is being performed. Like GPRS attach, the GPRS detach procedure is always initiated by the mobile station under test.
Attached	The mobile station is GPRS-attached. From this state, it is possible to initiate a TBF connection.
Connecting TBF	Transitory state: The CMU attempts to access the *TBF Established* state. Unlike the GPRS attach, the TBF connection must be initiated by the CMU.
TBF Established	The mobile station is in the multislot test mode A or B for GPRS specified in 3GPP TS 44.014 (see section 4.216 on p. 4.216). In this mode, it continuously transmits RLC data blocks until the TBF connection is released.

Note: *The* TBF Established *state was specified especially in order to facilitate production tests. Reaching this state is the goal of the CMU's GPRS signalling scheme. The CMU signalling states* Idle, Attached *and* TBF Established *must not be confused with the mobility management states* Idle, Standby *and* Ready *defined in GSM 03.60.*

A number of actions or control commands which can be initiated either by the CMU (e.g. *Signal On, Signal Off)* or by the mobile station (e.g. *MS Attach/Detach)* switch between the different signalling states. In *Fig. 4-88* on p. 4.215, dashed lines represent processes initiated by the mobile station.

Activating (E)GPRS

The CMU mimics a real GSM base station which may or may not support (E)GPRS. The instrument provides the two *Network Support* modes *GSM, GSM + GPRS* or *GSM + EGPRS* that can be selected in the *Network* or in the *Connection* tab of the *Connection Control* menu while the CMU is in the GSM *Signal Off* or *Idle* state (see *Network Support* softkey on p. 4.107 ff.).

Operating sequence

To establish an (E)GPRS connection proceed as follows:

1. In the *Menu Select* menu, select one of the menus in *GSM Signalling* mode.

The *Connection* tab of the *Connection Control* menu is opened. The CMU should be in the signalling state *Signal On*. The *Main Service* softkey is inactive.

2. Press the *Network Support* softkey to select *GSM + (E)GPRS*.
3. Press the *Main Service* softkey (which is now active) to select *Packet Data* and

switch over from the circuit switched GSM to the GPRS/EGPRS signalling scheme.

The CMU is now in the GPRS *Idle* state. It reaches the *Attached* state after the MS under test attempts a GPRS attach. The *Connection* tab contains an additional softkey labeled *Service Selection*.

4. Press *Service Selection* and select the GPRS test mode appropriate for your test case.
5. To establish a TBF connection proceed as outlined in Fig. 4-88 below and in the following sections.

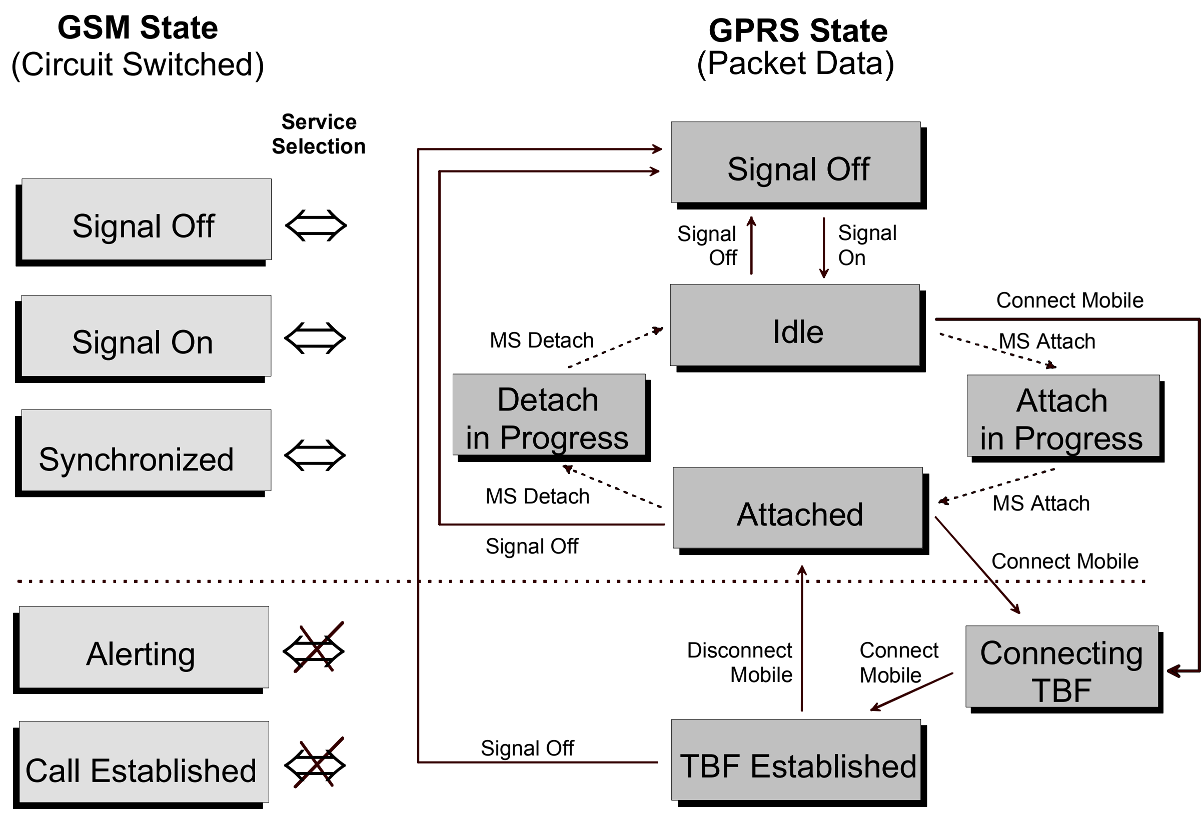


Fig. 4-88 GPRS signalling states

Note: Dual Transfer Mode

With option CMU-K44, Dual Transfer Mode, the CMU is also able to set up a combined circuit switched and packet data connection and perform RX and TX measurements. Refer to Chaper 9 of this manual for detailed information.

GPRS test mode

GPRS mobile tests are to be performed in *TBF Established* mode. This is why the menus for connection setup (*Connection Control – Connection)* appear immediately after the function group and mode *GSM400/GT800/850/900/1800/1900-MS Signalling* is activated. The test mode type (A or B, reduced signalling etc.; see *Service Selection* softkey on p. 4.217) must be selected before the TBF connection is attempted (i.e. in the *Signal Off*, *Idle* or *Attached* states).

All the tabs in the *Connection Control* menu can be called up any time by pressing the *Connect. Control* softkey at the top right in every measurement menu. They are linked with each other via the hotkey bar at the lower edge of the screen. Pressing the *Escape* key closes the active *Connection Control* menu and re-activates the underlying measurement menu.

Configurations Many applications in *Signalling* mode are only possible or useful in a particular signalling state (for example, many parameters characterizing the MS and its capabilities are announced to the CMU while the MS initiates a GPRS attach, i.e. they are only available for display in the *Attached* and the following signalling states). This implies that many of the *Connection Control* tabs and their functions change with the signalling state. For reference see the *Sig. State* field in the command tables in Chapter 6.

Connection Setup In addition to the five GSM *Connection* tabs[6], seven different *Connection* tabs corresponding to the seven possible GPRS signalling states are available. When a signalling state is reached, the corresponding *Connection* tab is opened automatically (exceptions: see *Connect. Control Guidance* parameter in section *Display Control (Connection Control – Misc.)* on p. 4.211 ff.). The three tabs *Attach in Progress, Detach in Progress* and *Connecting TBF* indicate transitory states. The remaining four tabs are described in the following sections.

Connection Control – Signal Off

The *Connection (Signal Off)* tab provides information on:

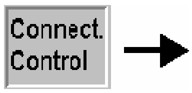
- The current GSM *(Circuit Switched)* and GPRS *(Packet Switched)* signalling states
- The characteristics of the MS under test *(MS Capabilities* and *Signalling Info*, if available, i.e. if a connection was set up before)
- The most important parameters characterizing the frequency and level of the signal sent by the CMU in the state Signal On *(BS Signal)*
- The *Network* code
- Selected AF and RF connectors and external attenuation *(AF/RF)*
- Status and result of wideband peak power measurement *(Wideband Power)*

Besides, it contains softkeys which lead to other services or signalling states:

- Select another service, e.g. circuit switched mode *(Service Selection)*
- Activate the control channel signal to which the mobile station can synchronize *(Signal On)*

The *Connection (Signal Off)* tab is opened when the function group *GSM-MS Signalling* is selected, or if the control channel signal is switched off *(Signal Off* softkey*)* while the system is in another signalling state. It is replaced by the *Connection (Idle)* menu after the control channel signal on the CMU is switched on (Softkey *Signal On*).

6 The GSM *Connection* tabs correspond to the *Signalling* tabs in firmware version earlier than V3.05 with a new design corresponding to the five GPRS *Connection* tabs described in this supplement.



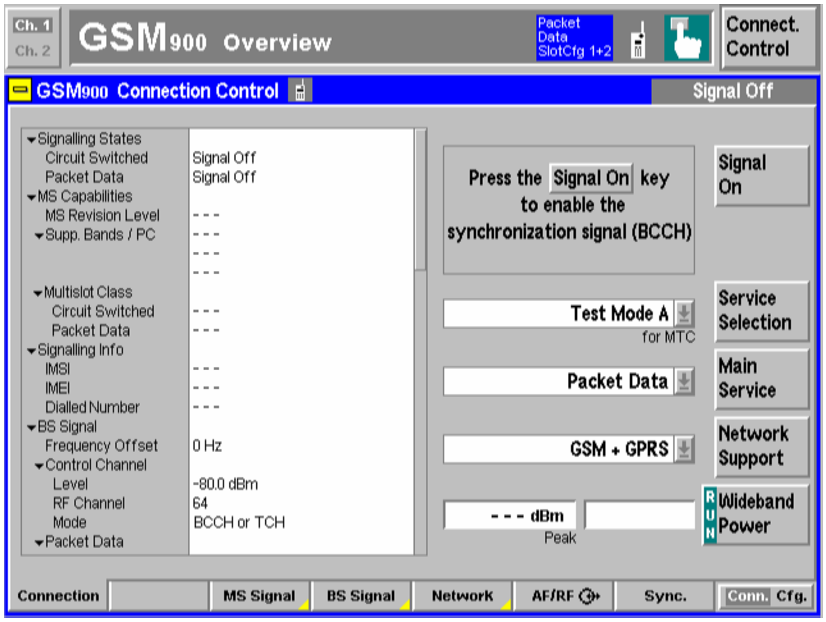


Fig. 4-89 Connection Control – Connection (Signal Off)

The function of the softkeys *Main Service, Network Support,* and *Wideband Power* is described in section *Signalling Control without Signal (State Signal Off)* on page 4.105. The parameter overview in the left half of the menu is also indicated in the other *Connection* tabs and is described in section *Connection Control with Call Established* on p. 4.169 ff. Some parameters are not always available, depending on the current and previous signalling states and settings. In this case the table shows invalid or unavailable settings ("---").

Header Message A Header Message displayed on top of each *Connection* tab informs on the current instrument state or indicates how to proceed to get to other signalling states.

Service Selection

The *Service Selection* softkey selects the GPRS test mode. The EGPRS test modes require option CMU-K43. All other test modes require option CMU-K42.

Test Mode A The mobile can be commanded to test mode A specified for MS transmitter RF tests; see below. The CMU uses the GPRS signalling scheme.

Test Mode B The mobile can be commanded to test mode B specified for MS receiver quality (BER) tests; see below. The CMU uses the GPRS signalling scheme.

EGPRS Loopb. sym. The mobile can be commanded to EGPRS Switched Radio Block Loopback Mode; see below. The same modulation is used in uplink and downlink direction. This mode is recommended if the mobile can transmit 8PSK-modulated signals (MCS5 to MCS9).

EGPRS Loopb. asym. The mobile can be commanded to EGPRS Switched Radio Block Loopback Mode; see below. 8PSK modulation (MCS5 to MCS9) is used in downlink direction and GMSK modulation (MCS1 to MCS4) in uplink direction. This mode is for mobiles which can not transmit 8PSK-modulated signals.

Red. Sig. Mode A No automatic connection setup: The mobile must be controlled by means of an external test interface so that the CMU can immediately reach the *Call Established* state without exchanging signalling messages. The connection is faster and is also possible if the DUT does not provide any higher layers (module tests). The reduced signalling mode is analogous to the *Signalling Channel* = *NONE* mode for circuit switched channels (see p. 4.199). The *Red. Sig. Mode A* is analogous to the *Test Mode A* and mainly intended for MS transmitter tests. In addition the USF BLER and the CRC Error can be measured; see section *BER Tests of PDTCHs* on p. 4.135 f.

Red. Sig. Mode B Test mode B in reduced signalling. In this mode the *BER, DBLER, USF BLER* and *CRC Error* can be measured.

Red. Sig. –
EGPRS sym. Reduced signalling with EGPRS modulation and coding schemes MCS1 to MCS9 and with the same modulation (either GMSK or 8PSK) in uplink and downlink direction. This mode is recommended if the mobile can transmit 8PSK-modulated signals (MCS5 to MCS9).

Red. Sig. –
EGPRS asym. Reduced signalling with EGPRS modulation and coding schemes and with 8PSK modulation in downlink (MCS5 to MCS9) and GMSK modulation in uplink direction (MCS1 to MCS4).

Downlink only The mobile only listens and receives DL data from the CMU; no uplink signal is transmitted. This mode is suitable for mobile-assisted BER tests.

BLER Full signalling involving the RLC layer for Block Error Rate (BLER) measurements; see section *BER Tests of PDTCHs* on p. 4.135 f.

Application Test Enables the test mode for *(E)GPRS Application Tests* (with option R&S CMU-K92). For detailed information refer to the manual for option R&S CMU-K92, stock no. 1157.4148.12.

Note: GPRS compatibility:

All modes are available for EGPRS channels (modulation and coding schemes MCS1 to MCS9; the asymmetric modes require an 8PSK scheme in the downlink). All modes except the EGPRS test modes and EGPRS reduced signalling modes can be used for GPRS channels (CS1 to CS4).

The *Service Selection* softkey is active if the CMU acts as a BTS that supports GPRS or EGPRS; see remark on *Activating (E)GPRS* on p. 4.214 and *Network Support* softkey on p. 4.107. The *Service Selection* softkey is inactive (grayed) unless *Network Support* is set to *GSM + GPRS* or *GSM + EGPRS*.

The *Service Selection* is shown in the configuration icon in the menu title bar, e.g.:

The *Best Meas. Menu (E)GPRS* function in the *Misc.* tab of the *Connection Control* menu selects an active measurement menu and application depending on the current traffic mode; see Table 4-20 on p. 4.212.

Remote control
`PROCedure:SIGNalling:PDATa:ACTion`
`SOFF | SON | CTMA | CTMB | CLBS | CLBA | CRA | CRSignalling | CDLonly | CBLer | DISConnect | HANDover | CRES | CREA | SATest`
`[SENSe:]SIGNalling:PDATa:SERVice?`

The GPRS test modes A and B are specified in 3GPP TS 44.014. Any MS must be capable of operating either in test mode A, in test mode B or in both test modes. The CMU can activate a test mode if the MS under test supports this mode.

In test mode A, the MS is commanded to continuously transmit RLC data blocks containing a pseudo random data sequence. In test mode B, the CMU transmits RLC blocks on the downlink containing a pseudo random data sequence; the MS loops back the received data.

The test mode is terminated when the CMU initiates the TBF release *(Disconnect Mobile)* or if the CMU's control channel is switched off *(Signal Off)*. The duration of test mode A can also be limited to a fixed number of PDUs that the MS has to transmit. Test mode configuration parameters are available in the *Network* tab; see description of the *Packet Data* parameters on p. 4.228.

In addition to the GPSRS test modes, the standard defines a EGPRS Switched Radio Block Loopback Mode. This test mode must be supported by any EGPRS MS. The EGPRS loopback mode is a Physical RF layer loopback performed before channel decoding designed to support BER testing. To support EGPRS MSs without 8PSK modulation capability in uplink, an asymmetric loopback mode is defined, where 8PSK modulated radio blocks (MCS5 to MCS9) are looped back with a GMSK modulation and coding scheme (MCS1 to MCS4).

Auto Slot Config.

Auto Slot Config. is an option to automatically activate an appropriate number of slots that is suitable for a particular measurement and supported by the connected MS. The setting *(Auto Slot Config. On)* takes effect after a connection/TBF is established (signalling states *Call Established/TBF Established)* and the CMU and MS operate in *Multislot Mode* (see *Slot Mode* settings on p. 4.177).

The maximum number of slots depends on the capacity of the mobile station (multislot class; see Table 4-19 on p. 4.170). The multislot class is transferred to the CMU during GPRS attach. Uplink and downlink slots are activated according to the needs of the active measurement:

- For transmitter tests, only on DL slot (equal to the *Main Timeslot)* but the maximum number of supported UL slots is activated.
- For BLER tests, the maximum number of DL slots but only one UL slot is activated. The maximum number of DL slots is never larger than the maximum DL slots supported by the CMU (4).
- For tests involving a closed loop (e.g. Test Mode B), the maximum number of slots supported both in the UL and DL is activated.

Remote control
`CONFigure:SIGNalling:PDATa:ASConfig:ENABle ON | OFF`

Table 4-21: MS multislot classes

Service Selection	Multislot class	Main Timeslot	Active Slots Downlink (MS RX)	Active Slots Uplink (MS TX)
Test Mode A Reduced Sig. Mode A	1	3	3	3
	2	3	3	3
	3	3	3	3 & 4
	4	3	3	3
	5	3	3	3 & 4
	6	3	3	3 & 4
	7	3	3	2 & 3 & 4
	8	3	3	3
	9	3	3	3 & 4
	10	3	3	3 & 4
	11	3	3	2 & 3 & 4
	12	3	3	2 & 3 & 4 & 5
Test Mode B Reduced Sig. Mode B	1	3	3	3
	2	3	3 & 4	3
	3	3	3	3 & 4
	4	3	2 & 3 & 4	3
	5	3	3 & 4	3 & 4
	6	3	3 & 4	3 & 4
	7	3	3 & 4	3 & 4
	8	4	2 & 3 & 4 & 5	4
	9	3	2 & 3 & 4	3 & 4
	10	3	2 & 3 & 4	3 & 4
	11	3	3 & 4	3 & 4 & 5
	12	3	3 & 4	3 & 4 & 5
BLER Downlink only	1	4	4	4
	2	4	4 & 5	4
	3	4	4 & 5	4
	4	4	3 & 4 & 5	4
	5	4	4 & 5	4
	6	4	3 & 4 & 5	4
	7	4	3 & 4 & 5	4
	8	4	2 & 3 & 4 & 5	4
	9	4	3 & 4 & 5	4
	10	4	2 & 3 & 4 & 5	4
	11	4	2 & 3 & 4 & 5	4
	12	4	2 & 3 & 4 & 5	4
EGPRS Loopb. sym. EGPRS Loopb. asym. Reduced Sig. – EGPRS sym. Reduced Sig. – EGPRS asym.	1	3	3	3
	2	3	3	3
	3	3	3	3
	4	3	3	3
	5	3	3	3
	6	3	3	3
	7	3	3	3
	8	3	3	3
	9	3	3	3
	10	3	3	3
	11	3	3	3
	12	3	3	3

Signal On

The *Signal On* softkey switches on a control channel signal to which the mobile station can synchronize. By switching on the signal, the CMU changes to the signalling state *Idle*.

Remote control

```
PROCedure:SIGNalling:PDATa:ACTion SON
PROCedure:SIGNalling:PDATa:ACTion SON
```

Connection Control – Idle

In addition to the parameter overview, the *Service Selection* softkey and the wideband power measurement described in section *Signalling Control without Signal (State Signal Off)* on page 4.105 ff. the *Connection (Idle)* tab contains the following softkeys which lead to other services or signalling states:

- Switch off the control channel signal for synchronization *(Signal Off)*
- Command the MS to GPRS test mode *(Connect Mobile* -> state *Connecting TBF)*

The *Connection (Idle)* tab is opened after the control channel signal on the CMU is switched on *(Signal On* softkey in the *Connection (Signal Off)* tab). This signal is switched on automatically when the *Signalling* test mode is activated. The *Signal Off* softkey leads back to the *Connection (Signal Off)* menu. *Connection (Idle)* is replaced by the *Connection (Connecting TBF)* and *Connection (TBF Established)* menus after the CMU attempts a TBF connection. It is replaced by the *Connection (Attached)* menu if the mobile station initiates a GPRS attach.

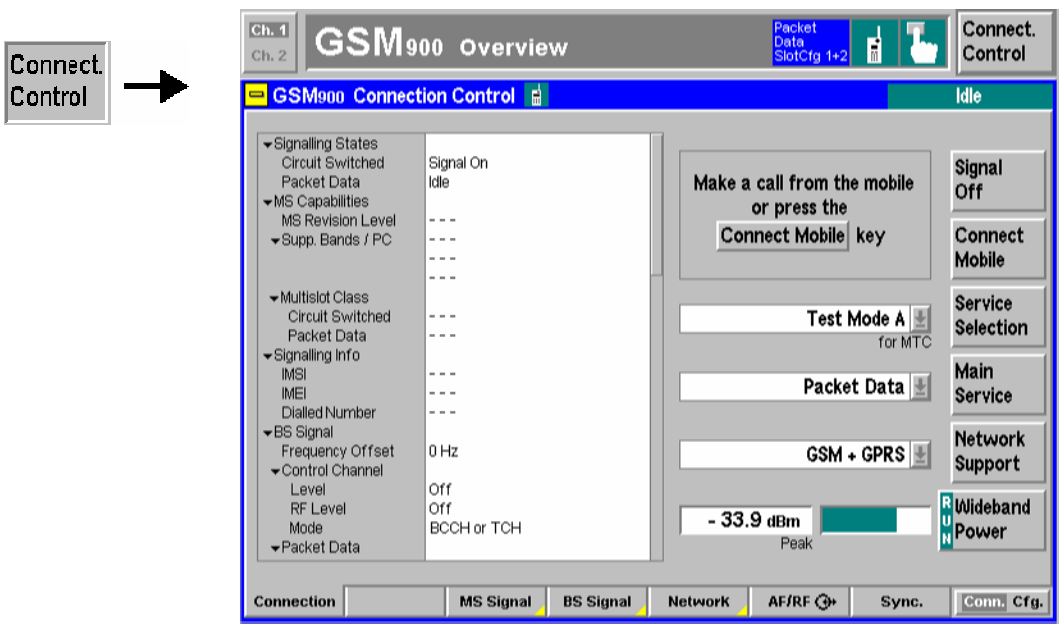


Fig. 4-90 Connection Control – Connection (Idle)

Connection Control – Attached

In addition to the parameter overview, the *Service Selection* softkey and the wideband power measurement described in section *Signalling Control without Signal (State Signal Off)* on page 4.105 ff. the *Connection (Attached)* tab contains the following softkeys which lead to other services or signalling states:

- Switch off the control channel signal for synchronization *(Signal Off)*
- Command the MS to GPRS test mode *(Connect Mobile* -> state *Connecting TBF)*

The *Connection (Attached)* tab is opened after the MS succeeds in establishing a GPRS attach or after the CMU releases a TBF connection *(Disconnect Mobile* softkey in the *Connection (TBF Established)* tab). The Signal Off softkey leads back to the *Connection (Signal Off)* menu.

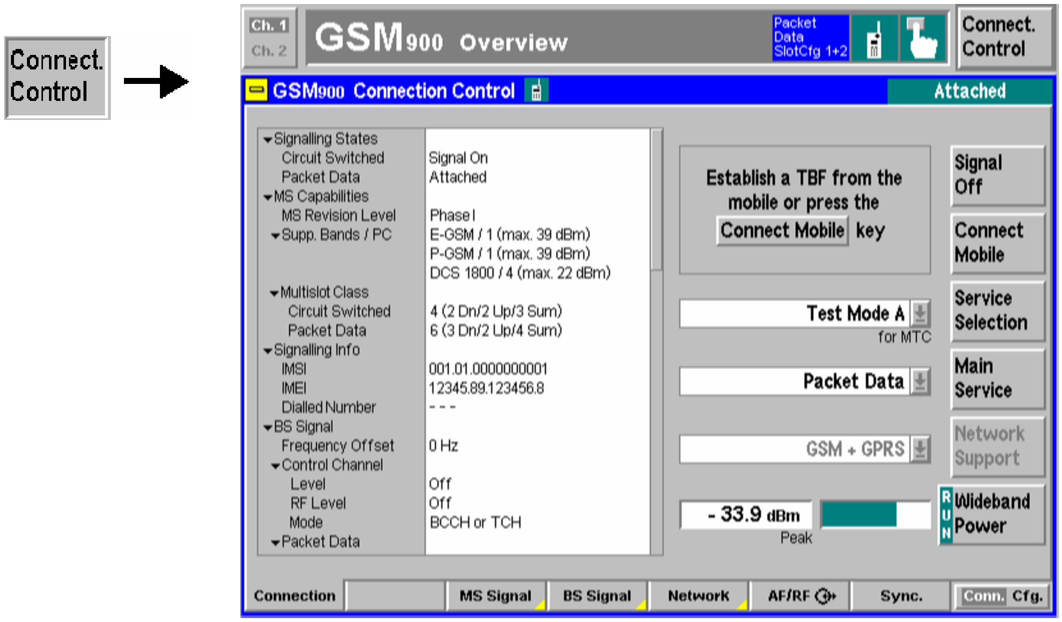


Fig. 4-91 Connection Control – Connection (Attached)

Connection Control – TBF Established

In addition to the parameter overview, the *Service Selection* softkey and the wideband power measurement described in section *Signalling Control without Signal (State Signal Off)* on page 4.105 ff. the *Connection (TBF Established)* tab contains the following softkeys which lead to other services or signalling states:

- Switch off the control channel signal for synchronization *(Signal Off)*
- Terminate the GPRS test mode *(Disconnect Mobile* -> state *Attached)*

The *Connection (TBF Established)* tab is opened after the CMU initiates a TBF connection *(Connect Mobile* softkey in the *Connection (Idle)* or *Connection (Attached)* tabs). The *Signal Off* softkey leads back to the *Connection (Signal Off)* menu. The *Disconnect Mobile* softkey terminates the test mode and leads back to the *Connection (Attached)* menu.

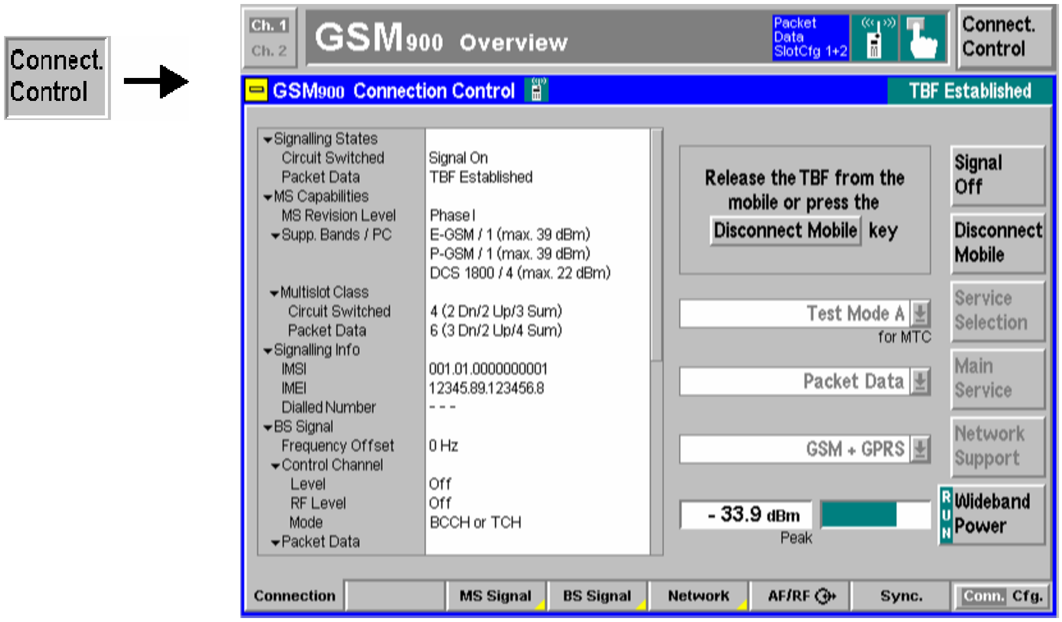


Fig. 4-92 Connection Control – Connection (TBF Established)

RF Signals of the MS (Connection Control – MS Signal)

The *MS Signal* tab configures the operating mode and the RF traffic channel signal of the MS under test. For packet data transfer the following parameters can be set:

- The *Main Timeslot* and the remaining timeslots *(Slot Configuration)* that are used in downlink and uplink direction
- The RF levels and power control parameters in all timeslots

GPRS Uplink Power Control

Power control of the MS is important for spectral efficiency in the cellular system as well as for the reduction of power consumption of the mobile station. In circuit switched mode, where a continuous two way connection between the BTS and the MS is maintained, **closed loop** power control is used: The BTS measures the received signal level from the MS and dynamically adapts the MS output power in 2-dB steps using a fixed scale of Power Control Levels (PCL).

In **open loop** power control, the path loss in downlink and in uplink is assumed to be identical. If the MS detects a reduction of the received signal level C, it tries to compensate for the changed propagation conditions by increasing its own output power P_{CH} by the same amount: The sum of P_{CH} + C is always kept constant. This fast but inaccurate power control mode is useful at the beginning of a packet transmission.

For a discontinuous, packet oriented GPRS connection, a combination of open loop and closed loop power control is used (GSM 11.10). The RF output power P_{CH} on each individual uplink PDCH shall be:

$$P_{CH} = \min(\Gamma_0 - \Gamma_{CH} - \alpha\,(C + 48), P_{MAX})$$

where Γ_0 is a network-specific constant (+39 dBm for GSM400, GSM GT800, GSM850 and GSM900, +36 dBm for GSM 1800 and GSM1900, i.e. the maximum nominal output power of an MS in the network), Γ_{CH} is a power control parameter depending on the MS and channel (analogous to the PCL in circuit switched mode), and α represents a system parameter. Both Γ_{CH} and α are controlled by the BTS. P_{CH} must not exceed the maximum allowed output power in the cell P_{MAX}.

A pure open loop power control is achieved by setting α = 1 and keeping Γ_{CH} constant. A closed loop is achieved by setting α = 0. The CMU is able to set the individual power control parameters Γ_{CH} for all uplink timeslots whereas the system parameter α is always set to 0.

The CMU provides a softkey-oriented version of the *MS Signal* tab and a table-oriented version with extended functionality. The *MS Signal* hotkey toggles between the two versions if it is pressed repeatedly. For packet data mode, the two tabs provide the same settings.

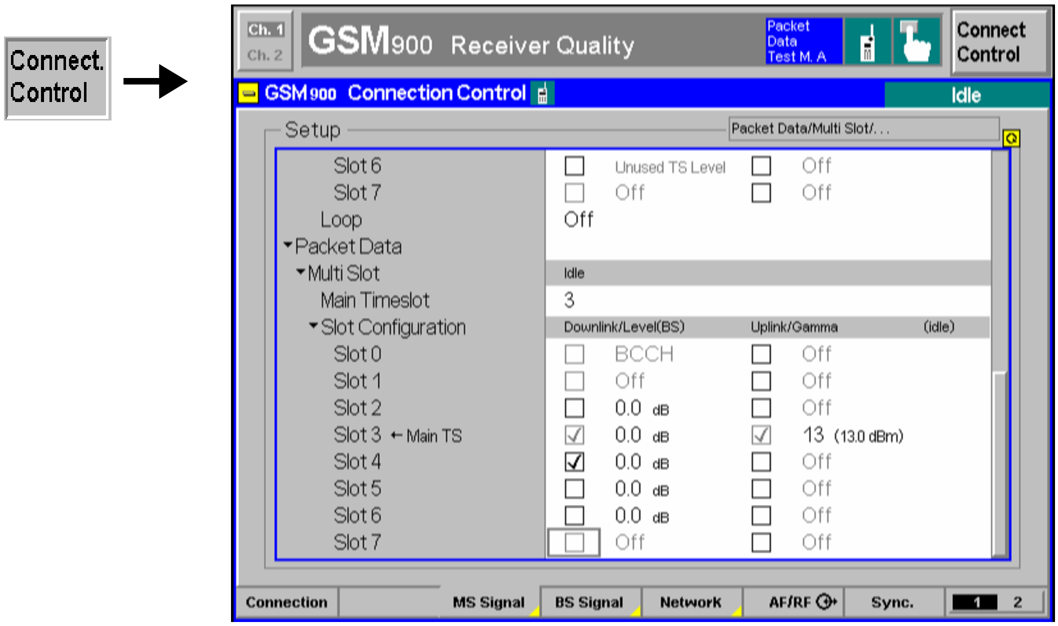


Fig. 4-93 Connection Control – MS Signal (table)

PMAX

The *PMAX* parameter sets the maximum MS transmitter output power allowed in the cell. The value corresponds to the output power at which the mobile station performs a location update to synchronize to the CMU. It is valid both for circuit switched and for packet data mode.

Remote control
`CONFigure:MSSignal:CCH:PMAX_`

Packet Data – Multi Slot

The *Packet Data – Multi Slot* section defines the timeslot configuration in the uplink and downlink:

Main Timeslot Timeslot used for signalling. The main timeslot can not be switched off in both the downlink and uplink; see *Slot Configuration* below. In *Receiver Quality* tests the main timeslot is always one of the measured slots.

PCL (MS) PCL (MS) sets (signalling states < Call Established) or changes (signalling states Call Established) the MS output power during the connection. where is this setting?

Remote control
`CONFigure:BSSignal:PDATa[:TCH]:MSLot:MTIMeslot`

Slot Configuration

Table of all used and unused timeslots (GSM timeslots 0 to 7) in the downlink and the uplink. The *Main Timeslot* is always active in both the downlink and uplink direction. The boxes enable (if checked) or disable the other timeslots.

Important Note: *The CMU can transmit signals in enabled as well as in disabled downlink timeslots. Enabling a downlink timeslot means that the MS is instructed to listen to a signal in this timeslot.*

To ensure that the UE signalling messages can be decoded properly, the main TS level must be sufficient compared to

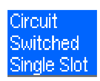
the levels in the other slots. In case of high level differences between the UL TSs (approx. > 10 dB), it is recommended to use the TS with the highest level as the main timeslot.

Level (BS) RF levels in the individual downlink timeslots (RF signal transmitted by the BS/CMU) relative to the *Reference Level* indicated above the *Slot Configuration* table and in the *BS Signal* tab (see section see section *RF Signals of the CMU (Connection Control – BS Signal)* on p. 4.225 f.).

Gamma Channel-specific power control parameter Γ_{CH} in dB; see note on GPRS power control above

Note: *The number of downlink and uplink channels must be compatible with the multislot class of the MS under test; see Table 4-19* on p. 4.170.

The *Slot Mode* and the *Slot Configuration* (for multislot mode) is shown in the configuration icon in the menu title bar, e.g.:



Remote control
```
CONFigure:MSSignal:PDATa[:TCH]:MSLot:SCONfig
CONFigure:BSSignal:PDATa[:TCH]:MSLot:SCONfig
PROCedure:SIGNalling:PDATa[:TCH]:MSLot:SCONfig
```

RF Signals of the CMU (Connection Control – BS Signal)

The *BS Signal* tab configures the RF signals of the CMU (which simulates a base station transmitting a GSM control and traffic channel signal), selects a frequency offset, the frequency hopping scheme and the traffic channel data. For multislot packet data transfer, the downlink (BS signal) and uplink (MS signal) signal configuration is defined in a common table, so the *BS Signal* tab provides many of the settings that are also available in the *MS Signal* tab. The following additional packet data parameters can be set:

- The downlink power control parameter *(P0)*
- The *RF Channel* that the CMU will use for packet data transfer

GPRS Downlink Power Control

A BTS can use downlink power control to reduce its output power. Downlink power control relies on a reduction of the PDCH power relative to the BCCH power. This power reduction is defined in terms of a power control parameter P0 which can be specific to a particular MS in the network (power control mode A) or the same for all MS with a TBF established on the same PDCH (power control mode B). For details refer to GSM 05.08 and GSM 04.60.

The P0 parameter can be selected for the BS Signal transmitted by the CMU. The CMU also uses this parameter and its BCCH level to calculate the *Reference Level* for all individual downlink channels in a GPRS multislot configuration.

The CMU provides a softkey-oriented version of the *BS Signal* tab and a table-oriented version with extended functionality. The *MS Signal* hotkey toggles between the two versions if it is pressed repeatedly. For packet data mode, the two tabs provide the same settings.

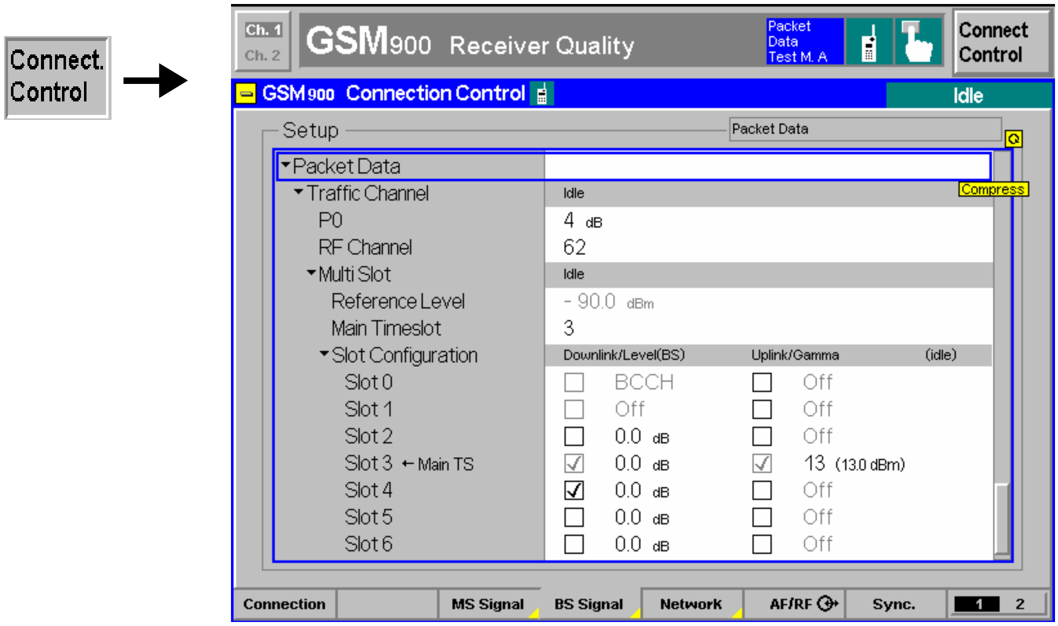


Fig. 4-94 Connection Control – BS Signal (table)

Packet Data – Traffic Channel

The *Packet Data – Traffic Channel* section defines the power control parameter P0 and the traffic channel that the CMU will use for data transfer:

P0 Downlink power control parameter P0; see background information at the beginning of this section

RF Channel GSM channel that the CMU will use for packet data transfer

Hopping Sequence Hopping sequence containing up to 6 channel numbers. *Off* is used to shorten the hopping sequence. Frequency hopping of the downlink traffic channel must be enabled explicitly.

Hopping Enable *(On)* or disable frequency hopping in the downlink traffic channel.

Reference Level Reference value for the downlink (BS) signal levels. The reference level is calculated from the BCCH level of the BS signal and the downlink power control parameter P0 according to *Reference Level = –85 dBm – P0.*

Remote control

```
CONFigure:BSSignal:PDATa[:TCH]:MSLot:PZERo
CONFigure:BSSignal:PDATa[:TCH]:MSLot:CHANnel
CONFigure:BSSignal:PDATa[:TCH]:MSLot:FHOPping:SEQuence
PROCedure:SIGNalling:PDATa[:TCH]:MSLot:FHOPping:ENABle
[SENSe:]BSSignal:PDATa[:TCH]MSLot:RLEVel?_
```

The remaining settings are described in section *RF Signals of the MS (Connection Control – MS Signal)* on p. 4.223 ff. The relationship between the table-oriented *BS Signal* tab and its softkey-oriented counterpart is analogous the *MS Signal* tab.

Network Parameters (Connection Control – Network)

The *Network* tab defines various parameters of the network that the CMU reports to the mobile station. The following settings are (E)GPRS-specific and available with option CMU-K42/-K43, *(E)GPRS Software Extension,* only:

- Capability of the network: *GSM only* or *GSM + GPRS* or *GSM + EGPRS (Network Support)*
- The *Main Service* of the mobile: *Circuit Switched* or *Packet Data*
- Routing Area Code *(RAC)*
- GPRS and EGPRS *Coding Scheme* and *Puncturing Scheme*
- Parameters of the GPRS test modes *(PC Meas. Chan., USF, Extend. Dyn. Alloc., Number of PDUs, Slot Offset, Test Mode with ACK, RLC Mode (Testmode B), Bit Stream)*

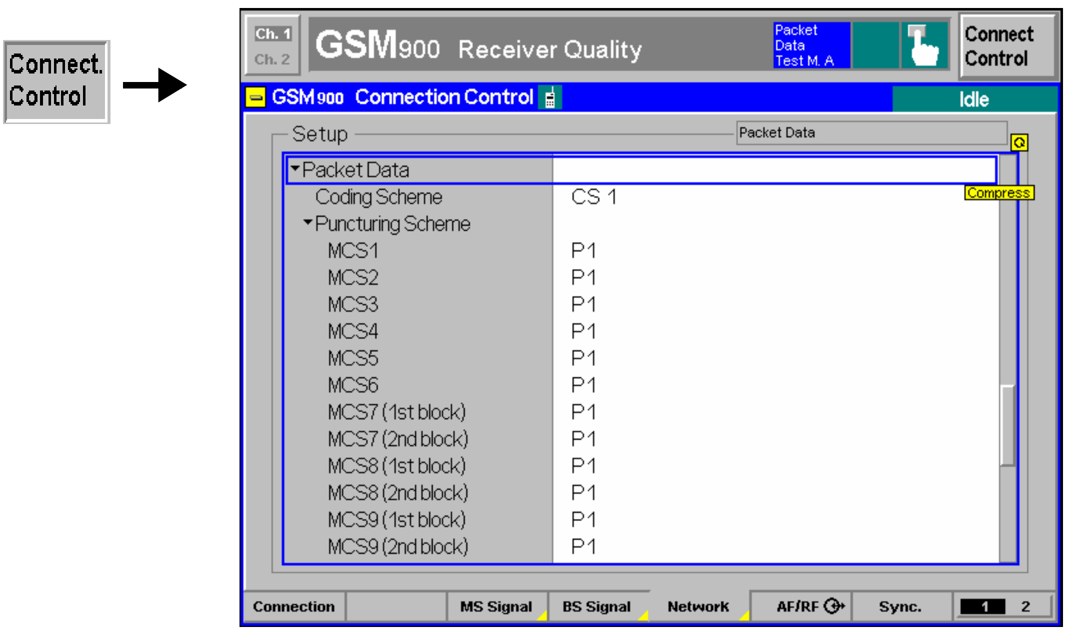


Fig. 4-95 Connection Control – Network

Network Support The *Network Support* parameter is to report to the MS under test whether or not the CMU currently supports GPRS or EGPRS; see *Network Support* softkey on p. 4.107.

Remote control
`CONFigure:NETWork:NSUPport GSM | GGPR`

Main Service *Main Service* selects the circuit switched or packet data connection scheme of the MS under test. It is equivalent to the *Main Service* softkey described on p. 4.107.

Remote control
`[:SENSe:]NETWork:MSERvice?` (query only)
The keywords `[:CSWitched]` and `:PDATa` in many signalling commands distinguish *Circuit Switched* or *Packet Data* main service, so there is no command needed for an explicit switchover except in *Dual Transfer Mode* (option R&S CMU-K44, see Chapter 9):
`CONFigure:NETWork:MSERvice`

Network Identity The *Network Identity* section contains parameters characterizing the radio network (see also section *Network Parameters (Connection Control – Network)* on p. 4.192

ff. One of them is specific to the packet data mode:

RAC Routing Area Code, set to 0. The RAC identifies the routing area within a location area.

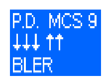
Remote control

`CONFigure:NETWork:IDENtity:RAC <RAC>`

Packet Data The *Packet Data* section contains parameters defining the traffic data channel coding schemes and the GPRS test mode (see *Service Selection* softkey on p. 4.217):

Coding Scheme Selection of the coding schemes for downlink traffic data channels: Coding schemes *CS1* to *CS4* for GPRS (with option CMU-K42); modulation and coding schemes *MCS1* to *MCS9* for EGPRS (with option CMU-K43). The GPRS coding schemes can be used to establish a TBF connection with full signalling; they are independent from the reduced signalling coding schemes selected via *Traffic Mode* (see p. 4.193).

The *Coding Scheme* is shown in the configuration icon in the menu title bar, e.g.:



Puncturing Sch. Puncturing scheme applied to each of the EGPRS modulation and coding schemes MCS1 to MCS9. Puncturing means that bits in the radio blocks are removed after channel coding in order to reduce the amount of transferred data and enhance the useful data rate. The puncturing schemes are selectable so that it is possible to test their influence on measured quantities, e.g. bit error rates. Moreover, it is possible to test incremental redundancy with a definite initial puncturing scheme; see below.

3 different puncturing schemes (PS) are defined. The modulation and coding schemes MCS3, MCS4 and MCS7 to MCS9 can be combined with 3 PS, the remaining modulation and coding schemes with 2 PS only.

For schemes MCS1 to MCS6, four normal bursts carry one RLC block. For the remaining schemes MCS7 to MCS9, four normal bursts carry two RLC blocks. The puncturing schemes for the two blocks can be set individually.

Incremental Redundancy Enable or disable Incremental Redundancy RLC mode for the downlink; see background information below.

With enabled incremental redundancy, the CMU uses the selected puncturing scheme as initial puncturing scheme but cyclically changes the puncturing scheme if data blocks must be retransmitted. This setting corresponds to normal operation of the BTS in the network.

With disabled incremental redundancy, the puncturing scheme is fixed. This setting is suitable for layer 1 tests at fixed transmission parameters.

PC Meas. Chan. Channel type (BCCH or PDCH) that the mobile uses to determine the received signal strength and quality. The PC Meas. Channel parameter corresponds to the GPRS power control parameter *PC_MEAS_CHAN* in the system information SI 13 Rest Octets (GSM 04.18).

USF Update State Flag in the range 0 to 7 to be set in the blocks transmitted to the MS in GPRS test mode.

USF Duty Cycle Defines the percentage of downlink GPRS radio blocks containing the USF assigned to the MS. This setting is provided in *TBF Established* signalling state only, after the selected USF is actually assigned to the MS under test.

100 % assigned means that all blocks contain the assigned USF. *0 % assigned, 100% random* means that each USF (0 to 7) except the assigned one is used with a probability of 1/7. *12.5 % assigned, 87.5 % random* means that each USF including the assigned one is used with a probability of 1/8.

This setting can be used to check whether the USF BLER depends on the transmitted USF. It is reset to 100% each time that a connection is set up.

Extend. Dyn. Alloc. Enable or disable Extended Dynamic Allocation of the mobile. Extended dynamic allocation is an optional medium access mode (3GPP TS 04.60).

With the *Auto* setting the CMU checks whether the mobile supports Extended Dynamic Allocation by evaluating the *GPRS Extended Dynamic Allocation* message received during the GPRS Attach. Extended Dynamic Allocation is enabled only if the mobile supports this feature.

Number of PDUs Number of Protocol Data Units (PDUs) that the MS is to transmit in the uplink during GPRS test mode A.

Slot Offset Timeslot (no. 0 to 7) that is to be taken as the first downlink timeslot when the MS is in multislot operation (downlink timeslot offset parameter in the GPRS_TEST_MODE_CMD).

Testmode with ACK Enable or disable periodic transmission of PACKET_UPLINK_ACK_NACK messages (3GPP TS 04.060) while the mobile operates in test mode B. The transmission period is 1 s; the mobile responds to each PACKET_UPLINK_ACK_NACK with a Packet Control Acknowledgement message (3GPP TS 44.060, section 11.2.2).

Control ACK Type Specifies whether a mobile in test mode A sends its CTRL_ACK messages (TS 44.060) on four access bursts *(Access Bursts)* or in an RLC/MAC block (PACKET CONTROL ACKNOWLEDGEMENT message, 4 GMSK-modulated *Normal Bursts).*

The *Access Bursts* setting induces periodic access bursts while a packet data connection is active. The bursts can be analyzed in the *Power – P/t Multislot* application; see *Continuous Access Burst Measurement* in Chapter 2. In test mode A, the CMU requests approx. one CTRL_ACK block per second (2 with a 1-block delay if a multislot configuration is active; see *Ctrl. Acks trigger* on p. 4.208 ff.). In test mode B, the access bursts can be activated as well, provided that the *Testmode with ACK* function is enabled.

RLC Mode (Testmode B) Explicit setting of the downlink RLC mode for a packet data connection in test mode B *(Service Selection = Test Mode B)*. According to standard 3GPP TS 44.014, test mode B corresponds to *Unacknowledged* operation where the MS loops back all data received. The alternative *Acknowledged* mode is to be used for special applications.

PDP Context Activation
Determines how the CMU reacts to a PDP context activation initiated by the MS. Packet Data Protocol (PDP) is a network protocol used by an external packet data network interfacing to GPRS.

The CMU can accept or reject a ACTIVATE PDP CONTEXT REQUEST message from the MS (see standard 3GPP TS 24.008). The purpose of the CMU setting is to prevent the MS from attempting repeated PDP context requests. Which setting is suitable depends on the mobile type.

T_{AVG_T}
Specifies the signal level filter period for power control in packet transfer mode T_{AVG_T} defined in standard 3GPP TS 45.008. With an entered value k, the filter period is $2^{k/2}/6$ multiframes. This parameter defines the update rate of the mobile's measurement reports in packet data mode (the larger k, the faster the measurement reports are updated); see section *MS Rcv. Reports – Received Results of the Mobile Phone* on p. 4.154 ff.

Bep Period
Defines the BEP_PERIOD and the BEP_PERIOD2, two related four-bit values defined in standard 3GPP TS 05.08, section 10.2.3.2.1. The BEP periods are filter constants for EGPRS Channel quality measurements (measurement reports, see section *MS Rcv. Reports – Received Results of the Mobile Phone* on p. 4.154 ff.) that the UE uses for the calculation of the *Mean BEP* and the *CV BEP* values. BEP_PERIOD is broadcast in the system information; BEP_PERIOD2 is used in the (dedicated) packet downlink assignment message. The BEP_PERIOD must be smaller or equal to 10; if *BEP Period* is set to a value between 11 and 15, then BEP_PERIOD is set to 10 whereas BEP_PERIOD2 takes on the specified value.

Test Mode RF Level Reporting
Enables or disables the transfer of the packet data receiver reports in the uplink signal. While the test mode is *Off*, the control blocks carrying the receiver reports are eliminated so that the BER measurement is slightly faster. The setting has no effect on the BLER measurement.

Bit Stream
Bit pattern (pseudo random sequence) that the CMU transmits to the MS in GPRS test mode.

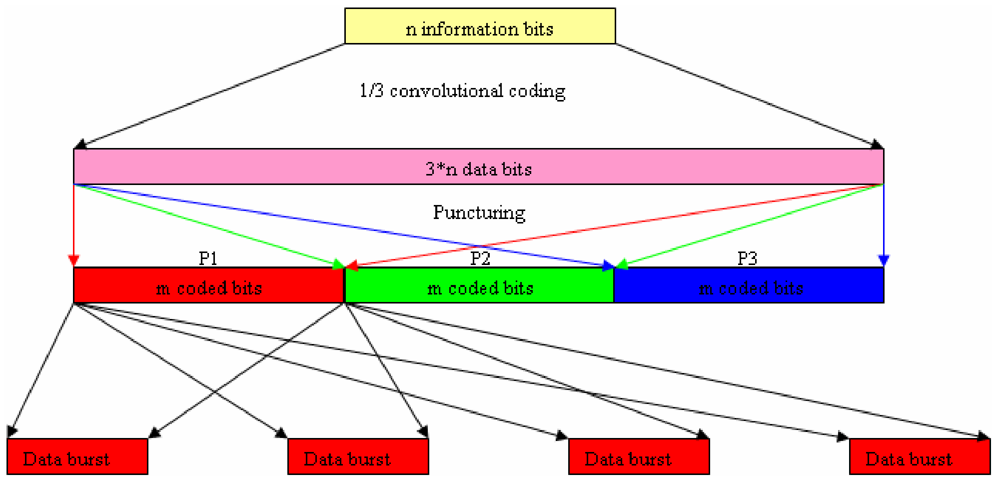
Remote control
```
CONFigure:NETWork:PDATa[:GPRS]:CSCHeme  <Mode>
PROCedure:NETWork:PDATa[:GPRS]:CSCHeme  <Mode>
CONFigure:NETWork:PDATa:EGPRs:PSCHeme  <Mode>
PROCedure:NETWork:PDATa:EGPRs:PSCHeme  <Mode>
CONFigure:NETWork:PDATa:EGPRs:PSCHeme:IREDundancy  <Enable>
CONFigure:NETWork:PDATa:GPRS:PCMChannel  <Type>
CONFigure:NETWork:PDATa:USF  <USF>
PROCedure:NETWork:PDATa:UDCYcle  A100 | A100 | A012
CONFigure:NETWork:PDATa:GPRS:EDAllocation  <Enable>
CONFigure:NETWork:PDATa:NOPDus  <Number>
CONFigure:NETWork:PDATa:SOFFset  <Offset>
CONFigure:NETWork:PDATa:GPRS:TWACk  <Enable>
CONFigure:NETWork:PDATa:CATYpe  NBUR | ABUR
PROCedure:NETWork:PDATa:CATYpe  NBUR | ABUR
CONFigure:NETWork:PDATa:RLCMode  ACKN | UNAC
CONFigure:NETWork:PDATa:PDPContext REJ | ACC
CONFigure:NETWork:PDATa:TAVGt <Value>
CONFigure:NETWork:PDATa:BPERiod 0 to 15
CONFigure:NETWork:PDATa:TRFL <Enable>
```

```
CONFigure:NETWork:PDATa:BITStream  <Mode>
PROCedure:NETWork:PDATa:BITStream  <Mode>
```

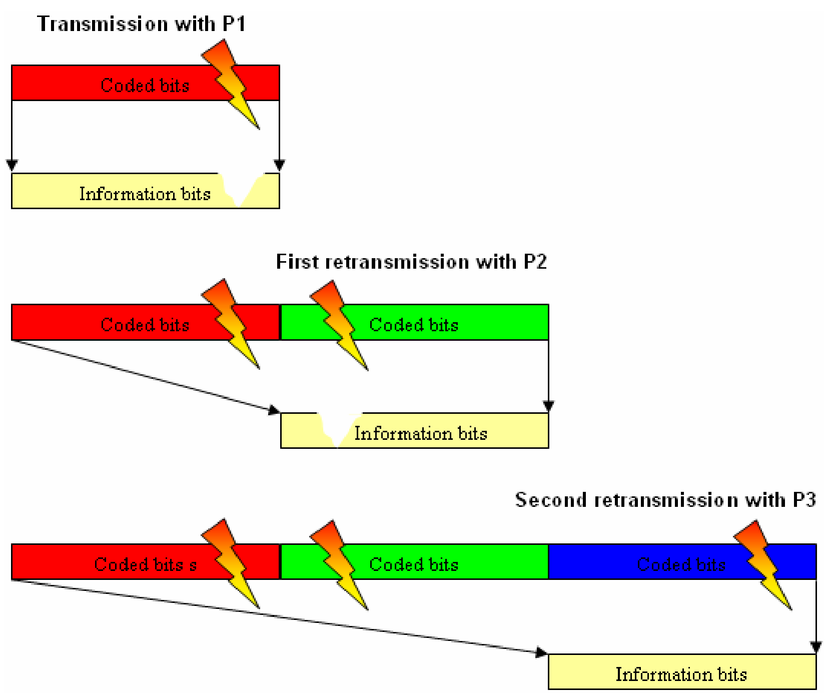
Incremental Redundancy

Incremental redundancy (IR) is used on EGPRS channels to minimize the number of data blocks that have to be transferred repeatedly (retransmitted) until they can be successfully decoded.

The IR mechanism relies upon the fact that for each input block of information bits, the EGPRS channel coder provides 2 or 3 output blocks of coded bits with equal length but different puncturing scheme. In principle, each output block is sufficient for recovering the original information bits, however, a combination of 2 (or even 3) output blocks leaves more redundancy bits for error correction and therefore increases the chance of correctly receiving the data block.



In incremental redundancy mode, the CMU starts transferring the output data block with the selected initial puncturing scheme. If decoding fails, the second data block is transmitted in addition and decoded together with the fist block. For modulation and coding schemes MCS3, MCS4 and MCS7 to MCS9, a third stage with a third puncturing scheme is available. The probability of error-free reception increases at each stage; multiple retransmissions of the same data under the same conditions are avoided.



Adaptive Multi-Rate (AMR) Speech Codec (Option R&S CMU-K45)

If an AMR speech codec test is selected (see *Traffic Mode* softkey on p. 4.193) the *Network* tab displays additional softkeys to configure the AMR codec and test the uplink and downlink codec adaptation (inband signalling). The following settings are provided:

- Selection of a subset of codec modes and switching thresholds *(AMR Rate Set)*
- Explicit setting of the codec mode at the CMU *(Codec Mode DL)* and the MS under test *(Codec Mode UL).*
- BS signal level setting in the used and in the unused timeslots *(TCH Level).*

In addition the R&S CMU provides the Frame Error Rate (FER) for inband signalling codewords; see section *AMR Reference Sensitivity Test* on p. 4.236 ff.

AMR codec

The Adaptive Multi-Rate (AMR) codec is an integrated speech codec with six or eight fixed user bit rates ranging from 4.75 kbit/s to 7.95 kbit/s (AMR Half Rate) or 12.2 kbit/s (AMR Full Rate). The speech coder is capable of switching its user bit rate upon command.

Decreasing the bit-rate impairs the speech quality but leaves more bits for error protection. This allows a dynamic trade-off between the speech quality and the stability of the connection as the quality of the radio link varies.

Codec mode selection is done from a set of 1 to 4 active codec modes (ACS, Active Codec Set) and an associated set of 1 to 3 switching thresholds for increasing and decreasing the bit rate. The necessary signalling messages are included in the AMR speech frames (inband signalling).

Test of inband signalling

The MS conformance test specification 3GPP TS 51.010 describes the procedure and conditions for inband signalling tests.

- The purpose of the downlink adaptation test is to verify that the MS can monitor the downlink quality of the dedicated traffic channel *(BS Signal)* and request a BS codec mode according to the thresholds provided at call setup.
- The purpose of the uplink adaptation test is to verify that the MS in the uplink direction applies the codec mode indicated by the network, and that the MS correctly signals the used codec mode to the network.

Both tests shall be performed with the codec mode and threshold settings quoted in Table 4-22 below. The values are different for full rate and half rate AMR speech coders.

Table 4-22 AMR Rate Set according to the conformance test specification

	AMR Full Rate			**AMR Half Rate**[7]		
Codec Mode	**TCH data rate**	**Threshold – Down**	**Threshold – Up**	**TCH data rate**	**Threshold – Down**	**Threshold – Up**
Mode 4	12.2 kbit/s	16.5 dB	+ ∞	–		
Mode 3	7.95 kbit/s	11.5 dB	18.5 dB	7.95 kbit/s	12.5 dB	∞
Mode 2	5.9 kbit/s	6.5 dB	13.5 dB	6.7 kbit/s	11.0 dB	15.0 dB
Mode 1	4.75 kbit/s	– ∞	8.5 dB	5.15 kbit/s	– ∞	13.0 dB

[7] A test model with 4 codec modes is described in standard 3GPP TS 45.009.

To prepare an AMR test…

1. Open the *Connection Control* menu and press the *Network* hotkey to open the *Network* tab. If necessary, press the hotkey again to access the softkey-oriented version of the tab.
2. Press *Traffic Mode* and select the AMR codec supported by your mobile phone *(AMR Full Rate* or *AMR Half Rate).* You can select the codec irrespective of the signalling state of your R&S CMU.

To test downlink codec adaptation…

3. Press *AMR Rate Set* to select up to four codec modes and adjust the upper and lower decision thresholds. Again you can do this irrespective of the signalling state of your R&S CMU.
4. If necessary, open the *Connection* tab and set up a call to or from the MS to enter the *Call Established* signalling state.
5. Press *TCH Level* and vary the used TS level.

The *Codec Mode DL* requested by the MS must be in accordance to the AMR Rate Set settings.

To test uplink codec adaptation…

6. Press *Codec Mode UL* and select one of the UL codec modes 1 to 4 for the MS under test.

The *Codec Mode UL* used by the MS must be equal to the selected mode.

To test the speech quality…

The speech quality of an AMR codec is assessed in terms of bit error rate or audio tests:

- The bit error rate is measured in the *Receiver Quality* menu; see section *Receiver Quality Measurements* on p. 4.133 ff. *BER* and *BER Average* tests can be made without restriction. Note that the AMR Full Rate codec does not provide any Class II bits and that both AMR codecs always operate in circuit-switched mode (no BLER results).
- Audio tests can be performed with option R&S CMU-B41, *Audio Generator and Analyzer.* All *Audio* menus and remote-control commands are described in the R&S CMU 200/300 operating manual.

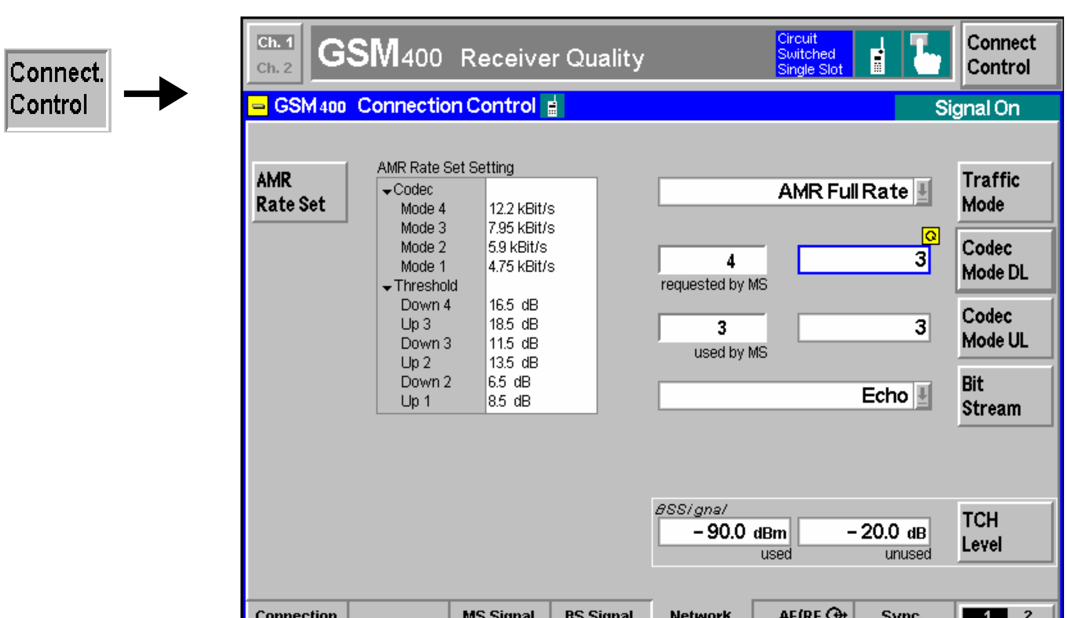
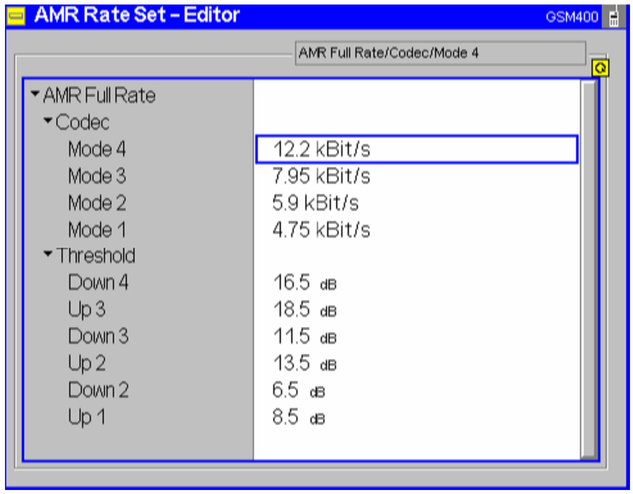


Fig. 4-96 Connection Control – Network parameters (AMR)

AMR Rate Set

The *AMR Rate Set* softkey opens a popup menu to define up to four codec modes and the decision thresholds for changing the codec mode.

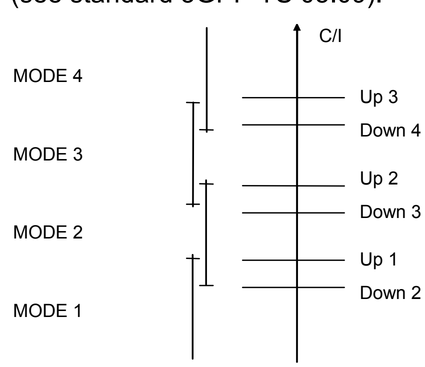


AMR Full Rate The first line of the *AMR Rate Set Editor* indicates the AMR codec type (Full Rate or Half Rate) selected by means of the *Traffic Mode* softkey.

Codec – Mode Selects the data rate for modes 4 to 1. For full rate codecs, the full set of 8 different rates (4.75 kbit/s, 5.15 kbit/s, 5.9 kbit/s, 6.7 kbit/s, 7.4 kbit/s, 7.95 kbit/s, 10.2 kbit/s, 12.2 kbit/s) is available. The last two rates are not provided for half rate codecs.

The selected data rates must be different from each other. The entered values are automatically sorted in descending order so that Rate (Mode 1) < Rate (Mode 2) < Rate (Mode 3) < Rate (Mode 4). To restrict the test model to 1, 2, or 3 modes, the codec modes can be switched off using the *ON/OFF* key.

Threshold Sets the lower decision thresholds for switching between modes j and j – 1 *(Down j* where j = 2, 3, 4) and the upper decision thresholds for switching between modes j and j + 1 *(Up j* where j 0 1, 2, 3). Both transition thresholds are given in terms of a normalized carrier to interferer (C/I) ratio and must be entered in 0.5 dB steps (see standard 3GPP TS 05.09).



To ensure stable operation near the thresholds, switching down to a lower codec mode is usually initiated at lower C/I threshold values than switching up to a higher codec mode. The difference between the upper and lower thresholds is generally termed hysteresis:

Hyst (j) = Up (j) – Down (j + 1).

Defining and testing threshold values

The standard places the following restrictions to the threshold values:

- The hysteresis must be positive or zero:
  Up (j) ≥ Down (j + 1) for j= 1 to 3
- Up and Down thresholds must be in descending order:
  Down 2 ≤ Down 3 ≤ Down 4
  Up 1 ≤ Up 2 ≤ Up 3

The C/I is estimated by the MS under test, so the mapping between the *TCH Level* and the thresholds depends on the test setup and on the mobile. As a general rule, reducing (increasing) the *TCH Level* in the used timeslot by n dB reduces (increases) the C/I ratio by roughly the same amount.

Remote control
```
CONFigure:NETWork[:CSWitched]:AMR:HRATe:RSETting
PROCedure:NETWork[:CSWitched]:AMR:HRATe:RSETting
CONFigure:NETWork[:CSWitched]:AMR:FRATe:RSETting
PROCedure:NETWork[:CSWitched]:AMR:FRATe:RSETting
```

The following two softkeys define the codec modes to be used in both signal directions:

Codec Mode DL

The *Codec Mode DL* softkey sets the codec mode that the CMU uses to generate the speech data transmitted to the MS under test. The CMU maintains this mode during the measurement, irrespective of the DL codec mode requested by the mobile under test.

The DL codec mode that the MS requests according to the *AMR Rate Set* settings is indicated to the left of the input field for the DL codec mode.

Note: *All Bit Stream settings involving a closed loop or pseudo-random bit sequences require equal uplink and downlink codec modes. Different codec modes can be tested with* Bit Stream = Handset *or* Handset Low.

Remote control
```
CONFigure:NETWork[:CSWitched]:AMR:HRATe:DLCMode
PROCedure:NETWork[:CSWitched]:AMR:HRATe:DLCMode
CONFigure:NETWork[:CSWitched]:AMR:FRATe:DLCMode
PROCedure:NETWork[:CSWitched]:AMR:FRATe:DLCMode
[SENSe:]MSSinfo:AMR:HRATe:DLCMode?
[SENSe:]MSSinfo:AMR:FRATe:DLCMode?
```

Codec Mode UL

The *Codec Mode UL* softkey sets the codec mode that the mobile under test shall use in uplink direction.

The actual UL codec mode used by the MS is indicated to the left of the input field for the UL codec mode.

Note: *All Bit Stream settings involving a closed loop or pseudo-random bit sequences require equal uplink and downlink codec modes. Different codec modes can be tested with* Bit Stream = Handset *or* Handset Low.

Remote control
```
CONFigure:NETWork[:CSWitched]:AMR:HRATe:ULCMode
PROCedure:NETWork[:CSWitched]:AMR:HRATe:ULCMode
CONFigure:NETWork[:CSWitched]:AMR:FRATe:ULCMode
PROCedure:NETWork[:CSWitched]:AMR:FRATe:ULCMode
[SENSe:]MSSinfo:AMR:HRATe:ULCMode?
[SENSe:]MSSinfo:AMR:FRATe:ULCMode?
```

TCH Level

The *TCH Level* softkey defines the downlink *(BS Signal)* TCH level in the used and unused timeslots (used/unused level mode) or the reference level (individual level mode). The level can be changed to check whether the MS requests the correct DL codec mode according to the *AMR Rate Set* settings (see above).

The two TCH levels are identical with the parameters in the *BS Signal* tab; see description on p. 4.186.

Remote control
```
CONFigure:BSSignal[:CSWitched][:TCH]:LEVel:UTIMeslot
PROCedure:BSSignal[:CSWitched][:TCH]:LEVel:UTIMeslot
CONFigure:BSSignal[:CSWitched][:TCH]:LEVel:UNTimeslot
PROCedure:BSSignal[:CSWitched][:TCH]:LEVel:UNTimeslot
```

Additional AMR settings are provided in the table-oriented version of the *Network* tab (see also p. 4.200):

Adaptive Multi-Rate (AMR)

Noise Suppression Switch noise suppression at the AMR codec of the mobile station on or off.

Remote control
```
CONFigure:NETWork[:CSWitched]:AMR:NSUPpression  ON | OFF
```

AMR Reference Sensitivity Test

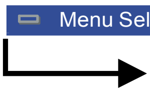
In the context of a *Receiver Quality* measurement (see section *Receiver Quality Measurements* on p. 4.133 ff.) it is possible to determine the Frame Error Rate (FER) for inband signalling codewords and measure the reference sensitivity and the co-channel rejection according to standard 3GPP TS 51.010 (see sections *Reference Sensitivity – TCH/AFS-INB, TCH/AHS-INB* and *Co-Channel Rejection – TCH/AFS-INB, TCH/AHS-INB;* interfering signals must be provided by external means).

To obtain the AMR inband FER…

1. In the *Menu Select* menu, select your GSM band and the *Signalling – Receiver Quality – BER* measurement.
2. Press *Connect. Contol* to open the *Connection Control* menu, open the *Connection* tab, and set up a call to the mobile.
3. Open the *Connection Control* menu again and press the *Network* hotkey to open the *Network* tab. If necessary, press the hotkey again to access the softkey-oriented version of the tab.
4. Press *Traffic Mode* and select the AMR codec supported by your mobile phone *(AMR Full Rate* or *AMR Half Rate).* You can select the codec irrespective of the signalling state of your R&S CMU.
5. Close the *Connection Control* menu

Tip: *To simplify the procedure you can use the* AMR *presettings of the measurement wizard, see Chapter 2.*

6. In the *Receiver Quality* menu, press *BER – Meas. Mode* and select *AMR Inband FER.*



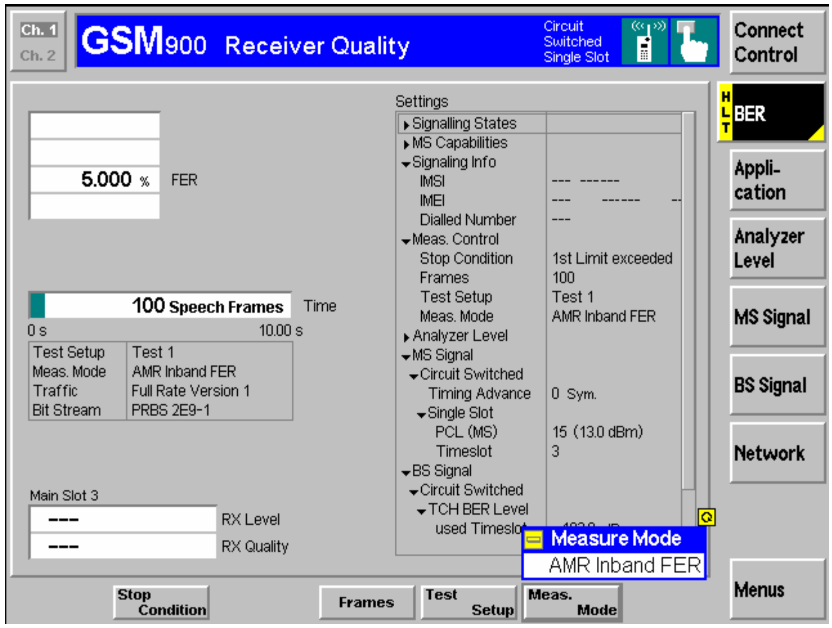


Fig. 4-97 Connection Control – Network parameters (AMR)

Measurement Procedure

The AMR inband FER measurement is performed at the TCH level set via *BS Signal – TCH Level BER.* At very small TCH levels, synchronization of the measurement may fail, in which case the R&S CMU displays a warning *“Too many errors. Measurement halted”*.

The UL and DL codec modes are changed every 24 speech frames according to the scanning pattern specified in standard 3GPP TS 51.010.

The AMR inband FER measurement is incompatible with the stop conditions *RF Level Search* and *Confidence.*

Results

The FER for inband signalling codewords is displayed in the upper left table. A frame error is registered when the UL codeword received from the MS differs from the transmitted DL codeword. One AMR speech frame contains one codeword, so the value corresponds to the FER for speech frames. The number of speech frames measured are monitored by the bar graph below the FER table.

Limit Check

If the FER result is above the FER limit defined in the *Limits* tab of the *Receiver Quality Configuration* menu (see page 4.163 ff.), then the output field turns red.

Contents

5 Remote Control – Basics

This chapter gives a survey of the basic features and concepts of GSM remote control commands. Remote control can be described in terms analogous to the ones used in chapter 3 for the classification of menus and settings for the graphical user interface. In the following, we will particularly point out the similarities and differences between manual and remote control.

Structure of the GSM Function Groups

Chapter 6 of this manual gives a description of all GSM remote control commands, including their parameters, as well as the default values and ranges of all numerical parameters.

Function group and mode

The commands for the function groups *GSM400-MS, GSM GT800, GSM850-MS, GSM900-MS, GSM1800-MS* and *GSM1900-MS* are largely identical, however, the ranges of numerical values and some default settings may not coincide. In such cases, the numerical values are explicitly quoted for all function groups.

Commands for the two modes *Signalling* and *Non Signalling* are listed separately although many of them have the same syntax. The commands for the measurement groups `WPOWer, NPOWer, POWer:SLOT, POWer:XSLot, POWer:FRAMe, POWer:MSLot, MODulation`, and `SPECtrum` are identical in both test modes, so they are reported only once.

Addressing

The CMU uses extended addressing: The instrument is assigned a primary address while each function group and test mode is identified via a secondary address. This allows the same remote commands to be used in several function groups and modes:

```
ibwrt(h_GSM900MS_SIG, "INITiate:POWer")
ibwrt(h_GSM1800MS_SIG, "INITiate:POWer")
ibwrt(h_GSM900MS_NSIG, "INITiate:POWer")
```

provided that the variables `h_GSM900MS_SIG` etc. have been appropriately defined, see program examples in chapter 7.

The remote control commands for first (`SYST:COMM:GPIB:ADDR`) and secondary (`SYST:REM:ADDR:SEC`) addressing are described in the CMU operating manual. The `SYST:REM:ADDR:SEC` command uses the following names to address the GSM network tests described in this manual:

GSM400MS_NSig,	*GSM400MS_Sig,*
GSMGT800MS_NSig,	*GSMGT800MS_Sig,*
GSM850MS_NSig,	*GSM850MS_Sig,*
GSM900MS_NSig,	*GSM900MS_Sig,*
GSM1800MS_NSig,	*GSM1800MS_Sig,*
GSM1900MS_NSig,	*GSM1900MS_Sig.*

Order of commands

The commands are arranged to form groups belonging to the same measurement or the same type of configurations. These groups are identified by the second-level keyword (as in `POWer`). Applications belonging to a measurement group (see chapter 5 of the CMU operating manual) are identified by the third-level keyword of each command (as in `SPECtrum:MODulation`). Chapter 6 is organized as follows:

- General configurations in the *Non Signalling* mode: `LEVel, RFANalyzer, RFGenerator, INPut, OUTPut, CORRection:LOSS, DM:CLOCk,` TRIGger, MMEMory

- Measurement groups *(Non Signalling* mode): POWer[:NORMal]..., POWer:MPR
- Common command and measurement groups (identical in *Non Signalling* and *Signalling* mode (OPTion, RESet, STATus:OPERation, IQIF, WPOWer, NPOWer, POWer:SLOT, POWer:XSLot, POWer:FRAMe, POWer:MSLot, MODulation..., SPECtrum...)
- Measurement groups *(Signalling* mode): POWer[:NORMal]..., POWer:ABURst..., POWer:PCL, POWer:MPR, RXQuality...
- General configurations and signalling in the *Signalling* mode (LEVel, TRIGger, SIGNalling, HANDover, MCONtrol, MSSignal, BSSignal, NETWork, INPut, OUTPut, CORRection:LOSS, DM:CLOCk), RREPorts, MSSinfo, MMEMory
- GPRS signalling (with option CMU-K42)

The structure of chapter 6 differs from chapter 4 *(Functions and their Application)* where the measurements are presented first and special configurations are reported at the end of each signalling mode section.

The menu of the graphical user interface corresponding to a group of commands is quoted at the beginning of each section. Lists of all commands (by function and alphabetical) are annexed to chapter 6.

SCPI Conformity In view of the particular requirements of GSM measurements not all commands could be taken from the SCPI standard. However, the syntax and structure of all commands is based on SCPI rules. For a detailed description of the SCPI standard refer to chapter 5 of the CMU operating manual.

Remote Control All commands may be used for control of the CMU via GPIB and serial (RS-232) interface.

Measurement Control

The commands in the measurement groups WPOWer, NPOWer, POWer..., MODulation..., SPECtrum..., and RXQuality... have an analogous structure and syntax. The measurements are controlled according to common concepts which are explained in detail in Chapter 5 of the CMU operating manual. The following sections show how the general concepts are applied to GSM-MS measurements.

Measurement Groups

The measurement groups are referred to as *measurement objects* (keyword <meas_obj>) in remote control. Most measurement objects correspond to a measurement group or application in manual control. For GSM measurements, the following measurement objects are defined:

Table 5-1Measurement objects in Signalling and Non Signalling mode

Non Signalling		Signalling	
Meas. Object	**Measurement group / Application**	**Meas. Object**	**Measurement group / Application**
`WPOWer`	*Wideband Power* softkey (wide-band peak power measurement).	`WPOWer`	*Wideband Power* softkey (wide-band peak power measurement).
`NPOWer`	No equivalent in manual control. Narrow-band power.	`NPOWer`	No equivalent in manual control. Narrow-band power.
`POWer[:NORMal][:GMSK]` `POWer[:NORMal]:EPSK`	*P/t Norm. GMSK* *P/t Norm. 8PSK* Burst power as a function of time.	`POWer[:NORMal][:GMSK]`	*P/t Norm. GMSK* *P/t Norm. 8PSK* Normal burst power as a function of time.
`POWer:MSLot`	*P/t Multislot* Burst power vs. time in up to 4 consecutive timeslots (GMSK or 8PSK modulation).	`POWer:MSLot`	*P/t Multislot* Burst power vs. time in up to 4 consecutive timeslots (GMSK or 8PSK modulation).
`POWer:MPR`	No equivalent in manual control Combined power and modulation measurement which should be used if scalar modulation results are needed while a power measurement is running.	`POWer:MPR`	No equivalent in manual control Combined power and modulation measurement which should be used if scalar modulation results are needed while a power measurement is running.
`POWer:SLOT`	*P/Slot Graph* Average burst power in 8 consecutive timeslots.	`POWer:SLOT`	*P/Slot Graph* Average burst power in 8 timeslots of a TDMA frame.
`POWer:XSLOt`	*P/Slot Table* Average burst power in up to 512 consecutive timeslots.	`POWer:XSLOt`	*P/Slot Table* Average burst power in up to 512 consecutive timeslots.
`POWer:FRAMe`	*P/Frame* Average burst power in a particular timeslot in 128 consecutive frames.	`POWer:FRAMe`	*P/Frame* Average burst power in a particular timeslot in 128 consecutive frames.
		`POWer:PCL`	Average burst power as a function of the PCL of the mobile phone on three or seven different channels.
		`POWer:ABURst[:GMSK]`	*P/t Access GMSK* Power of single access burst as a function of time. No 8PSK modulation available.

Non Signalling		Signalling	
Meas. Object	**Measurement group / Application**	**Meas. Object**	**Measurement group / Application**
`MODulation[:PERRor][:GMSK]`	No equivalent in manual control Fast phase and frequency error measurement excluding the I/Q imbalance and origin offset.	**`MODulation[:PERRor][:GMSK]`**	No equivalent in manual control Fast phase and frequency error measurement excluding the I/Q imbalance and origin offset
`MODulation:XPERror[:GMSK]`	*Ext. Phase Err. GMSK* Extended phase and frequency error measurement including the I/Q imbalance and origin offset.	**`MODulation:XPERror[:GMSK]`**	*Ext. Phase Err. GMSK* Extended phase and frequency error measurement including the I/Q imbalance and origin offset.
`MODulation:OVERview:EPSK`	*Overview 8PSK* 8PSK scalar modulation parameters including statistical evaluation.	**`MODulation:OVERview:EPSK`**	*Overview 8PSK* 8PSK scalar modulation parameters including statistical evaluation.
`MODulation:EVMagnitude:EPSK`	*EVM 8PSK* Error vector magnitude in 8PSK modulation.	**`MODulation:EVMagnitude:EPSK`**	*EVM 8PSK* Error vector magnitude in 8PSK modulation.
`MODulation:PERRor:EPSK`	*Phase Error 8PSK* Phase error in 8PSK modulation.	**`MODulation:PERRor:EPSK`**	*Phase Error 8PSK* Phase error in 8PSK modulation.
`MODulation:MERRor:EPSK`	*Magn. Error 8PSK* Magnitude error in 8PSK modulation.	**`MODulation:MERRor:EPSK`**	*Magn. Error 8PSK* Magnitude error in 8PSK modulation.
`SPECtrum:MODulation`	*Modulation* Off-carrier power due to the modulation for GSMK or 8PSK modulation schemes including time domain meas.	**`SPECtrum:MODulation`**	*Modulation* Off-carrier power due to the modulation for GSMK or 8PSK modulation schemes including time domain meas.
`SPECtrum:SWITching`	*Switching* Off-carrier power due to the switching for GSMK or 8PSK modulation schemes including time domain meas.	**`SPECtrum:SWITching`**	*Switching* Off-carrier power due to the switching for GSMK or 8PSK modulation schemes including time domain meas.
`SPECtrum:MSWitching`	*Modulation & Switching* Combined spectrum due to modulation and due to switching measurement	**`SPECtrum:MSWitching`**	*Modulation & Switching* Combined spectrum due to modulation and due to switching measurement
–	–	**`RXQuality:BER<nr>,`** **`RXQuality:BAVerage`** **`RXQUality:BLER`**	*BER* *BER Average* *BLER* Receiver quality measurements, i.e. measurement of the bit error rate, residual bit error rate, Block Error Rate etc. with limit check.

The measurement objects in Table 5-1 are complemented by groups of commands used to retrieve results that are automatically provided by the mobile station (e.g. the receiver parameters reported by the mobile phone). These command groups do not represent real measurements; they consist of queries only. For an overview, see the list of remote control commands at the end of chapter 6.

Measurement Statistics

The *repetition mode* defines how many evaluation periods are measured if the measurement is not stopped explicitly (measurement control commands STOP..., ABORT...) or by a limit failure. With remote control the three repetition modes *Single Shot, Continuous* and *Counting* are available (*Counting* is not available in manual control, see chapter 3).

In POWer, MODulation, and SPECtrum measurements, different traces corresponding to the result in the current period, the maximum, minimum, or average evaluated over a set of periods are determined within one measurement. The four results can be queried independently.

Table 5-2 Repetition mode in remote control

Setting	Description	Command
Statistic Count	Integer number of evaluation periods forming one statistics cycle. An evaluation period is equal to a burst length (POWer | MODulation | SPECtrum) or a frame (RXQuality measurements). The statistic count is set together with the measured quantity.	CONFigure:<meas_obj>:CONTrol SCALar | ARRay, **1 ... 1000 | NONE** (<meas_obj> = POWer... | MODulation... | SPECtrum... etc., see Table 5-1) CONFigure:RXQuality:BER<nr>|BAVerage:CONTrol <Mode>, **1 ... 200000 | NONE**
Repetition mode Single Shot	The measurement is stopped after one statistics cycle.	CONFigure:<meas_obj>:CONTrol:REPetition **SINGleshot**, <StopCondition>, <Stepmode> (<meas_obj> = WPOWer | POWer... | MODulation... | SPECtrum...) CONFigure:RXQuality:**BER**<nr>:...
Continuous	The measurement is continued until stopped explicitly or by a limit failure. Average values are calculated according to the formulas in chapter 3, section "*General Settings*".	CONFigure:<meas_obj>:CONTrol:REPetition **CONTinuous**, <StopCondition>, <Stepmode> (<meas_obj> = WPOWer | POWer | MODulation | SPECtrum:MODulation, SPECtrum:SWITching) CONFigure:RXQuality:**BAVerage**:...
Counting	Repeated single shot measurement with configured statistics cycles. The calculation of statistical quantities (minimum, maximum, average) is restarted after each statistics cycle; each cycle is treated as an independent single shot measurement.	CONFigure:<meas_obj>:CONTrol:REPetition **1 ... 10000**, <StopCondition>, <Stepmode> (<meas_obj> = WPOWer | POWer... | MODulation... | SPECtrum...) This mode is not available for RXQuality measurements. A counting measurement with 1 evaluation period is equivalent to a single shot measurement..

Setting	Description	Command
Traces	The specifiers CURRent, MAXimum, MINimum, MMAX, and AVERage denote the traces for the current evaluation period, the maximum, minimum, extreme value, or average of a set of evaluation periods. They correspond to the *Display Mode* set in the measurement configuration menus. In general all four traces are evaluated during the measurement. They are selected via a keyword in the queries initiating a measurement and retrieving the results.	Measurement results: READ:ARRay:<meas_obj>[:RESult]<disp>? .... where <meas_obj> = POWer... | MODulation...| SPECtrum... Burst matching: CALCULATE:<meas_obj>[:RESult]: LIMit:MATChing<disp>? .... where <disp> = [:CURRent] | :AVERage | | :MMAXimum | :MAXimum | :MINimum

Specifying Limits

The following table gives an overview of the types of limits and possible results of the limit check.

Table 5-3 Limits and limit check

Type	Description	Command
Scalar limits	Limit values for a single (scalar) measured quantity. Depending on the measured quantity, either an upper limit or upper and lower limits can be defined.	CONFigure:<meas_obj>:LIMit:<Spec.> [<LowerLimit>,]<UpperLimit> <Spec.> denotes a keyword (an array of keywords) specifying the measured quantity.
Limit lines	For POWer and SPECtrum measurements a tolerance template consisting of up to 16 time ranges (areas) can be defined (the POWer:MSLot template is composed of several single-slot templates).	CONFigure:<meas_obj>:LIMit:LINE:<Spec.> <Limit_line_param.> <Spec.> denotes the two keywords specifying the upper or lower limit line in a time range and the burst type considered. <Limit_line_param.> contains the coordinates of the start and end points of the limit line plus an information whether the current range is valid or not.
Limit check	All scalar limits belonging to the same measurement group are read out together with the command on the right side.	CALCulate:<meas_obj.>[:RESult]:LIMit: MATChing?
	Possible results of the scalar limit check are listed on the right side. Further messages assessing, e.g., the power ramp or the result of the BER test in general, may be issued in particular cases (see detailed command description in chapter 6).	NMAU not matching, underflow NMAL not matching, overflow INV measured value invalid OK no limit failure
	The result of the limit check depends on the statistics settings (see section *Measurement Statistics* on page *5.5*).	CALCULATE:ARRay:<meas_obj>[:RESult] :LIMit:MATChing<disp>? .... where <disp> = [:CURRent] | :AVERage | | :MMAXimum | :MAXimum | :MINimum

Status Reporting System

A general description of SCPI status registers and of the status reporting system is given in chapter 5 of the CMU operating manual. This section is devoted to the particular features concerning GSM measurements.

The CMU offers 30 independent `STATus:OPERation:CMU:SUM1|2:CMU<nr>` sub-registers (<nr>=1 ... 15) which are implemented in hierarchical form. The bits of the 30 STATus:OPERation registers are set only after the registers are assigned to a function group and measurement mode.

In the EVENt part, the STATus:OPERation register contains information on which actions the instrument has executed since the last readout. All fife parts of the registers can be read using one of the commands of the subsystem `STATus:OPERation:CMU:SUM1|2:CMU<nr>:...`

Note: *Symbolic status register evaluation by means of the commands `STATus:OPERation:SYMBolic:ENABle` and `STATus:OPERation:SYMBolic[:EVENt]?` is a convenient alternative method of retrieving status information. See also section* Symbolic Status Event Register Evaluation *in chapter 5 of the CMU operating manual and chapter 6 of this manual.*

GSM mobile tests comprise the two signalling modes *Non Signalling* and *Signalling* for each of the function groups *GSM400/GT800/850/900/1800/1900-MS* so that a total of 12 secondary addresses can be used.

In the status registers for the *Non Signalling* mode the following bits are assigned:

Table 5-4 Meaning of the bits used in the `STATus:OPERation:CMU:SUM1|2:CMU<nr>` sub-registers assigned to *GSMxxx-MS Non Signalling*

Bit-No.	Meaning	Symbol in `STATus:OPERation:SYMBolic...`
4	**Measurement Invalid** This bit is set if the active measurement could not performed and terminated correctly (e.g. because of a low signal level) so that the measurement results are invalid.	**MINV**
11	**RF Input Overdriven** This bit is set if the RF input level at connector RF1, RF2 or RF 4 IN is larger than the specified *RF Max. Level* plus an appropriate margin.	**RFIO**
12	**RF Input Underdriven** This bit is set while the RF input level at connector RF1, RF2 or RF 4 IN falls below the measurement range controlled by the specified *RF Max. Level.*	**RFIU**

In the status registers for the *Signalling* mode the bit assignment is as follows:

Table 5-5 Meaning of the bits used in the `STATus:OPERation:CMU:SUM1|2:CMU<nr>` sub-registers assigned to *GSMxxx-MS Signalling*

Bit-No.	Meaning	Symbol in `STATus:OPERation:SYMBolic...`
0	**Call from Mobile** This bit is set while the CMU receives a call from the mobile under test.	**CFM**

Bit-No.	Meaning	Symbol in `STATus:OPERation:SYMBolic...`
1	**Release from Mobile** This bit is set while the connection to the mobile is being released.	**RFM**
2	**Synchronization Lost** This bit is set if the CMU had to leave the signalling state "Synchronized".	**SLOS**
3	**Location Update** This bit is set while a location update is being performed.	**LUPD**
4	**Measurement Invalid** This bit is set if the active measurement could not performed and terminated correctly (e.g. because of a low signal level) so that the measurement results are invalid.	**MINV**
6	**Paging failed** This bit is set if the mobile does not respond to the CMU's paging messages within a fixed period of time.	**PFA**
7	**IMSI Detach** This bit is set if the CMU disconnected from the network.	**IDET**
8	**SMS received** This bit is set if a short message has been received but not yet read.	**SMSR**
10	**Measurement report** This bit is set if a measurement report from the mobile has been received.	**MREP**
11	**RF Input Overdriven** This bit is set if the RF input level at connector RF1, RF2 or RF 4 IN is larger than the specified *RF Max. Level* plus an appropriate margin.	**RFIO**
12	**RF Input Underdriven** This bit is set while the RF input level at connector RF1, RF2 or RF 4 IN falls below the measurement range controlled by the specified *RF Max. Level.*	**RFIU**

Special Terms and Notation

Below we list some particular features in the syntax of the GSM commands. The general description of the SCPI command syntax can be found in chapter 5 of the CMU operating manual, section *Structure and Syntax of Device Messages.*

Description of commands

The commands are arranged in tables. From top to bottom, the table rows contain the following entries:

1. Complete command syntax including the complete parameter list or a list of identifiers to be quoted in the parameter description below. The keyword on the right side gives a short description of the command. If possible, it is identical to the corresponding function (softkey, hotkey etc.) in manual control.
2. List of all parameters with short description, range of values and default units (for numerical parameters)

3. Detailed description of the command, signalling state and firmware version required. If no signalling state is indicated, the commands can be executed in any signalling states. Please note the remarks at the beginning of the sections for each measurement group.

Detailed lists of default values are annexed to the command description. Whenever possible, groups of analogous commands are described in common tables.

Order of commands

The commands are arranged according to their function specified by the keyword in the second level or in the second/third level combined. Lower-level keywords define the command in more detail. This means that commands with the same second-level, third-level etc. keywords are generally grouped together in the same sections.

Example: `CONFigure:POWer:CONTrol:GRID <Enable>`

Commands with the keyword *POWer* in the second level belong to the power measurement. The keywords in the third and fourth level indicate that the command controls whether a grid is displayed in the power versus time diagram.

Scalar results and arrays

To limit the number of remote control commands in an application program, all scalar results of a measurement group are usually measured together and returned in a common list. Arrays (e.g. the traces for `POWer` and `MODulation` measurements) are returned as comma-separated lists of values; it is possible to retrieve either the whole list (see commands `READ:ARRay...` etc.) or the values located in a number of subranges that are part of the total measurement range (see commands `READ:SUBarrays...;` the subarrays are defined via `CONFigure:SUBarrays...`).

Parameters

Setting commands are usually supplemented by a parameter or a list of several parameters. Parameters either provide alternative options (setting a or setting b or setting c ..., see special character "|"), or they form a comma-separated list (setting x,y).

<Par_Name>

In the command tables and lists, parameters are generally described by a name (identifier) written in angle brackets (<>). The identifiers merely serve as a parameters description; in an application program they must be replaced by one of the possible settings reported in the detailed parameter description.

Example: `CONFigure:POWer:CONTrol <Mode>,<Statistics>`

```
with    <Mode>       = SCALar | ARRay
        <Statistics> = 1 to 10000 | NONE
```

possible command syntax: `CONF:POW:CONT SCAL,NONE`

NAN

NAN (not a number) is generally used to represent missing data, e.g. if a portion of a trace has not been acquired yet. It is also returned after invalid mathematical operations such as division by zero. As defined in the SCPI standard, NAN is represented as 9.91 E 37.

INV

INV (invalid) is returned e.g. if a limit check is performed without defining the appropriate tolerance values.

Upper / lower case

Upper/lower case characters characterize the long and short form of the keywords in a command. The short form consists of all upper-case characters, the long form of all upper case plus all lower case characters. On the CMU, either the short form or the long form are allowed; mixed forms will generally not be recognized. Note that the instrument itself does not distinguish upper case and lower case characters.

Special characters

| A vertical stroke in the parameter list characterizes alternative parameter settings. Only one of the parameters separated by **|** must be selected.

Example: The following command has two alternative settings:

```
TRIGger:SEQuence:DEFault ON | OFF
```

[ ] *Key words* in square brackets can be omitted when composing the command header (see chapter 5 of the CMU manual, section "Structure of a Command"). The complete command must be recognized by the instrument for reasons of compatibility with the SCPI standard.

Parameters in square brackets are optional as well. They may be entered in the command or omitted.

{ } Braces or curly brackets enclose one or more parameters that may be included zero or more times.

<nr> This symbol denotes a numeric suffix, e.g. an enumeration index for input and output connectors.

Lists of commands

Command: The *Command* column of the table contains all remote control commands arranged according to their function (configurations or measurement objects). Within a section, the commands are listed in alphabetical order.

Parameters: The *Parameter* column lists the parameters of the commands.

Remarks: The *Remarks* column gives additional information about the commands which

– Have no query form *(no query)*
– Have only a query form *(query only)*
– Can be used both as setting commands and as queries (*with query*, this applies to all commands belonging to none of the two preceding categories)

Alphabetical Lists Chapter 6 concludes with alphabetical command lists for both test modes.

Contents

6 Remote Control – Commands

In the following, all remote-control commands for the function groups *GSM400/GT800/850/900/1800/1900-MS* will be presented in tabular form with their parameters and the ranges of values. The chapter is organized in analogy to the reference part for manual operation (chapter 4).

- The measurement modes *Non Signalling* and *Signalling* are presented separately.
- Within the measurement modes, general configurations *(Connection Control)* and the individual measurement groups are described separately.
- Command and measurement groups that are identical in both test modes *(WPOWer, NPOWer, POWer:SLOT,...,IQIF*, symbolic status register evaluation) are presented in a separate section between the two test modes.

General notes on remote control in the function group *GSM400/GT800/850/900/1800/1900-MS* can be found in chapter 5. An introduction to remote control according to the IEEE 488.2/SCPI standard is given in chapter 5 of the CMU200/300 operating manual.

Connection Control (Non Signalling only)

In the *Non Signalling* mode, a GSM-specific RF signal can be generated and an RF signal with GSM characteristics analyzed. No signalling parameters are transferred.

The remote-control commands presented in this section determine the RF analyzer and trigger settings and the signals generated by the CMU, the inputs and outputs used as well as the reference frequency. They correspond to the settings in the popup menu of the softkey *Connect. Control*, located to the right of the headline of each main menu.

Subsystem LEVel (Input Level)

The subsystem *LEVel* controls the level in the RF input signal path. It corresponds to the table section *Input Level* in the *Analyzer* tab of the *Connection Control* menu.

[SENSe:]LEVel:MODE <*Mode*>				Input level – Mode
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
MANual | **AUTomatic**	Manual setting Automatic setting corresponding to average power of signal applied	AUT	-	V2.10
Description of command				
This command defines how the maximum input level is set.				

[SENSe:]LEVel:MAXimum <*Level*>				Max. Level
<Level>	Description of parameters	Def. value	Def. unit	FW vers.
–40 dBm to +53 dBm **–54 dBm to +39 dBm** **–77 dBm to 0 dBm**	Maximum input level for RF 1 Maximum input level for RF 2 Maximum input level for RF 4 IN	+30.0 +30.0 0.0	dBm	V1.20
Description of command				
This command defines the maximum expected input level. This is possible even if the level is determined automatically (command `LEV:MODE AUT`). The value range depends on the RF input used and the external attenuation set (see `[SENSe:]CORRection:LOSS:INPut<nr>[:MAGNitude]` command). If option R&S CMU-U99 *(RF 1 with RF 2 Level Range)* is fitted, RF 1 takes on the level range of RF2.				

[SENSe:]LEVel:ATTenuation <*Mode*>				Attenuation
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
NORMal | **LNOise |** **LDIStortion**	Mixer level in normal range Low noise (mixer level 10 dB higher than in normal setting) Low distortion (mixer level 10 dB lower than in normal setting)	LNOise	–	V1.20
Description of command				
This command tunes the RF analyzer for normal setting, low noise level (full dynamic range), or low distortion (high intermodulation spacing).				

[SENSe:]LEVel:DEFault <Enable>				Default Settings
<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	The parameters are set to their default values Some or all parameters differ from the default values	ON	–	V1.20
Description of command				
If used as a setting command with the parameter *ON* this command sets all parameters of the subsystem to their default values (the setting *OFF* causes an error message). If used as a query the command returns whether all parameters are set to their default values *(ON)* or not *(OFF)*.				

Subsystem RFANalyzer (Analyzed Input Signals)

The subsystem *RFANalyzer* configures the RF analyzer, i.e., it specifies which type of RF signals can be analyzed. It corresponds to the panel *Analyzer Settings* in the *Analyzer* tab of the popup menu *Connect. Control*.

[SENSe:]RFANalyzer:CHANnel <Number>				RF Channel
<Number>	Description of parameters	Def. value	Def. unit	FW vers.
0.2 MHz to 2700 MHz (see also data sheet)	Input frequency	455.0 (GSM400) 814.0 (GSM GT800) 837.0 (GSM850) 903.0 (GSM900) 1750.0 (GSM1800) 1880.0 (GSM1900)	MHz MHz MHz MHz MHz MHz	V2.00
Description of command				
This command defines the frequency of the RF signal analyzed. As an alternative to frequencies, the corresponding GSM channels (with the character string CH annexed to the channel number) can be entered (259CH to 293 CH and 306CH to 340CH for GSM400, 350CH to 425CH for GSM GT800, 128CH to 251CH for GSM850, 1CH to 124CH or 955CH to 1023CH for GSM900, 512CH to 885CH for GSM1800, 512CH to 810CH for GSM1900, see GSM channel tables in chapter 4). The assignment of channel numbers and frequencies meets the GSM specification for the uplink (signal direction from mobile to CMU). The query always returns frequencies.				

[SENSe:]RFANalyzer:FREQuency:OFFSet *<FreqOffset>*				Frequency Offset
<FreqOffset>	Description of parameters	Def. value	Def. unit	FW vers.
–100 kHz to +100 kHz	Offset for channel frequency	0	kHz	V1.20
Description of command				
This command defines an offset for the channel frequency set with the command `[SENSe:]RFANalyzer:CHANnel <Number>`. The offset frequency must be in multiples of 1 Hz.				

[SENSe:]RFANalyzer:TSEQuence *<TrainingSequence>*				Training Sequence
<TrainingSequence>	Description of parameters	Def. value	Def. unit	FW vers.
OFF | **GSM0 to GSM7 |** **DUMMy |** **ANY**	No training sequence detected GSM-specific training sequence GSM dummy burst Arbitrary training sequence allowed	OFF	–	V1.15
Description of command				
This command determines the training sequence of the signal analyzed. If no training sequence is specified *(OFF),* the CMU measures all signals. In the setting *ANY,* it uses any training sequence for synchronization.				

CONFigure:RFANalyzer:TPCL *<PCL>*				TPCL
<PCL>	Description of parameters	Def. value	Def. unit	FW vers.
0 to 31	Template PCL	15	–	V2.10
Description of command				
This command defines the template PCL which is used for dynamic limit line correction in the `POWer` measurement.				

[SENSe:]RFANalyzer:MODulation *<Mod_Scheme>*				Modulation
<Mod_Scheme>	Description of parameters	Def. value	Def. unit	FW vers.
GMSK | EPSK	Modulation scheme GMSK or EPSK	GMSK	–	V2.15
Description of command				
This command selects one of the supported modulation schemes.				

CONFigure:RFANalyzer:MCONtrol:TSOFfset <*Slots*>				Trig. Slot Offset
<Slots>	Description of parameters	Def. value	Def. unit	FW vers.
0 to 7	Trigger slot offset, no. of slots	0	–	V3.05
Description of command				
This command defines a delay time between the trigger time and the measured timeslot.				

RFANalyzer:DEFault <Enable>				Default Settings
<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	The parameters are set to their default values Some or all parameters differ from the default values	ON	–	V3.05
Description of command				
If used as a setting command with the parameter *ON* this command sets all parameters of the subsystem to their default values (the setting *OFF* causes an error message). If used as a query the command returns whether all parameters are set to their default values *(ON)* or not *(OFF)*.				

Subsystem RFGenerator

The subsystem *RFGenerator* configures and controls the RF generator. The generator generates two independent RF signals Tx and Aux Tx (with option CMU-B95, *Additional RF Generator)*, referenced by the third-level keywords `[:TX]` and `:AUXTx` respectively. The generator corresponds to the *Generator* tab in the popup menu *Connect. Control*.

Subsystem RFGenerator[:TX] (TX Generator Control)

The subsystem *RFGenerator[:TX]* controls the RF generator providing the *Tx* signal. It corresponds to the *Generator Tx – Generator Control* function in the *Generator* tab of the *Connection Control* menu.

INITiate:RFGenerator[:TX] **ABORt:RFGenerator[:TX]**	Start RF generator, reserve resources Switch off RF generator, release resources	⇒ *RUN* ⇒ *OFF*
Description of command		FW vers.
These commands have no query form. They start and stop the RF generator for the TX signal, setting it to the status indicated in the top right column.		V1.15

FETCh:RFGenerator[:TX]:STATus?				Generator
Returned values	Description of parameters	Def. value	Def. unit	FW vers.
OFF | **RUN |** **ERR**	Generator switched off (`ABORt` or `*RST`) Running (`INITiate`) Switched off (could not be started)	OFF	–	V1.15
Description of command				
This command is always a query. It returns the current TX generator status.				

Generator Level – Subsystem RFGenerator[:TX]:LEVel

The subsystem *RFGenerator[:TX]:LEVel* determines the level of the generated TX signal. It corresponds to the *Generator TX* level settings in the *Generator* tab of the popup menu *Connect. Control*.

SOURce:RFGenerator[:TX]:LEVel:UTIMeslot <Level>				RF Level used
<Level>	Description of parameters	Def. value	Def. unit	FW vers.
–137.0 dBm to –27.0 dBm	RF1 level in used timeslot	–27.0	dBm	V1.15
–137.0 dBm to –10.0 dBm	RF2 level in used timeslot	–27.0	dBm	
–90.0 dBm to +13.0 dBm	RF 3 OUT level in used timeslot	–27.0	dBm	
Description of command				
This command determines the TX generator level in the used timeslot. The value range depends on the RF output of the CMU used and the external attenuation set (see `[SENSe:]CORRection:LOSS:OUTPut<nr>[:MAGNitude]` command). The level ranges and defaults are valid for GMSK-modulated generator signals. With 8PSK modulation, all level ranges are shifted by –4.0 dB and the default level for RF1 is changed to –31.0 dBm. If option R&S CMU-U99 *(RF 1 with RF 2 Level Range)* is fitted, RF 1 takes on the level range of RF2.				

SOURce:RFGenerator[:TX]:LEVel:UNTimeslot <*Level*>				RF Level unused
<Level>	Description of parameters	Def. value	Def. unit	FW vers.
–110.0 dB to +0.0 dB	Level in unused timeslots, RF 1	–80.0	dB	V1.15
–110.0 dB to +17.0 dB	Level in unused timeslots, RF 2	–80.0	dB	
–63.0 dB to +40.0 dB	Level in unused timeslots, RF 3 OUT	–80.0	dB	
Description of command				
This command determines the TX generator level in the unused timeslots relative to the level in the used timeslot. The absolute level in the unused timeslots, i.e. the sum of numerical values set under *UTIMeslot* and *UNTimeslot* must also lie within the range for the RF output. This condition further restricts the permissible maximum level for the unused timeslots. If option R&S CMU-U99 *(RF 1 with RF 2 Level Range)* is fitted, RF 1 takes on the level range of RF2.				

RF Generator Frequency – Subsystem RFGenerator…:FREQuency

The subsystem *RFGenerator…:FREQuency* determines the frequency of the generated RF signals *TX* and *Aux TX*. It corresponds to the softkeys *RF Channel* and *Freq. Offset* in the *Generator* tab in the popup menu *Connect. Control*.

Note: *The* Frequency *can be selected independently for the* TX *and* Aux TX *signals. The selected* Frequency Offset *is a small correction to the frequency which applies to both signals.*

SOURce:RFGenerator:FM:DEViation <*FrequencyOffset*>				Frequency Offset
<FrequencyOffset>>	Description of parameters	Def. value	Def. unit	FW vers.
–100 kHz to +100 kHz	Frequency offset	0	kHz	V1.15
Description of command				
This command determines a frequency offset for the CMU signals in the selected RF channel (relative to the frequency specified in the GSM standard). In firmware versions V3.50 and higher, the frequency offset also applies to *Aux TX* signals.				

SOURce:RFGenerator[:TX]:FREQuency <*Number*>				RF Channel (TX)
<Number>	Description of parameters	Def. value	Def. unit	FW vers.
0.2 MHz to 2700 MHz (see also data sheet)	Input frequency	465.0 (GSM400) 859.0 (GSM GT800) 882.0 (GSM850) 948.0 (GSM900) 1845.0 (GSM1800) 1960.0 (GSM1900)	MHz MHz MHz MHz MHz MHz	V1.15
Description of command				
This command defines the frequency of the generated RF signal. The resolution is 200 kHz; all values entered are rounded to 200 kHz steps. As an alternative to frequencies, the corresponding GSM channels (with the character string CH annexed to the channel number) can be entered (259CH to 293 CH and 306CH to 340CH for GSM400, 350CH to 425CH for GSM GT800, 128CH to 251CH for GSM850, 1CH to 124CH or 955CH to 1023CH for GSM900, 512CH to 885CH for GSM1800, 512CH to 810CH for GSM1900, see GSM channel tables in chapter 4). The assignment of channel numbers and frequencies meets the GSM specification for the downlink (signal direction from mobile to CMU). The query always returns frequencies.				

Subsystem RFGenerator:MODulation

The subsystem *RFGenerator:MODulation* determines an information which is modulated on the RF signal generated by the CMU and the signal shape. It corresponds to the panel *Generator Modulation* in the *Generator* tab in the popup menu *Connect. Control*.

CONFigure:RFGenerator:MODulation:BIT:SELection <*Selection*>				Bit Modulation
<Selection>	Description of parameters	Def. value	Def. unit	FW vers.
OFF | **PRBS |** **DUMMybursts |** **ALL0 |** **EALL0 |** **EPRBs**	No modulation sequence (unmod. carrier) Pseudo-random bit sequence GSM dummy bursts Modulation sequence consisting of zeros Zeros, 8PSK modulation Pseudo-random bit sequence, 8PSK mod.	ALL0	–	V1.15 V2.15 (8PSK)
Description of command				
The command selects a bit sequence used to modulate the generated signal.				

CONFigure:RFGenerator:MODulation:TSEQuence:SELection <*SELection*>				Training Sequence
<Selection>	Description of parameters	Def. value	Def. unit	FW vers.
GSM0 to GSM7 | **DUMMy |** **ALL0**	GSM standard training sequences no. 0 to 7 GSM dummy burst Training sequence consisting of zeros only	GSM0	–	V1.15
Description of command				
The command selects a training sequence used to modulate the signal generated by the CMU.				

CONFigure:RFGenerator:MODulation:TRANsmission *<Mode>*				Transmission
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
BURSt | **CONTinuous**	Bursted RF signal Continuous signal (not for 8PSK modulation)	BURSt	–	V1.15
Description of command				
This command determines whether the CMU generates a burst or a continuous RF carrier signal. An 8PSK-modulated signal is always bursted.				

Subsystem RFGenerator:AUXTx... (Aux TX Signal)

The subsystem *RFGenerator:AUXTx* configures the auxiliary generator signals *Aux Tx* (only with option R&S CMU-B95 or R&S CMU-B96, *Additional RF Generator)*. It corresponds to the *Generator Aux Tx* section in the *Generator* tab of the *Connection Control* menu*.*

The options provide an additional RF signal that can be applied to one of the RF connectors RF1 or RF2 plus an overrange signal `OLEVel` (R&S CMU-B96 only). It is possible to superimpose the RF signals at the same output connector or use different connectors (commands `OUTPut[:TX][:STATe]`, `OUTPut:AUXTx[:STATe]`, `OUTPut:AUXTx:OLEVel[:STATe]`). Moreover, it is possible to assign independent external attenuation factors to both signals (`[SENSe:] CORRection:LOSS:OUTPut<nr>…[:MAGNitude]`, `SOURce:CORRection:LOSS:OUTPut <nr>…[:MAGNitude]`).

Aux Tx is generated with the training sequence and bit modulation settings of the primary TX signal (`...RFGenerator:MODulation...`) but with no ramping.

INITiate:RFGenerator:AUXTx **ABORt:RFGenerator:AUXTx**	Start Aux Tx generator, reserve resources Switch off generator, release resources	⇒ *RUN* ⇒ *OFF*
Command description		FW vers.
These commands have no query form. They start or stop the RF generator for the Aux Tx signal, setting it to the status indicated in the top right column.		V3.50

FETCh:RFGenerator:AUXTx:STATus?				Generator status
Returned value	Parameter description	Def. value	Def. unit	FW vers.
OFF | **RUN |** **ERR**	Generator switched off (`ABORt or *RST`) Running (`INITiate`) Switched off (could not be started)	OFF	–	V3.50
Command description				
This command is always a query. It returns the current Aux Tx generator status.				

SOURce:RFGenerator:AUXTx:LEVel <Level> — RF Level

<Level>	Parameter description	Def. value	Def. unit	FW vers.
–122.0 dBm to –72.0 dBm **–110.0 dBm to –60.0 dBm**	Aux Tx output level at RF1 Aux Tx output level at RF2	–72.0 –60.0	dBm dBm	V3.50

Command description

This command defines the Aux Tx signal level. The value range depends on the RF output of the CMU used and the external attenuation set (see `[SENSe:]CORRection:LOSS:OUTPut<nr>:AUXTx[:MAGNitude]` command).

The level ranges and defaults are valid for GMSK-modulated generator signals. With 8PSK modulation, all level ranges are shifted by –4.0 dB and the default level for RF2 is changed to –64.0 dBm. If option R&S CMU-U99 *(RF 1 with RF 2 Level Range)* is fitted, RF1 takes on the level range of RF2.

SOURce:RFGenerator:AUXTx:OLEVel <*Level*> — RF Level Overrange (R&S CMU-B96)

<Level>	Parameter description	Def. value	Def. unit	FW vers.
–124 dBm to –24 dBm | OFF **–120 dBm to –10 dBm | OFF** **–107 dBm to +13 dBm | OFF**	Overrange output level at RF 1 Overrange output level at RF 2 Overrange output level at RF 3 OUT	OFF OFF OFF	dBm dBm dBm	V3.80

Command description

This command defines the level of the *Overrange* signal. The resolution is 1 dB (all values entered are rounded to integer dBm values). OFF switches the overrange signal off entirely.

The level range depends on the used RF output of the CMU and the external attenuation. Moreover, in the SSB mode (see command `SOURce:RFGenerator:MODulation SSB`), the level ranges for all three connectors are shifted by –2 dB. The level ranges are also modified if the Tx and Aux Tx signals are both active and superimposed at the same connector or if option R&S CMU-U99 *(RF 1 with RF 2 Level Range)* is fitted.

SOURce:RFGenerator:AUXTx:FREQuency <*Frequency*> — Frequency (Aux TX)

<Frequency>	Parameter description	Def. value	Def. unit	FW vers.
350 MHz to 550 MHz | **700 MHz to 1100 MHz |** **1400 MHz to 2200 MHz**	Aux Tx frequency	465.0 (GSM400) 859.0 (GSM GT800) 882.0 (GSM850) 948.0 (GSM900) 1845.0 (GSM1800) 1960.0 (GSM1900)	MHz MHz MHz MHz MHz MHz	V3.50

Command description

This command defines the frequency of the generated Aux Tx signal. The resolution is 200 kHz; all values entered are rounded to 200 kHz steps. If a value between the three distinct frequency bands is entered, the instrument generates an error message.

Subsystem for Input and Output (Connectors, External Attenuation)

The subsystem for input and output configures the input and output connectors. The subsystem corresponds to the tab *RF* in the popup menu *Connect. Control*.

INPut[:STATe] <*State*>				RF Input
<State>	Description of parameters	Def. value	Def. unit	FW vers.
RF1 | **RF2 |** **RF4**	Connector RF 1 used as input Connector RF 2 used as input Connector RF 4 IN used as input	RF2	–	V1.15
Description of command				
This command determines the connector to be used for RF input signals. The bidirectional connectors RF 1 and RF 2 can be used both as input and output connectors in the same measurement (see `OUTPut[:STATe]`). Only one input and one output may be active at the same time, a new RF input setting supersedes the previous one.				

OUTPut[:STATe] <*State*>				RF Output
<State>	Description of parameters	Def. value	Def. unit	FW vers.
RF1 | **RF2 |** **RF3**	Connector RF 1 used as output Connector RF 2 used as output Connector RF 3 OUT used as output	RF2	–	V1.15
Description of command				
This command determines the connector to be used for RF output signals. The bidirectional connectors RF 1 and RF 2 can be used as input and output connectors in the same measurement (see `INPut[:STATe]`). Only one input and one output may be active at the same time, a new RF output setting supersedes the previous one.				

[SENSe:]CORRection:LOSS:INPut<nr>[:MAGNitude] <*Attenuation*> **SOURce:CORRection:LOSS:INPut<nr>[:MAGNitude] <*Attenuation*>**				Ext. Att. Input
<Attenuation>	Description of parameters	Def. value	Def. unit	FW vers.
–50 dB to +90 dB	Ext. attenuation at input<nr> where <nr> = 1, 2, 4	0.0	dB	V1.15
Description of command				
This command assigns an external attenuation value to the inputs of the instrument *(RF 1, RF 2, RF4 IN)*.				

[SENSe:]CORRection:LOSS:OUTPut<nr>[:MAGNitude] <*Attenuation*> **SOURce:CORRection:LOSS:OUTPut<nr>[:MAGNitude] <*Attenuation*>**				Ext. Att. Output
<Attenuation>	Description of parameters	Def. value	Def. unit	FW vers.
–50 dB to +90 dB	Ext. attenuation at output<nr> where <nr> = 1, 2, 3	0.0	dB	V1.15
Description of command				
This command assigns an external attenuation value to the outputs of the instrument *(RF 1, RF 2, RF3 OUT)*.				

OUTPut:AUXTx[:STATe] <*State*>				RF Output (Aux TX)
<State>	Parameter description	Def. value	Default unit	FW vers.
RF1 **RF2**	Connector RF1 used as output Connector RF2 used as output	RF2	–	V3.50
Command description				
This command determines the output connector to be used for the generated Aux Tx signal. The bidirectional connectors RF 1 and RF 2 can be used both as input and output connectors in the same measurement. Only one input and one output may be active simultaneously, so the previous one is automatically deactivated on switch-over.				

[SENSe:]CORRection:LOSS:OUTPut<nr>:AUXTx[:MAGNitude] <*Absorption*> **SOURce:CORRection:LOSS:OUTPut<nr>:AUXTx[:MAGNitude] <*Absorption*>**				Ext. Att. Output (Aux TX)
<Absorption>	Parameter description	Def. value	Default unit	FW vers.
–50 dB to +90 dB	Ext. attenuation at output <nr>, where <nr> = 1,2	0.0	dB	V3.50
Command description				
This command assigns an external attenuation value to the outputs of the instrument. An external attenuation of x dB increases the Aux Tx signal level (`SOURce:RFGenerator:AUXTx:LEVel`) by x dB.				

OUTPut:AUXTx:OLEVel[:STATe] <*State*>				RF Output (Overrange)
<State>	Parameter description	Def. value	Default unit	FW vers.
RF1 | **RF2 |** **RF3**	Connector RF1 used as output Connector RF2 used as output Connector RF3 OUT used as output	RF2	–	V3.80
Command description				
This command determines the output connector to be used for the *Overrange* signal (with option R&S CMU-B96 only). Note that while the *Overrange* signal is at RF 1 the Tx signal (`OUTPut[:TX][:STATe]`) cannot be fed to RF 3 OUT and vice versa.				

[SENSe:]CORRection:LOSS:OUTPut<nr>:AUXTx:OLEVel[:MAGNitude] <*Absorption*> **SOURce:CORRection:LOSS:OUTPut<nr>:AUXTx:OLEVel[:MAGNitude] <*Absorption*>**				Ext. Att. Output (Overrange)
<Absorption>	Parameter description	Def. value	Default unit	FW vers.
–50 dB to +90 dB	Ext. attenuation at output <nr>, where <nr> = 1, 2, 3	0.0	dB	V3.80
Command description				
This command assigns an external attenuation value to the outputs of the instrument. An external attenuation of x dB increases the Aux Tx signal level (`SOURce:RFGenerator:AUXTx:OLEVel`) by x dB.				

Subsystem DM:CLOCk (Synchronization)

The subsystem *DM:CLOCk* sets a system clock specific to the network. This frequency is set in the tab *Sync.* in the popup menu *Connect. Control*.

SOURce:DM:CLOCk:STATe <*Mode*>				REF OUT 2 on/off
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
ON | OFF	Switch on/off system clock	OFF	–	V1.15
Description of command				
This commands switches the system clock specific to the network at the *REF OUT 2* connector on or off.				

SOURce:DM:CLOCk:FREQuency <Frequency>				REF OUT 2
<Frequency>	Description of parameters	Def. value	Def. unit	FW vers.
1.219 MHz to 39.000 MHz	Input value for the system clock	13.000	MHz	V1.15
Description of command				
This command determines the system clock frequency applied to *REF OUT 2*. The frequency entered is internally rounded to one of the following discrete values:				

39.000 MHz,	19.500 MHz,	13.000 MHz,	9.750 MHz,	7.800 MHz,	6.500 MHz,	5.571 MHz,
4.875 MHz,	4.333 MHz,	3.900 MHz,	3.545 MHz,	3.250 MHz,	3.000 MHz,	2.786 MHz,
2.600 MHz,	2.438 MHz,	2.294 MHz,	2.166 MHz,	2.053 MHz,	1.950 MHz,	1.857 MHz,
1.773 MHz,	1.696 MHz,	1.625 MHz,	1.560 MHz,	1.500 MHz,	1.444 MHz,	1.393 MHz,
1.349 MHz,	1.300 MHz,	1.258 MHz,	1.219 MHz			

Subsystem TRIGger (Trigger Mode)

The subsystem *TRIGger* defines the trigger mode. It corresponds to the *Trigger* tab in the *Connection Control* menu.

TRIGger[:SEQuence]:SOURce <*Source*>				Source
<Source>	Description of parameters	Def. value	Def. unit	FW vers.
FRUN	The power measurement is triggered by the TDMA timing of the GSM input signal	IFPower*)	–	V1.15
RFPower	Wideband RF power trigger			
IFPower	Narrow-band IF power trigger			
EXTern	External trigger signal at connector AUX3/4.			
Description of command				
This command defines the source for the trigger event. The settings *RFPower* and *IFPower* require burst signals. The setting *FRUN* requires burst signals with incorporated training sequence. Some measurements are not compatible with all trigger sources, see chapter 4.				
*) Firmware version V3.50 and higher. Earlier versions use FRUN as default value.				

TRIGger[:SEQuence]:THReshold:RFPower <*Threshold*> — Level – RF Power

<Threshold>	Parameter description	Def. value	Default unit	FW vers.
LOW | **MEDium |** **HIGH**	Low trigger threshold *(RF Max. Level* – 26 dB) Medium trigger threshold *(RF Max. Level* – 16 dB) High trigger threshold *(RF Max. Level* – 6 dB)	MEDium	–	V3.10

Command description

This command sets the RF input signal level at which the measurement is triggered relative to the maximum RF input level; see `[SENSe:]LEVel:MAXimum`. The setting has effect for trigger source `RFPower` only (see `TRIG:SEQ:SOUR`).

TRIGger[:SEQuence]:THReshold:IFPower <*Threshold*> — Level – IF Power

<Threshold>	Parameter description	Def. value	Default unit	FW vers.
–47 dB to 0 dB	IF power threshold	–26	dB	V3.10

Command description

This command sets the IF signal level at which the measurement is triggered. The IF power threshold is defined relative to the maximum RF input level; see `[SENSe:]LEVel:MAXimum`. The setting has effect for trigger source `IFPower` only (see `TRIG:SEQ:SOUR`).

TRIGger[:SEQuence]:SLOPe <*Slope*> — Slope

<Slope>	Parameter description	Def. value	Default unit	FW vers.
POSitive | **NEGative**	Rising edge Falling edge	POS	–	V3.10

Command description

This command qualifies whether the trigger event occurs on the *Rising Edge* or on the *Falling Edge* of the trigger signal. The setting has no influence on *Free Run* measurements (see `TRIG:SEQ:SOUR`).

TRIGger[:SEQuence]:SOURce:EXTernal <*Source*> — Ext. Trigger (AUX 3/4)

<Source>	Description of parameters	Def. value	Def. unit	FW vers.
PIN6 | PIN7 | PIN8	Pin for external trigger signal	PIN8	–	V3.10

Description of command

This command determines the pins on the AUX 3 or AUX4 connectors used for the external trigger signal. The setting only has effect if the trigger source is an *External* signal.

TRIGger[:SEQuence]:DEFault <Enable> — Default Settings

<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	The parameters are set to their default values Some or all parameters differ from the default values	ON	–	V1.15

Description of command

If used as a setting command with the parameter *ON* this command sets all parameters of the subsystem to their default values (the setting *OFF* causes an error message).

If used as a query the command returns whether all parameters are set to their default values *(ON)* or not *(OFF)*.

Config. File Management – System MMEMory

The `MMEMory` system provides mass storage capabilities for the CMU. The functionality of this system is included in the *Data* menu; see CMU200/300 operating manual.

The mass storage of the CMU may be internal or external. The internal mass storage device is a section on the internal hard disk that is reserved for mass storage (directory c:\temp). The external mass storage device is either a floppy disk or a PCMCIA memory card, depending on the instrument configuration. The <*msus*> (mass storage unit specifier) parameter in the `MMEMory` commands denotes the root directory of the *INTernal* or *EXTernal* mass storage device.

The <FileName> parameter is a string. The contents of the string may contain characters for specifying subdirectories, e.g. "\TEMP\TRASH\test.txt" for the file named *test.txt* in the *TEMP\TRASH* subdirectory of the root directory or "TEMP\TRASH\test.txt" for the file named *test.txt* in the *TEMP\TRASH* subdirectory of the current directory, to be queried with the base system command `MMEMory:DIRectory[:CURRent]?`. The file name itself may contain the period as a separator for extensions.

MMEMory:SAVE:CURRent *<FileName> [,<msus>]*

Save configurations in current function group and test mode

Parameters	Parameter description	Def. value	Def. unit	FW vers.
"<FileName>",	Name of the config. file to be created	–	–	V3.10
INTernal | EXTernal	Storage device of the config. file	INTernal	–	

Command description

This command saves the configuration of the current function group and test mode to a configuration file. A "?" in the specified file name will be replaced by current numbers that are automatically incremented, starting with zero. The auto-increment function overwrites an existing file with a "9" in its file name. For instrument settings that may be different in manual and remote control (e.g. the repetition mode for many measurements) the manual setting is saved. The command is available in all function groups. This command is CMU-specific.

MMEMory:RECall:CURRent *<FileName> [,<msus>]*

Recall configurations in current function group and test mode

Parameters	Parameter description	Def. value	Def. unit	FW vers.
"<FileName>",	Name of the config. file to be recalled	–	–	V3.10
INTernal | EXTernal	Storage device of the config. file	INTernal	–	

Command description

This command recalls the configuration of the current function group and test mode from a configuration file. The command is available in all function groups. This command is CMU-specific.

Measurement Groups (Non Signalling only)

The measurement groups in this section are either provided in *Non Signalling* mode only or implemented with major differences in the two test modes.

POWer[:NORMal]

The subsystem *POWer[:NORMal]* measures the MS transmitter output power versus time. The subsystem corresponds to the measurement menu *Power* and the associated popup menu *Power Configuration.*

Important note on GMSK and 8PSK modulation:

The keywords `[:GMSK]` and `:EPSK` in the remote control commands denote GMSK and 8PSK modulation, respectively. The `:EPSK` commands in Non Signalling measurements are included in firmware versions V2.15 and higher. The firmware version numbers quoted in the command tables refer to GMSK modulation.

Control of measurement – Subsystem Power

The subsystem *POWer* controls the power measurement.

INITiate:POWer[:NORMal][:GMSK] **INITiate:POWer[:NORMal]:EPSK**	Start new measurement	⇒ RUN
ABORt:POWer[:NORMal][:GMSK] **ABORt:POWer[:NORMal]:EPSK**	Abort running measurement and switch off	⇒ OFF
STOP:POWer[:NORMal][:GMSK] **STOP:POWer[:NORMal]:EPSK**	Stop measurement after current stat. cycle	⇒ STOP
CONTinue:POWer[:NORMal][:GMSK] **CONTinue:POWer[:NORMal]:EPSK**	Next measurement step (only stepping mode)	⇒ RUN
Description of command		FW vers.
These commands have no query form. They start and stop the power measurement, setting it to the status indicated in the top right column.		V1.15

CONFigure:POWer[:NORMal][:GMSK]:EREPorting <*Mode*> **CONFigure:POWer[:NORMal]:EPSK:EREPorting <*Mode*>**				Event Reporting
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
SRQ | **SOPC |** **SRSQ |** **OFF**	Service request Single operation complete SRQ and SOPC No reporting	OFF	–	1.17
Description of command				
This command defines the events generated when the measurement is terminated or stopped *(event reporting,* see chapter 5 of CMU200 manual).				

FETCh:POWer[:NORMal][:GMSK]:STATus? **FETCh:POWer[:NORMal]:EPSK:STATus?**				Measurement Status
Return	Description of parameters	Def. value	Def. unit	FW vers.
OFF | **RUN |** **STOP |** **ERR |** **STEP |** **RDY,**	Measurement in the *OFF* state (`*RST` or `ABORt`) Running (after `INITiate, CONTinue` or `READ`) Stopped (`STOP`) *OFF* (could not be started) Stepping mode *(<stepmode>=STEP)* Stopped according to repetition mode and stop condition	OFF	–	V1.15
1 to 10000 | **NONE,**	Counter for current statistics cycle No counting mode set	 NONE	–	
1 to 1000 | **NONE**	Counter for current evaluation period within a cycle Statistic count set to off	 NONE	–	
Description of command				
This command is always a query. It returns the status of the measurement (see chapters 3 and 5).				

CONFigure:POWer[:NORMal][:GMSK]:TOFFset *<Offset>* **CONFigure:POWer[:NORMal]:EPSK:TOFFset *<Offset>***				Bit Offset
<Offset>	Description of parameters	Def. value	Def. unit	FW vers.
–4.00 bit to +4.00 bit	Number of bits	0	bit	V2.15
Description of command				
This command defines an offset time in ¼ bit units by which the burst is shifted relative to the time axis and the tolerance template.				

CONFigure:POWer[:NORMal][:GMSK]:FILTer *<Filter>* **CONFigure:POWer[:NORMal]:EPSK:FILTer *<Filter>***				Filter
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
G500 | **B600**	500 kHz Gaussian filter 600 kHz bandpass filter	G500 for GMSK modulation B600 for 8PSK modulation	–	V3.05
Description of command				
This command selects the measurement filter for the *P/t* measurement. The default filter setting differs for the two modulation schemes.				

Test Configuration

The commands of the following subsystems determine the parameters of the signal power measurement. They correspond to the *Power Configuration* popup menu. For a detailed explanation of the different power tolerance templates defined in the GSM standard see chapter 4.

Subsystem POWer:CONTrol

The subsystem *POWer:CONTrol* defines the repetition mode, statistic count, and stop condition of the measurement. These settings are provided in the *Control tab* in the popup menu *Power Configuration.*

CONFigure:POWer[:NORMal][:GMSK]:CONTrol *<Mode>, <Statistics>*
CONFigure:POWer[:NORMal]:EPSK:CONTrol *<Mode>, <Statistics>*

Scope of Measurement

<Mode>	Desciption of parameters	Def. value	Def. unit	
SCALar | **ARRay**	Scalar values only (incl. ramp matching) Scalar measured values and arrays	ARRay	–	
<Statistics>	Description of parameters	Def. value	Def. unit	FW vers.
1 to 1000 | **NONE**	Number of bursts per statistics cycle Statistics off (equivalent to 1)	100	–	V1.15

Description of command

This command specifies the type of measured values and defines the number of bursts forming a statistics cycle.

CONFigure:POWer[:NORMal][:GMSK]:CONTrol:REPetition
CONFigure:POWer[:NORMal]:EPSK:CONTrol:REPetition
<Repetition>,<StopCond>,<Stepmode>

Test cycles

<Repetition>	Description of parameters	Def. value	Def. unit	
CONTinuous | **SINGleshot |** **1 to 10000,**	Continuous measurement (until `STOP` or `ABORT`) Single shot measurement (until `Status = RDY`) Multiple measurement (*counting*, until `Status = STEP | RDY`)	SING	–	
<StopCond>	Description of parameters	Def. value	Def. unit	FW vers.
SONerror | **NONE,**	Stop measurement in case of error *(stop on error)* Continue measurement even in case of error	NONE	–	V1.15
<Stepmode>	Description of parameters	Def. value	Def. unit	
STEP | **NONE**	Interrupt measurement after each statistics cycle Continue measurement according to its rep. mode	NONE	–	

Description of command

This command determines the number of statistics cycles, the stop condition and the stepping mode for the measurement.

Note: *In the case of READ commands (`READ:...`), the <Repetition> parameter has no effect; the measurement is always stopped after a single shot.*

DISPlay:POWer[:NORMal][:GMSK]:CONTrol:GRID *<Enable>*
DISPlay:POWer[:NORMal]:EPSK:CONTrol:GRID *<Enable>*

Grid

<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	Switch on the grid lines Switch off the grid lines	ON	–	V1.15

Description of command

This command switches the grid lines in the test diagram on or off.

CONFigure:POWer[:NORMal]:EPSK:CONTrol:RPMode *<Mode>*				Ref. Power Mode
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
CURRent | **AVERage |** **DCOMpens**	Ref. Power calculated from current burst Ref. Power calculated from average curve Data compensated/corrected reference power	CURR	–	V2.15
Description of command				
This command determines how the reference power (0-dB line in the *P/t Norm. 8PSK* test diagram) for 8PSK-modulated signals is calculated.				

CONFigure:POWer[:NORMal][:GMSK]:CONTrol:DEFault <Enable> **CONFigure:POWer[:NORMal]:EPSK:CONTrol:DEFault <Enable>**				Default Settings
<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	The parameters are set to their default values Some or all parameters differ from the default values	ON	–	V2.00
Description of command				
If used as a setting command with the parameter *ON* this command sets all parameters of the subsystem to their default values (the setting *OFF* causes an error message). If used as a query the command returns whether all parameters are set to their default values *(ON)* or not *(OFF)*.				

Subsystem POWer:LIMit:LINE

The subsystem *POWer:LIMit:LINE* defines the limit lines, i.e. the tolerance values for the power measurement. The subsystem corresponds to the tab *Limit Lines* in the popup menu *Power Configuration.*

CONFigure:POWer[:NORMal][:GMSK]:LIMit:LINE:UPPer<nr>[:STATic]:ENABle *<Enable>* **CONFigure:POWer[:NORMal]:EPSK:LIMit:LINE:UPPer<nr>[:STATic]:ENABle *<Enable>*** **CONFigure:POWer[:NORMal][:GMSK]:LIMit:LINE:UPPer<nr>[:STATic]** **CONFigure:POWer[:NORMal]:EPSK:LIMit:LINE:UPPer<nr>[:STATic]**			Upper Limit Line
Parameters for query: ***for setting:***	***<StartTime>, <EndTime>, <StartRelLevel>, <EndRelLevel>, <StartAbsLevel>, <EndAbsLevel>, <StartVisibility>, <EndVisibility>*** ***<StartTime>, <EndTime>, <StartRelLevel>, <EndRelLevel>, <StartAbsLevel>, <EndAbsLevel>, <Visibility>***		
Parameters	Value range	Description of parameters	Def. values
<Enable>	ON | OFF	Area on/off	see below
<StartTime>, **<EndTime>,** **<StartRelLevel>,** **<EndRelLevel>,** **<StartAbsLevel>,** **<EndAbsLevel>,** **<Visibility>** **<StartVisib>** **<EndVisib>**	–10 bit to +156 ¾ bit | OFF –10 bit to +156 ¾ bit | OFF, –100 dB to 20 dB | OFF, –100 dB to 20 dB | OFF, –90 dBm to 50.0 dBm OFF, –90 dBm to 50.0 dBm | OFF, ON | OFF	Start point of time End point of time Start point of level (relative) End point of level (relative) Start point of level (absolute) End point of level (absolute) Range of limit lines on/off	
Description of command			FW vers.
These commands activate and define upper limit lines for normal bursts. The limit lines are defined area by area; the suffix <nr> numbers the various areas in the burst diagram (see chapter 4).			V1.15

For GMSK modulation (keyword `[:GMSK]`), 8 areas are defined in the default setting, another 8 areas can be activated if required. The default settings are given in the table below:

	for Enable		forTable					
Suffix	Enable	Start Time	Stop Time	Start rel.Level	Stop rel.Level	Start abs.Level	Stop abs.Level	Visibility
1	ON	–10.0 bit	–7 ¼ bit	–59.0[1] dB	–59.02 dB	–36.0[2] dBm	–36.0[2] dBm	ON
2	ON	–7 ¼ bit	–4 ½ bit	–30.0 dB	–30.0 dB	–17.0[3] dBm	–17.0[3] dBm	ON
3	ON	–4 ½ bit	–2 ¼ bit	–6.0 dB	–6.0 dB	OFF	OFF	ON
4	ON	–2 ¼ bit	+½ bit	+4.0 dB	+4.0 dB	OFF	OFF	ON
5	ON	½ bit	150 ¼ bit	+1.0 dB	+1.0 dB	OFF	OFF	ON
6	ON	150 ¼ bit	152 ½ bit	–6.0 dB	–6.0 dB	OFF	OFF	ON
7	ON	152 ½ bit	155 ¼ bit	–30.0 dB	–30.0 dB	–17.0[3] dBm	–17.0[3] dBm	ON
8	ON	155 ¼ bit	156 ¾ bit	–59.0[1] dB	–59.0[1] dB	–36.0[2] dBm	–36.0[2] dBm	ON
9	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
...								
16	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF

The setting *Visibility = Off* implies that the corresponding range, including the limit check, is switched off. *Enable = Off* switches off the entire limit check.

The default settings for 8MSK modulation (EDGE channels, keyword `:EPSK`) are given in the table below:

	for Enable		forTable					
Suffix	Enable	Start Time	Stop Time	Start rel.Level	Stop rel.Level	Start abs.Level	Stop abs.Level	Visibility
1	ON	–10.0 symb	–7 ¼ symb	–59.0[1] dB	–59.0[1] dB	–36.0[2] dBm	–36.0[2] dBm	ON
2	ON	–7 ¼ symb	–4 ½ symb	–30.0 dB	–30.0 dB	–17.0[3] dBm	–17.0[3] dBm	ON
3	ON	–4 ½ symb	–2 ¼ symb	–6.0 dB	–6.0 dB	OFF	OFF	ON
4	ON	–2 ¼ symb	+½ symb	+4.0 dB	+4.0 dB	OFF	OFF	ON
5	ON	½ symb	1 ½ symb	+2.4 dB	+2.4 dB	OFF	OFF	ON
6	ON	1 ½ symb	146 ½ symb	+4.0 dB	+4.0 dB	OFF	OFF	ON
7	ON	146 ½ symb	147 ½ symb	+2.4 dB	+2.4 dB	OFF	OFF	ON
8	ON	147 ½ symb	150 ¼ symb	+4.0 dB	+4.0 dB	OFF	OFF	ON
9	ON	150 ¼ symb	152 ½ symb	–6.0 dB	–6.0 dB	OFF	OFF	ON
10	ON	152 ½ symb	155 ¼ symb	–30.0 dB	–30.0 dB	–17.0[3] dBm	–17.0[3] dBm	ON
11	ON	155 ¼ symb	156 ¾ symb	–59.0[1] dB	–59.0[1] dB	–36.0[2] dBm	–36.0[2] dBm	ON
12	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
...								
16	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF

1 GSM400/850/900. The value for GSM1800 and GSM1900 is –48.0 dB.

2 GSM400/850/900. The value for GSM1800 and GSM1900 is –48.0 dBm.

3 GSM400/850/900. The value for GSM1800 and GSM1900 is –20.0 dBm.

CONFigure:POWer[:NORMal][:GMSK]:LIMit:LINE:LOWer<nr>[:STATic]:ENABle ***<Enable>***
CONFigure:POWer[:NORMal]:EPSK:LIMit:LINE:LOWer<nr>[:STATic]:ENABle ***<Enable>***

CONFigure:POWer[:NORMal][:GMSK]:LIMit:LINE:LOWer<nr>[:STATic]
CONFigure:POWer[:NORMal]:EPSK:LIMit:LINE:LOWer<nr>[:STATic] Lower Limit Line

Parameters for query: ***<StartTime>, <EndTime>, <StartRelLevel>, <EndRelLevel>, <StartAbsLevel>, <EndAbsLevel>, <StartVisibility>, <EndVisibility>***
for setting: ***<StartTime>, <EndTime>, <StartRelLevel>, <EndRelLevel>, <StartAbsLevel>, <EndAbsLevel>, <Visibility>***

Parameters	Value range	Description of parameters	Def. value
<Enable>	ON | OFF	Definition section on/off	See be-low
<StartTime>,	–10 bit to +156 ¾ bit | OFF	Start point of time	
<EndTime>,	–10 bit to +156 ¾ bit | OFF,	End point of time	
<StartRelLevel>,	–100 dB to 20 dB | OFF,	Start point of level (relative)	
<EndRelLevel>,	–100 dB to 20 dB | OFF,	End point of level (relative)	
<StartAbsLevel>,	–90 dBm to 50 dBm | OFF,	Start point of level (absolute)	
<EndAbsLevel>,	–90 dBm to 50 dBm | OFF,	End point of level (absolute)	
<Visibility>	ON | OFF	Range of limit lines on/off	
<StartVisib.>			
<EndVisib>			

Description of command	FW vers.
These commands activate and define lower limit lines for normal bursts. The limit lines are defined area by area; the suffix <nr> numbers the various areas in the burst diagram (see chapter 4).	V1.15

Only 1 area is defined in the default setting, another 15 areas can be activated if required. The default settings for GMSK modulation (keyword `[:GMSK]`) are shown in the table below:

	for Enable		for Table					
	Start	Stop	Start	Stop	Start	Stop		
Suffix	Enable	Time	Time	rel.Level	rel.Level	abs.Level	abs.Level	Visibility
1	ON	–10.0 bit	½ bit	OFF	OFF	OFF	OFF	OFF
2	ON	½ bit	147 ½ bit	–1.0 dB	–1.0 dB	OFF	OFF	ON
3	ON	147 ½ bit	156 ¾ bit	OFF	OFF	OFF	OFF	ON
4	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
...								
16	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF

The default settings for 8MSK modulation (EDGE channels, keyword `:EPSK`) are given in the table below:

	for Enable		for Table					
	Start	Stop	Start	Stop	Start	Stop		
Suffix	Enable	Time	Time	rel.Level	rel.Level	abs.Level	abs.Level	Visibility
1	ON	–10.0 symb	½ symb	OFF	OFF	OFF	OFF	OFF
2	ON	½ symb	1 symb	–2.0 dB	–2.0 dB	OFF	OFF	ON
3	ON	1 symb	1 ½ symb	0.0 dB	0.0 dB	OFF	OFF	ON
4	ON	1 ½ symb	146 ½ symb	–15.0 dB	–15.0 dB	OFF	OFF	ON
5	ON	146 ½ symb	147 symb	0.0 dB	0.0 dB	OFF	OFF	ON
6	ON	147 symb	147 ½ symb	–2.0 dB	–2.0 dB	OFF	OFF	ON
7	ON	147 ½ symb	156 ¾ symb	OFF	OFF	OFF	OFF	OFF
8	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
...								
16	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF

CONFigure:POWer[:NORMal][:GMSK]:LIMit:LINE:UPPer<AreaNr>:DYNamic<RangeNr>:ENABle
CONFigure:POWer[:NORMal]:EPSK:LIMit:LINE:UPPer<AreaNr>:DYNamic<RangeNr>:ENABle
<Enable>

CONFigure:POWer[:NORMal][:GMSK]:LIMit:LINE:UPPer<AreaNr>:DYNamic<RangeNr>
CONFigure:POWer[:NORMal]:EPSK:LIMit:LINE:UPPer<AreaNr>:DYNamic<RangeNr> ***<fromTPCL>, <toTPCL>, <Correction>, <Enable>***

Dynamic Correction

<fromTPCL>	Description of parameters	Def. value	Def. unit	
0 to 31 | OFF	First template PCL for which area <AreaNr> is changed	See table below	–	
<toTPCL>	Description of parameters	Def. value	Def. unit	
0 to 31 | OFF	Last template PCL for which area <AreaNr> is changed.	See table below	–	
<***Correction>***	Description of parameters	Def. value	Def. unit	
-10 dB to +10 dB | OFF	Correction value (relative) for the limit line in area <AreaNr> applied for all template PCLs between <fromTPCL> and <toTPCL>	See table below	dB	
<***Enable>***	Description of parameters	Def. value	Def. unit	FW vers.
ON | OFF	Enable or disable dynamic correction in the current limit line area and PCL range	See table below	–	V2.00

Description of command

These command activates and defines dynamic correction of the upper limit line of area <AreaNr> (<AreaNr> = 1 to 16) depending on the template PCL range <RangeNr> (<RangeNr> = 1 to 10 for each area). The template PCL is set via `CONFigure:RFANalyzer:TPCL`.

In the areas no. 3 and 6, the following ranges are defined (both modulation schemes):

Range	fromTPCL	toTPCL	Correction	Enable
1	16	16	+2.0 dB	ON
2	17	17	+4.0 dB	ON
3	18	19	+5.0 dB	ON
4	OFF	OFF	0.0 dB	OFF
5	OFF	OFF	0.0 dB	OFF
6	OFF	OFF	0.0 dB	OFF
7	OFF	OFF	0.0 dB	OFF
8	OFF	OFF	0.0 dB	OFF
9	OFF	OFF	0.0 dB	OFF
10	OFF	OFF	0.0 dB	OFF

In the remaining areas, the dynamic limit line correction is disabled in all ranges.

CONFigure:POWer[:NORMal][:GMSK]:LIMit:LINE:UPPer<AreaNr>:ALL:DYNamic:ENABle
CONFigure:POWer[:NORMal]:EPSK:LIMit:LINE:UPPer<AreaNr>:ALL:DYNamic:ENABle
<Enable>

Dynamic Correction on/off

<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | OFF	Switch dynamic correction on or off	ON	–	V2.00

Description of command

This command switches the dynamic correction of the upper limit area <nr> for all ten TPCL ranges on or off.

CONFigure:POWer[:NORMal][:GMSK]:LIMit:LINE:UPPer:ALL:DYNamic:ENABle *<Enable>*
CONFigure:POWer[:NORMal]:EPSK:LIMit:LINE:UPPer:ALL:DYNamic:ENABle *<Enable>*

Dynamic Correction on/off

<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | OFF	Switch dynamic correction for the whole template on or off	ON	–	V2.00

Description of command

This command switches the dynamic correction of the upper limit line in all areas and for all TPCL ranges on or off. The query returns 160 Boolean values corresponding to the limit check in PCL ranges 1 to 10 (inner loop) in each of the areas 1 to 16 (outer loop).

CONFigure:POWer[:NORMal][:GMSK]:LIMit:LINE:LOWer<AreaNr>:DYNamic<RangeNr>
CONFigure:POWer[:NORMal]:EPSK:LIMit:LINE:LOWer<AreaNr>:DYNamic<RangeNr>
<fromTPCL>, <toTPCL>, <Correction>, <Enable>

Dynamic Correction

<fromTPCL>	Description of parameters	Def. value	Def. unit	
0 to 31 | OFF	First TPCL for which area <AreaNr> is changed	OFF	TPCL	
<toTPCL>	**Description of parameters**	**Def. value**	**Def. unit**	
0 to 31 | OFF	Last TPCL for which area <AreaNr> is changed.	OFF	TPCL	
<Correction>	**Description of parameters**	**Def. value**	**Def. unit**	
-10 dB to +10 dB | OFF	Correction value (relative) for the limit line in area <AreaNr> applied for all TPCLs between <fromTPCL> and <toTPCL>	OFF	dB	
<Enable>	**Description of parameters**	**Def. value**	**Def. unit**	**FW vers.**
ON | OFF	Enable or disable dynamic correction in the current limit line area and TPCL range	OFF	–	V2.00

Description of command

These command activates and defines dynamic correction of the lower limit line of <AreaNr> (<AreaNr> = 1 to 16) depending on the template PCL range <RangeNr> (<RangeNr> = 1 to 10 for each area). The template PCL is set via `CONFigure:RFANalyzer:TPCL`.

By default, the dynamic limit line correction is disabled in all ranges and areas.

CONFigure:POWer[:NORMal][:GMSK]:LIMit:LINE:LOWer<AreaNr>:ALL:DYNamic:ENABle
CONFigure:POWer[:NORMal]:EPSK:LIMit:LINE:LOWer<AreaNr>:ALL:DYNamic:ENABle
<Enable>

Dynamic Correction on/off

<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | OFF	Switch dynamic correction on or off	OFF	–	V2.00

Description of command

This command switches the dynamic correction of the lower limit area <AreaNr> for all ten template PCL ranges on or off. The query returns 160 Boolean values corresponding to the limit check in PCL ranges 1 to 10 (inner loop) in each of the areas 1 to 16 (outer loop).

CONFigure:POWer[:NORMal][:GMSK]:LIMit:LINE:LOWer:ALL:DYNamic:ENABle *<Enable>*
CONFigure:POWer[:NORMal]:EPSK:LIMit:LINE:LOWer:ALL:DYNamic:ENABle *<Enable>*

Dynamic Correction on/off

<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | OFF	Switch dynamic correction for the whole template on or off	OFF	–	V2.00

Description of command

This command switches the dynamic correction of the lower limit line in all areas and for all template PCL ranges on or off.

CONFigure:POWer[:NORMal][:GMSK]:LIMit:LINE:DEFault *<Enable>* Default Settings
CONFigure:POWer[:NORMal]:EPSK:LIMit:LINE:DEFault *<Enable>*

<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	All parameters are set to their default values Some or all parameters differ from the default values	ON	–	V1.15

Description of command

If used as a setting command with the parameter *ON* this command sets all parameters of the subsystem to their default values (the setting *OFF* causes an error message). If used as a query the command returns whether all parameters are set to their default values *(ON)* or not *(OFF)*.

Subsystem POWer:LIMIt:ABPower

The subsystem *POWer:LIMit:ABPower* defines the limit values for the average burst power. The subsystem corresponds to the tab *Limits* in the popup menu *Power Configuration.*

CONFigure:POWer[:NORMal][:GMSK]:LIMit:ABPower<nr> ***<StartPCL>, <StopPCL>, <LowerLimit>, <UpperLimit>*** — Average Burst Power

CONFigure:POWer[:NORMal][:GMSK]:LIMit:ABPower<nr>:ENABle *<Enable>*

Parameter	Value range	Description of parameters	Def. value
<Enable>	**ON | OFF**	Definition section on/off	see below
<StartPCL>,	**0 to 31**	Start value for PCL	see below
<StopPCL>,	**0 to 31**	End value for PCL	
<LowerLimit>,	**–10.0 dB to 0.0 dB**	Lower level limit	
<UpperLimit>	**0.0 dB to +10.0 dB**	Upper level limit	

Description of command	FW vers.
These commands determine the tolerances for ranges of template power control levels (TPCLs). <nr> is the number of the group ($< nr > \in \{1,...,10\}$). The setting *MAX* is synonymous with the highest TPCL.	V1.15

4 level ranges are defined in the default setting, another 6 ranges can be activated if required. The default settings for GSM 900/1800/1900 are according to the following table. The default settings for GSM850, GSM GT800, and GSM400 are identical to GSM900:

	For Enable	for table			
Suffix	Enable	StartPCL	StopPCL	LowerLimit	UpperLimit
1	ON	MAX	MAX	–2.0 dB	+2.0 dB
2	ON	0	2/8/8	–2.0/–3/–3 dB	+2.0/3.0/3.0 dB
3	ON	3/9/9	15/13/13	–3.0/–4/–4 dB	+3.0/4.0/4.0 dB
4	ON	16/14/14	31/28/29	–5.0 dB	+5.0 dB
5	OFF/ON/ON	OFF/29/30	OFF/29/31	OFF/–2.0/–2.0 dB	OFF/5.0/2.0 dB
6	OFF/ON/OFF	OFF/30/OFF	OFF/31/OFF	OFF/–3.0 dB/OFF	OFF/2.0 dB/OFF
10	OFF	OFF	OFF	OFF	OFF

Subsystem SUBarrays:POWer

The subsystem *SUBarrays:POWer* defines the measurement range and the type of output values.

CONFigure:SUBarrays:POWer[:NORMal][:GMSK] Definition of Subarrays
CONFigure:SUBarrays:POWer[:NORMal]:EPSK
<Mode>,<Start>,<Samples>{,<Start>,<Samples>}

<Mode>	Description of parameters	Def. value	Def. unit	
ALL | **ARIThmetical |** **MINimum |** **MAXimum |** **IVAL,**	Return all measurement values Return arithm. mean value in every range Return minimum value in every range Return maximum value in every range Return single interpolated value at <Start>	ALL	–	
<Start>	Description of parameters	Def. value	Def. unit	
–10 bit to 156 ¾ bit,	Start time in current range (in bit for GMSK, symbols for 8PSK modulation)	–10	bit	
<Samples>	Description of parameters	Def. value	Def. unit	FW vers.
1 to 668	Number of samples in current range	668	–	V2.00

Description of command

This command configures the `READ:SUBarrays:POWer...`, `FETCh:SUBarrays:POWer...`, and `SAMPle:SUBarrays:POWer` commands. It restricts the measurement to up to 32 subranges where either all measurement results (the number of which is given by the second numerical parameter) or a single statistical value is returned. The subranges are defined by the start time and the number of test points which are located on a fixed, equidistant grid with a step width of ¼ bit. If <Start> does not coincide with a test point then the range will start at the next test point that is larger than <Start>.

For <Mode> = IVAL, the <Samples> parameter is ignored and the CMU returns a single measurement value corresponding to the abscissa value <Start>. If <Start> is located between two test points with valid results then the result is calculated from the results at these two adjacent test points by linear interpolation.

The subranges may overlap but must be within the total range of the *POWer* measurement. Test points outside this range are not measured (result *NAN)* and do not enter into the ARIThmetical, MINimum and MAXimum values.

By default, only one range corresponding to the total measurement range is used and all measurement values are returned.

Measured Values – Subsystem POWer

The subsystem *POWer* determines and returns the results of the signal power measurement. They correspond to the graphical measurement menu *Power* with its various display elements.

READ[:SCALar]:POWer[:NORMal][:GMSK]? **READ[:SCALar]:POWer[:NORMal]:EPSK?**	Scalar results: Start single shot measurement and return results
FETCh[:SCALar]:POWer[:NORMal][:GMSK]? **FETCh[:SCALar]:POWer[:NORMal]:EPSK?**	Read out measurement results (unsynchronized)
SAMPle[:SCALar]:POWer[:NORMal][:GMSK]? **SAMPle[:SCALar]:POWer[:NORMal]:EPSK?**	Read out measurement results (synchronized)

Returned values	Value range	Def. value	Def. unit	FW vers.
AvgBurstPwCurr,	–137 dBm to +53 dBm	NAN	dBm	V1.15
PeakBurstPwCurr,	–137 dBm to +53 dBm	NAN	dBm	
BurstsOutOfTol,	0.0 % to 100.0 %	NAN	%	
BurstMatching	INV | MATC | NMAT | OUT | NTR | NRAM | OFLW | UFLW | NTSC | OFF	INV	–	
AvgBurstPwAvg	–137 dBm to +53 dBm	NAN	dBm	

Description of command

These commands are always queries. They start a measurement and return all scalar measurement results (see chapter 5). These are:

Average power of current burst
Peak power of current burst
Burst out of tolerance
Average power of averaged trace

The calculation of results in an *average* or *peak* measurement is described in chapter 3 (cf. *display modes*).The following messages may be returned for the value *BurstMatching*:

INV	*invalid*
MATC	*matching*
NMAT	*not matching*
OUT	*out of range*
NTR	*no trigger*
NRAM	*not ramping (burst not found)*
OFLW	*overflow*
UFLW	*underflow*
NTSC	*no training sequence code*
OFF	*off*

CALCulate[:SCALar]:POWer[:NORMal][:GMSK]:LIMit:MATChing?
CALCulate[:SCALar]:POWer[:NORMal]:EPSK:LIMit:MATChing? Limit Matching

Returned values	Value range	Def. value	Def. unit	FW vers.
AvgBurstPwCurr,	NMAU | NMAL | INV | OK	INV	–	V1.15
PeakBurstPwCurr,	NMAU | NMAL | INV | OK	INV	–	
BurstMatching,	MATC | NMAT | INV | NTSC | OUT	INV	–	
AvgBurstPwAvg	NMAU | NMAL | INV | OK	INV	–	

Description of command

This command is always a query. It indicates whether and in which way the permissible tolerances for the scalar measured values (see command above) have been exceeded.

The following messages may be returned for the values A*vgBurstPower and PeakBurstPower*:

NMAU	Tolerance value underflow	*not matching, underflow*
NMAL	Tolerance value exceeded	*not matching, overflow*
INV	Measurement invalid	*invalid*
OK	Tolerance value matched	

The following messages may be returned for the value *BurstMatching*:

MATC	*matching*
NMAT	*not matching*
INV	*invalid*
NTSC	*no training sequence code*
OUT	*out of range*

READ:ARRay:POWer[:NORMal][:GMSK][:CURRent]? Burst Power
READ:ARRay:POWer[:NORMal]:EPSK[:CURRent]?
READ:ARRay:POWer[:NORMal][:GMSK]:AVERage?
READ:ARRay:POWer[:NORMal]:EPSK:AVERage?
READ:ARRay:POWer[:NORMal][:GMSK]:MAXimum?
READ:ARRay:POWer[:NORMal]:EPSK:MAXimum?
READ:ARRay:POWer[:NORMal][:GMSK]:MINimum?
READ:ARRay:POWer[:NORMal]:EPSK:MINimum?
Start single shot measurement and return results ⇒ RUN
FETCh:ARRay:POWer[:NORMal][:GMSK][:CURRent]?
FETCh:ARRay:POWer[:NORMal]:EPSK[:CURRent]?
FETCh:ARRay:POWer[:NORMal][:GMSK]:AVERage?
FETCh:ARRay:POWer[:NORMal]:EPSK:AVERage?
FETCh:ARRay:POWer[:NORMal][:GMSK]:MAXimum?
FETCh:ARRay:POWer[:NORMal]:EPSK:MAXimum?
FETCh:ARRay:POWer[:NORMal][:GMSK]:MINimum?
FETCh:ARRay:POWer[:NORMal]:EPSK:MINimum?
Read meas. results (unsynchronized) ⇒ RUN
SAMPle:ARRay:POWer[:NORMal][:GMSK][:CURRent]?
SAMPle:ARRay:POWer[:NORMal]:EPSK[:CURRent]? **SAM-**
Ple:ARRay:POWer[:NORMal][:GMSK]:AVERage?
SAMPle:ARRay:POWer[:NORMal]:EPSK:AVERage?
SAMPle:ARRay:POWer[:NORMal][:GMSK]:MAXimum?
SAMPle:ARRay:POWer[:NORMal]:EPSK:MAXimum?
SAMPle:ARRay:POWer[:NORMal][:GMSK]:MINimum?
SAMPle:ARRay:POWer[:NORMal]:EPSK:MINimum?
Read results (synchronized) ⇒ RUN

Returned values	Description of parameters	Def. value	Def. unit	FW vers.
–100.0 dB... + 20.0 dB,	BurstPower[1], 1st value for burst power	NAN	dB	V1.15
...	...	...	...	
–100.0 dB... + 20.0 dB	BurstPower[x], xth value for burst power	NAN	dB	

Description of command

These commands are always queries. They output the burst power versus time in a fixed ¼ bit pattern. The number of measured values is 668, corresponding to a time range of –10 bit to 156 ¾ bit.

The calculation of results in the modes *current, average, maximum* and *minimum* is explained in chapter 3 (cf. *display modes*).

READ:SUBarrays:POWer[:NORMal][:GMSK][:CURRent]? Subarray Results
READ:SUBarrays:POWer[:NORMal]:EPSK[:CURRent]?
READ:SUBarrays:POWer[:NORMal][:GMSK]:AVERage?
READ:SUBarrays:POWer[:NORMal]:EPSK:AVERage?
READ:SUBarrays:POWer[:NORMal][:GMSK]:MAXimum?
READ:SUBarrays:POWer[:NORMal]:EPSK:MAXimum?
READ:SUBarrays:POWer[:NORMal][:GMSK]:MINimum?
READ:SUBarrays:POWer[:NORMal]:EPSK:MINimum?
Start single shot measurement and return results ⇒ *RUN*
FETCh:SUBarrays:POWer[:NORMal][:GMSK][:CURRent]?
FETCh:SUBarrays:POWer[:NORMal]:EPSK[:CURRent]?
FETCh:SUBarrays:POWer[:NORMal][:GMSK]:AVERage?
FETCh:SUBarrays:POWer[:NORMal]:EPSK:AVERage?
FETCh:SUBarrays:POWer[:NORMal][:GMSK]:MAXimum?
FETCh:SUBarrays:POWer[:NORMal]:EPSK:MAXimum?
FETCh:SUBarrays:POWer[:NORMal][:GMSK]:MINimum?
FETCh:SUBarrays:POWer[:NORMal]:EPSK:MINimum?
Read meas. results (unsynchronized) ⇒ *RUN*
SAMPle:SUBarrays:POWer[:NORMal][:GMSK][:CURRent]?
SAMPle:SUBarrays:POWer[:NORMal]:EPSK[:CURRent]? SAM-Ple:SUBarrays:POWer[:NORMal][:GMSK]:AVERage?
SAMPle:SUBarrays:POWer[:NORMal]:EPSK:AVERage?
SAMPle:SUBarrays:POWer[:NORMal][:GMSK]:MAXimum?
SAMPle:SUBarrays:POWer[:NORMal]:EPSK:MAXimum?
SAMPle:SUBarrays:POWer[:NORMal][:GMSK]:MINimum?
SAMPle:SUBarrays:POWer[:NORMal]:EPSK:MINimum?
Read results (synchronized) ⇒ *RUN*

Ret. values by subrange	Description of parameters	Def. value	Def. unit	FW vers.
–100.0 dB... + 20.0 dB	BurstPower[1], 1st value for burst power	NAN	dB	V2.00
...	...	...	...	
–100.0 dB... + 20.0 dB	BurstPower[x], xth value for burst power	NAN	dB	

Description of command

These commands are always queries. They output the burst power versus time in a fixed ¼-bit pattern and in the subranges defined by means of the `CONFigure:SUBarrays:POWer` command. In the default setting of the configuration command the `READ:SUBarrays..., FETCh:SUBarrays..., and SAMPle:SUBarrays...` command group is equivalent to the `READ:ARRay..., FETCh:ARRay..., and SAMPle:ARRay...` command group described above.

The `CONFigure:SUBarrays:POWer` command defines a maximum of 32 subranges. If one of the statistical modes `(ARIThmetical, MINimum, MAXimum)` is set, only one value is returned by subrange.

The calculation of *current, average, minimum,* and *maximum* results is explained in chapter 3 (cf. *display mode*).

CALCulate:ARRay:POWer[:NORMal][:GMSK]:LIMit:MATChing[:CURRent]?
CALCulate:ARRay:POWer[:NORMal]:EPSK:LIMit:MATChing[:CURRent]?
CALCulate:ARRay:POWer[:NORMal][:GMSK]:LIMit:MATChing:AVERage?
CALCulate:ARRay:POWer[:NORMal]:EPSK:LIMit:MATChing:AVERage?
CALCulate:ARRay:POWer[:NORMal][:GMSK]:LIMit:MATChing:MAXimum?
CALCulate:ARRay:POWer[:NORMal]:EPSK:LIMit:MATChing:MAXimum?
CALCulate:ARRay:POWer[:NORMal][:GMSK]:LIMit:MATChing:MINimum?
CALCulate:ARRay:POWer[:NORMal]:EPSK:LIMit:MATChing:MINimum?

Burst Matching

Returned values	Value range	Def. value	Def. unit	FW vers.
<Matching>	MATC | NMAT | INV | NTSC | OUT	INV	–	V1.15

Description of command

This command is always a query. It indicates whether and in which way the tolerances for the burst power (see preceding command) have been exceeded.

The following messages may be returned for the measured value *Matching*:

MATC	*matching*
NMAT	*not matching*
INV	*invalid*
NTSC	*no training sequence code*
OUT	*out of tolerance*

CALCulate:ARRay:POWer[:NORMal][:GMSK]:AREA:LIMit:MATChing[:CURRent]?
CALCulate:ARRay:POWer[:NORMal]:EPSK:AREA:LIMit:MATChing[:CURRent]?
CALCulate:ARRay:POWer[:NORMal][:GMSK]:AREA:LIMit:MATChing:AVERage?
CALCulate:ARRay:POWer[:NORMal]:EPSK:AREA:LIMit:MATChing:AVERage?
CALCulate:ARRay:POWer[:NORMal][:GMSK]:AREA:LIMit:MATChing:MAXimum?
CALCulate:ARRay:POWer[:NORMal]:EPSK:AREA:LIMit:MATChing:MAXimum?
CALCulate:ARRay:POWer[:NORMal][:GMSK]:AREA:LIMit:MATChing:MINimum?
CALCulate:ARRay:POWer[:NORMal]:EPSK:AREA:LIMit:MATChing:MINimum?
Range Violation

Returned value	Description of parameters	Def. value	Def. unit	FW vers.
32 bit value,	Indicator for upper limit matching in area 1 to 16 (16 least significant bits),	NAN	–	V1.20
32 bit value	Indicator for lower limit matching in area 1 to 16 (16 least significant bits)	NAN	–	

Description of command

This command is always a query. If a bit is set in the two returned values the corresponding section of the limit lines is exceeded.

POWer:MPR

The subsystem *POWer:MPR* combines the *POWer* and *MODulation* systems, i.e. it measures the signal power vs. time and the scalar modulation parameters simultaneously. The subsystem contains all commands for measurement control and for the output of measurement results; configurations such as limit lines must be defined separately in the *POWer* and *MODulation* systems.

The *POWER:MPR* has no equivalent in manual control where the power and modulation measurement results are displayed separately.

Control of measurement – Subsystem POWer:MPR

The subsystem *POWer:MPR* controls the combined power and modulation measurement.

INITiate:POWer[:NORMal][:GMSK]:MPR	Start new measurement	⇒ *RUN*
ABORt:POWer[:NORMal][:GMSK]:MPR	Abort running measurement and switch off	⇒ *OFF*
STOP:POWer[:NORMal][:GMSK]:MPR	Stop measurement after current stat. cycle	⇒ *STOP*
CONTinue:POWer[:NORMal][:GMSK]:MPR	Next meas. step (only *stepping mode*)	⇒ *RUN*
Description of command		FW vers.
These commands have no query form. They start and stop the combined power and modulation measurement, setting it to the status indicated in the top right column.		V2.00

CONFigure:POWer[:NORMal][:GMSK]:MPR:EREPorting <*Mode*>				Event Reporting
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
SRQ | **SOPC |** **SRSQ |** **OFF**	Service request Single operation complete SRQ and SOPC No reporting	OFF	–	V2.00
Description of command				
This command defines the events generated when the measurement is terminated or stopped *(event reporting,* see chapter 5 of CMU200 manual).				

FETCh:POWer[:NORMal][:GMSK]:MPR:STATus?				Measurement Status
Return	Description of parameters	Def. value	Def. unit	FW vers.
OFF | **RUN |** **STOP |** **ERR |** **STEP |** **RDY,**	Measurement in the *OFF* state (`*RST` or `ABORt`) Running (after `INITiate, CONTinue` or `READ`) Stopped (`STOP`) *OFF* (could not be started) Stepping mode *(<stepmode>=STEP)* Stopped according to repetition mode and stop condition	OFF	–	V2.00
1 to 10000 | **NONE,**	Counter for current statistics cycle No counting mode set	NONE	–	
1 to 1000 | **NONE**	Counter for current evaluation period within a cycle Statistic count set to off	NONE	–	
Description of command				
This command is always a query. It returns the status of the measurement (see chapters 3 and 5).				

Subsystem POWer:MPR:CONTrol

The subsystem *POWer:MPR:CONTrol* defines the repetition mode, statistic count, and stop condition of the measurement.

CONFigure:POWer[:NORMal][:GMSK]:MPR:CONTrol *<Mode>, <Statistics>*				Scope of Measurement
<Mode>	Desciption of parameters	Def. value	Def. unit	
SCALar | **ARRay**	Scalar values only (incl. ramp matching) Scalar measured values and arrays	ARRay	–	
<Statistics>	Description of parameters	Def. value	Def. unit	FW vers.
1 to 1000 | **NONE**	Number of bursts per statistics cycle Statistics off (equivalent to 1)	100	–	V2.00
Description of command				
This command specifies the type of measured values and defines the number of bursts forming a statistics cycle.				

CONFigure:POWer[:NORMal][:GMSK]:MPR:CONTrol:REPetition *<Repetition>,<StopCond>,<Stepmode>*				Test Cycles
<Repetition>	Description of parameters	Def. value	Def. unit	
CONTinuous | **SINGleshot |** **1 to 10000**	Continuous measurement (until `STOP` or `ABORT`) Single shot measurement (until `Status = RDY`) Multiple measurement (*counting*, until `Status = STEP | RDY`)	SING	–	
<StopCond>	Description of parameters	Def. value	Def. unit	
SONerror | **NONE**	Stop measurement in case of error *(stop on error)* Continue measurement even in case of error	NONE	–	
<Stepmode>	Description of parameters	Def. value	Def. unit	FW vers.
STEP | **NONE**	Interrupt measurement after each statistics cycle Continue measurement according to its rep. mode	NONE	–	V2.00
Description of command				
This command determines the number of statistics cycles, the stop condition and the stepping mode for the measurement. **Note:** *In the case of READ commands (`READ:...`), the <Repetition> parameter has no effect; the measurement is always stopped after a single shot.*				

Test Configuration

The commands of the following subsystems configure the combined power and modulation measurement. Note that configurations such as limit lines must be defined separately in the *POWer* and *MODulation* systems.

Subsystem SUBarrays:POWer:MPR

The subsystem *SUBarrays:POWer:MPR* defines the measurement range and the type of output values.

CONFigure:SUBarrays:POWer[:NORMal][:GMSK]:MPR <Mode>,<Start>,<Samples>{,<Start>,<Samples>}
Definition of Subarrays

<Mode>	Description of parameters	Def. value	Def. unit	
ALL | **ARIThmetical |** **MINimum |** **MAXimum |** **IVAL,**	Return all measurement values Return arithm. mean value in every range Return minimum value in every range Return maximum value in every range Return single interpolated value at <Start>	ALL	–	
<Start>	Description of parameters	Def. value	Def. unit	
–10 bit to 156 ¾ bit,	Start time in current range	–10	bit	
<Samples>	Description of parameters	Def. value	Def. unit	FW vers.
1 to 668	Number of samples in current range	668	–	V2.00

Description of command

This command configures the `READ:SUBarrays...`, `FETCh:SUBarrays...,`, and `SAMPle:SUBarrays:POWer:MPR` commands. It restricts the measurement to up to 32 subranges where either all measurement results (the number of which is given by the second numerical parameter) or a single statistical value is returned. The subranges are defined by the start time and the number of test points which are located on a fixed, equidistant grid with a step width of ¼ bit. If <Start> does not coincide with a test point then the range will start at the next test point that is larger than <Start>.

For <Mode> = IVAL, the <Samples> parameter is ignored and the CMU returns a single measurement value corresponding to the abscissa value <Start>. If <Start> is located beween two test points with valid results then the result is calculated from the results at these two adjacent test points by linear interpolation.

The subranges may overlap but must be within the total range of the *Power* measurement. Test points outside this range are not measured (result *NAN)* and do not enter into the ARIThmetical, MINimum and MAXimum values.

By default, only one range corresponding to the total measurement range is used and all measurement values are returned.

Measured Values – Subsystem POWer:MPR

The subsystem *POWer:MPR* determines and returns the results of the combined power and modulation measurement.

READ[:SCALar]:POWer[:NORMal][:GMSK]:MPR? Scalar Results:
Start single shot measurement and return results
FETCh[:SCALar]:POWer[:NORMal][:GMSK]:MPR?
Read out measurement results (unsynchronized)
SAMPle[:SCALar]:POWer[:NORMal][:GMSK]:MPR?
Read out measurement results (synchronized)

Returned values	Value range	Def. value	Def. unit	FW vers.
AvgBurstPwCurr,	–137 dBm to +53 dBm	NAN	dBm	V2.00
PeakBurstPwCurr,	–137 dBm to +53 dBm	NAN	dBm	
BurstsOutOfTol,	0.0 % to 100.0 %	NAN	%	
BurstMatching,	INV | MATC | NMAT | OUT | NTR | NRAM | OFLW | UFLW | NTSC | OFF	INV	–	
PhErrPeakCurrent,	–100.0 ° to +100.0 °	NAN	deg	
PhErrPeakAverage,	–100.0 ° to +100.0 °	NAN	deg	
PhErrPeakMaxMin,	–100.0 ° to +100.0 °	NAN	deg	
PhErrRMSCurrent,	–100.0 ° to +100.0 °	NAN	deg	
PhErrRMSAverage,	–100.0 ° to +100.0 °	NAN	deg	
PhErrRMSMaxMin,	–100.0 ° to +100.0 °	NAN	deg	
FreqErrCurrent,	–1000.0 Hz to + 1000.0 Hz	NAN	Hz	
FreqErrAverage,	–1000.0 Hz to + 1000.0 Hz	NAN	Hz	
FreqErrMaxMin,	–1000.0 Hz to + 1000.0 Hz	NAN	Hz	
AvgBurstPwAvg	–137 dBm to +53 dBm	NAN	dBm	

Description of command

These commands are always queries. They start a combined power vs. time and modulation measurement and return all scalar measurement results. For detailed information refer to the description of the analogous commands in the POWer and MODulation systems.

READ:ARRay:POWer[:NORMal][:GMSK]:MPR[:CURRent]? Traces
READ:ARRay:POWer[:NORMal][:GMSK]:MPR:AVERage?
READ:ARRay:POWer[:NORMal][:GMSK]:MPR:MAXimum?
READ:ARRay:POWer[:NORMal][:GMSK]:MPR:MINimum?
Start single shot measurement and return results ⇒ *RUN*
FETCh:ARRay:POWer[:NORMal][:GMSK]:MPR[:CURRent]?
FETCh:ARRay:POWer[:NORMal][:GMSK]:MPR:AVERage?
FETCh:ARRay:POWer[:NORMal][:GMSK]:MPR:MAXimum?
FETCh:ARRay:POWer[:NORMal][:GMSK]:MPR:MINimum?
Read meas. results (unsynchronized) ⇒ *RUN*
SAMPle:ARRay:POWer[:NORMal][:GMSK]:MPR[:CURRent]? SAMPle:ARRay:POWer[:NORMal][:GMSK]:MPR:AVERage?
SAMPle:ARRay:POWer[:NORMal][:GMSK]:MPR:MAXimum?
SAMPle:ARRay:POWer[:NORMal][:GMSK]:MPR:MINimum?
Read results (synchronized) ⇒ *RUN*

Returned values	Description of parameters	Def. value	Def. unit	FW vers.
–100.0 dB... + 20.0 dB	BurstPower[1], 1st value for burst power	NAN	dB	V2.00
...	...	...	...	
–100.0 dB... + 20.0 dB	BurstPower[x], xth value for burst power	NAN	dB	

Description of comm

These commands are always queries. They return the burst power versus time in a fixed ¼- bit pattern. The number of measured values is 668, corresponding to a time range of –10 bit to 156 ¾ bit.

The calculation of *current, average, minimum* and *maximum* results is explained in chapter 3 (cf. *display mode*).

READ:SUBarrays:POWer[:NORMal][:GMSK]:MPR[:CURRent]? Subarray Results
READ:SUBarrays:POWer[:NORMal][:GMSK]:MPR:AVERage?
READ:SUBarrays:POWer[:NORMal][:GMSK]:MPR:MAXimum?
READ:SUBarrays:POWer[:NORMal][:GMSK]:MPR:MINimum?
Start measurement and wait for end ⇒ *RUN*
FETCh:SUBarrays:POWer[:NORMal][:GMSK]:MPR[:CURRent]?
FETCh:SUBarrays:POWer[:NORMal][:GMSK]:MPR:AVERage?
FETCh:SUBarrays:POWer[:NORMal][:GMSK]:MPR:MAXimum?
FETCh:SUBarrays:POWer[:NORMal][:GMSK]:MPR:MINimum?
Read meas. results (unsynchronized) ⇒ *RUN*
SAMPle:SUBarrays:POWer[:NORMal][:GMSK]:MPR[:CURRent]? SAMPle:SUBarrays:POWer[:NORMal][:GMSK]:MPR:AVERage?
SAMPle:SUBarrays:POWer[:NORMal][:GMSK]:MPR:MAXimum?
SAMPle:SUBarrays:POWer[:NORMal][:GMSK]:MPR:MINimum?
Read results (synchronized) ⇒ *RUN*

Ret. values by subrange	Description of parameters	Def. value	Def. unit	FW vers.
–100.0 dB... + 20.0 dB	BurstPower[1], 1st value for burst power	NAN	dB	V2.00
...	...	...	...	
–100.0 dB... + 20.0 dB	BurstPower[x], xth value for burst power	NAN	dB	

Description of command

These commands are always queries. They return the burst power versus time in a fixed ¼- bit pattern and in the subranges defined by means of the `CONFigure:SUBarrays:POWer[:NORMal][:GMSK]:MPR` command. In the default setting of the configuration command the `READ:SUBarrays...`, `FETCh:SUBarrays...`, and `SAMPle:SUBarrays...` command group is equivalent to the `READ:ARRay...`, `FETCh:ARRay...`, and `SAMPle:ARRay...` command group described above.

The `CONFigure:SUBarrays:POWer[:NORMal][:GMSK]:MPR` command defines a maximum of 32 subranges. If one of the statistical modes (`ARIThmetical`, `MINimum`, `MAXimum`) is set, only one value is returned by subrange.

The calculation of *current, average, minimum,* and *maximum* results is explained in chapter 3 (cf. *display mode*).

CALCulate[:SCALar]POWer[:NORMal][:GMSK]:MPR:LIMit:MATChing? Tolerance Error

Returned values	Value range	Def. value	Def. unit	FW vers.
AvgBurstPwCurr,	NMAU | NMAL | INV | OK	INV	–	V2.00
PeakBurstPwCurr,	NMAU | NMAL | INV | OK	INV	–	
BurstMatching,	INV | MATC | NMAT | OUT | NTR | NRAM | OFLW | UFLW | NTSC | OFF	INV	–	
PhErrPeakCurrent,		INV	–	
PhErrPeakAverage,		INV	–	
PhErrPeakMaxMin,		INV	–	
PhErrRMSCurrent,	For all measured values:	INV	–	
PhErrRMSAverage,		INV	–	
PhErrRMSMaxMin,		INV	–	
	NMAU | NMAL | INV | OK			
FreqErrCurrent,		INV	–	
FreqErrAverage,		INV	–	
FreqErrMaxMin,		INV	–	
AvgBurstPwAvg		INV	–	

Description of command

This command is always a query. It indicates whether and in which way the tolerances for the scalar results (see command above) in the *Power* and the *modulation* measurement have been exceeded.

The following messages may be returned for the values A*vgBurstPower* and *PeakBurstPower* and for all results of the modulation measurement:

NMAU	Tolerance value underflow	*not matching, underflow*
NMAL	Tolerance value exceeded	*not matching, overflow*
INV	Measurement invalid	*invalid*
OK	Tolerance value matched	

The following messages may be returned for the value *BurstMatching*:

INV	*invalid*
MATC	*matching*
NMAT	*not matching*
OUT	*out of range*
NTR	*no trigger*
NRAM	*not ramping (burst not found)*
OFLW	*overflow*
UFLW	*underflow*
NTSC	*no training sequence code*
OFF	*off*

Common Measurements and Command Groups

The commands for the measurement groups in this section are identical or almost identical in both test modes. Minor differences between *Non Signalling* and *Signalling* commands are possible; they will be pointed out throughout the section.

Note1: ***Measurements and signalling states***

To perform any kind of measurement and obtain a meaningful result, an appropriate test setup is required (see application examples in chapter 2 of this manual). Consequently, if the measurements reported in this section are performed in Signalling mode, the Call Established (CEST) signalling state must be reached before any of the commands retrieving test results (`READ...?`, `FETCh...?`, `SAMPle...?`, or `CALCulate...LIMit?`) can be used. Test configurations, however, can be defined any time.

Exception: *The wideband power (`WPOWer`) does not involve any signalling. It can be measured irrespective of the current signalling state.*

Note2: ***GMSK and 8PSK modulation***

The keywords `[:GMSK]` and `:EPSK` in the remote control commands denote GMSK and 8PSK modulation, respectively. The `:EPSK` commands in Signalling measurements are included in firmware versions V3.05 and higher. The firmware version numbers quoted in the command tables refer either to GMSK modulation or EPSK modulation in Non Signalling mode.

Option Query

The *Options* subsystem contains the commands for querying information on the instrument and the available options. It corresponds to the *Options* tab in the *Setup* menu opened via the *SETUP* key on the front panel.

SYSTem:OPTions:INFO:CURRent?			Device Info
Response	Def. value	Default unit	FW vers.
Example: Rohde&Schwarz,CMU 200-1100.0008.02,840675/018, V3.10C:SP02 2002-09-05"GSM900MS_Sig"	–	–	V3.10
Command description			
This command returns the information on the device comprising the manufacturer, model, serial number and firmware version of the current function group. This command is always a query.			

Partial Reset

The *RESet* subsystem restores the (factory) default values for the current function group and test mode. It is similar to the *Reset* menu opened via the *RESET* key on the front panel.

SYSTem:RESet:CURRent	Partial Reset
Command description	FW vers.
This command sets all parameters of the current function group and test mode to default values. The command is available in all function groups. In contrast to the *Reset* menu the command restores the default values defined for remote control operation. In cases where remote and manual control use distinct settings (e.g. the repetition mode for many measurements), the manual control settings are left unchanged.	V3.10

I/Q-IF Interface

The subsystem *IQIF* configures the signal paths for I/Q and IF signals provided by option CMU-B17, *I/Q and IF Interfaces*. It corresponds to the *I/Q-IF* tab of the *Connection Control* menu.

Hint: ***How to make sense out of parameter names***

In all path configurations except bypass, both the I/Q and IF output are connected (to either the RF Unit, the Digital Unit or one of the I/Q-IF inputs). The paths differ in the connection of the input branches: The qualifier IO denotes a connected input (with connected output), XO denotes a disconnected input (with connected output). Many parameters of the IQIF commands are composed of two IO/XO qualifiers, the first one standing for the IF signal, the second for the I/Q signal.

Example: *The parameter IOXO denotes a connected IF input and a disconnected IF output, while both output branches are connected.*

For more information see Chapter 4 and the application examples in the CMU200/300 operating manual.

CONFigure:IQIF:RXTXcombined <*Scenario*>				I/Q-IF
<*Scenario*>	Description of parameters	Def. value	Def. unit	FW vers.
BYP **BYIQ** **XOIO** **IOIO** **IOXO** **FPAT** **UDEF**	RX/TX Bypass, `RXPath = BYP, TXPath = BYP` Bypass w. I/Q-OF OUT, `RXPath = TXPath =BYIQ` I/Q IN/OUT, `RXPath = TXPath = XOIO` IF IN_I/Q IN/OUT, `RXPath = TXPath = IOIO` IF IN/OUT, `RXPath = TXPath = IOXO` Fading Path, `RXPath = BYP, TXPath = XOIO` User-defined scenario, can not be set but may be returned by the query `CONF:IQIF:RXTX?`	BYP	–	V3.10
Description of command				
This command selects the I/Q-IF test scenario, overwriting the current RX and TX path settings (see commands `CONFigure:IQIF:RXPath` and `CONFigure:IQIF:TXPath` below). Six different predefined test scenarios with fixed RX and TX path are provided. Additional scenarios may be defined by selecting any other combination of RX and RX paths. ***Note:*** *`UDEF` is not provided as a setting parameter. If the RX/TX path combination defined via `CONFigure:IQIF:RXPath` and `CONFigure:IQIF:TXPath` doesn't correspond to any of the predefined scenarios, then a user-defined scenario is set implicitly, i.e. the query `CONF:IQIF:RXTX?` returns the value `UDEF`.*				

CONFigure:IQIF:RXPath *<Path>*				RX Path
<Path>	Description of parameters	Def. value	Def. unit	FW vers.
BYP **BYIQ** **XOIO** **IOIO** **IOXO**	Bypass Bypass w. I/Q-IF OUT I/Q IN/OUT IF IN_I/Q IN/OUT IF IN/OUT	BYP	–	V3.10
Description of command				
This command selects the RX signal path, leaving the TX path (see command `CONFigure:IQIF:TXPath` below) unchanged but adapting the I/Q-IF test scenario to the new RX/TX path combination: If the combination corresponds to a predefined scenario, then `CONFigure:IQIF:RXTXcombined` is set to the predefined scenario; otherwise it is set to `UDEF`.				

CONFigure:IQIF:TXPath *<Path>*				TX Path
<Path>	Description of parameters	Def. value	Def. unit	FW vers.
BYP **BYIQ** **XOIO** **IOIO** **IOXO**	Bypass Bypass w. I/Q-IF OUT I/Q IN/OUT IF IN_I/Q IN/OUT IF IN/OUT	BYP	–	V3.10
Description of command				
This command selects the TX signal path, leaving the RX path (see command `CONFigure:IQIF:RXPath` above) unchanged but adapting the I/Q-IF test scenario to the new RX/TX path combination: If the combination corresponds to a predefined scenario, then `CONFigure:IQIF:RXTXcombined` is set to the predefined scenario; otherwise it is set to `UDEF`.				

IQIF:DEFault <Enable>				Default Settings
<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	The parameters are set to their default values Some or all parameters differ from the default values	ON	–	V3.10
Description of command				
If used as a setting command with the parameter *ON* this command sets all parameters of the subsystem to their default values (the setting *OFF* causes an error message). If used as a query the command returns whether all parameters are set to their default values *(ON)* or not *(OFF)*.				

Symbolic Status Event Register Evaluation

The following commands are used to retrieve the events reported in function groups *GSM400/GT800/850/900/1800/1900-MS Non Signalling* and *Signalling*; see section *Symbolic Status Event Register Evaluation* in Chapter 5 of the CMU operating manual.

STATus:OPERation:SYMBolic:ENABle <Event>{,<Event>}				Symbolic status evaluation
Parameter list	Parameter description	Def. Value[1]	Default Unit	FW vers.
<Event>{,<Event>} | NONE	List of symbols for events to be reported No event reported	NONE	–	V3.05
Command description				
This command enables event reporting for one or several events in the current *GSMxxx-MS Non Signalling* function group, i.e. it sets the corresponding bits in the `STATus:OPERation:CMU:SUM<nr>:CMU<nr_event>:ENABle` register (`<nr> = 1 | 2, <nr_event>` denotes the current function group) and in all sum registers up to the status byte. The events and the corresponding symbols for the function group are listed in Chapter 5 (see section *Status Registers).* The symbols may be entered in arbitrary order.				

STATus:OPERation:SYMBolic[:EVENt]?				Symbolic status evaluation
Response	Parameter description	Def. Value[2]	Default Unit	FW vers.
NONE | <Event>{,<Event>}	No event in the *RF* function group List of reported events	NONE	–	V3.05
Command description				
This command is always a query. It lists the events reported in the current *GSMxxx-MS Non Signalling* function group and deletes these events in the `STATus:OPERation:CMU:SUM<nr>:CMU<nr_event>:EVENt` register as well as in all sum registers.				

[1] The default values quoted in this command are achieved after a `STATus:PRESet` command. `*RST` does not overwrite the entries in the status registers; see section *Reset Values of the Status Reporting Systems* in chapter 5.

[2] The default values quoted in this command are achieved after a `*CLS` command. `*RST` does not overwrite the entries in the status registers; see section *Reset Values of the Status Reporting Systems* in chapter 5.

WPOWer

The subsystem *WPOWer* measures the power of the signal transmitted by the mobile phone using a wideband filter. It corresponds to the softkey *Wideband Power* in the *Connect. Control* menu.

INITiate:WPOWer	Start new measure ment	⇒ *RUN*
ABORt:WPOWer	Abort measurement and switch off	⇒ *OFF*
STOP:WPOWer	Stop measurement	⇒ *STOP*
CONTinue:WPOWer	Next measurement step (only *counting mode*)	⇒ *RUN*
Description of command		FW vers.
These commands have no query form. They start or stop the measurement, setting it to the status given in the top right column.		1.15[3]

CONFigure:WPOWer:EREPorting <*Mode*>				Event Reporting
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
SRQ | **SOPC |** **SRSQ |** **OFF**	Service request Single operation complete SRQ and SOPC No reporting	OFF	–	1.17
Description of command				
This command defines the events generated when the measurement is terminated or stopped *(event reporting,* see chapter 5 of CMU200 operating manual).				

FETCh:WPOWer:STATus?				Measurement
Return	Description of parameters	Def. value	Def. unit	FW vers.
OFF | **RUN |** **STOP |** **ERR |** **STEP |** **RDY,** **1 ... 10000 |** **NONE**	Measurement in the *OFF* state (`*RST` or `ABORt`) Running (after `INITiate, CONTinue` or `READ`) Stopped (`STOP`) *OFF* (could not be started) Stepping mode *(<stepmode>=STEP)* Stopped according to repetition mode and stop condition Counter for current statistics cycle No counting mode set	OFF NONE	– –	1.15
Description of command				
This command is always a query. It returns the status of the measurement (see chapters 3 and 5 of CMU operating manual).				

[3] For firmware versions <V2.15, the keyword `WPOWer` is replaced by `SPOWer` in all commands.

CONFigure:WPOWer:CONTrol:REPetition *<Repetition>,<StopCond>,<Stepmode>*				Test cycles
<Repetition>	Description of parameters	Def. value	Def. unit	
CONTinuous | **SINGleshot |** **1 ... 10000**	Continuous measurement (until `STOP` or `ABORT`) Single shot measurement (until `Status = RDY`) Multiple measurement (*counting*, until `Status = STEP | RDY`)	SING	–	
<StopCond>	Description of parameters	Def. value	Def. unit	
SONerror | **NONE**	Start measurement in case of error *(stop on error)* Continue measurement even in case of error	NONE	–	
<Stepmode>	Description of parameters	Def. value	Def. unit	FW vers.
STEP | **NONE**	Interrupt measurement after each statistics cycle Continue measurement according to its rep. mode	NONE	–	1.15

Description of command

This command determines the number of statistics cycles, the stop condition and the stepping mode for the measurement.

Note: *In the case of READ commands (`READ:...`), the <Repetition> parameter has no effect; the measurement is always stopped after a single shot.*

Measured Values – Subsystem WPOWer?

The subsystem *WPOWer?* retrieves the results of the wideband power measurement.

READ[:SCALar]:WPOWer? **FETCh[:SCALar]:WPOWer?** **SAMPle[:SCALar]:WPOWer?**	Start single shot measurement and return results Read out measurement results (unsynchronized) Read out measurement results (synchronized)			
Return	Description of parameters	Def. value	Def. unit	FW vers.
–30.0dBm to +30.0 dBm	Maximum burst power (not averaged)	NAN	dBm	1.15

Description of command

These commands are always queries. They start the measurement of the maximum burst power *(peak burst power)* and return the result.

NPOWer

The subsystem *NPOWer* measures the power of the signal transmitted by the mobile phone using the RF analyzer configuration of the *POWer* measurement. Compared to *WPOWer*, the *NPOWer* measurement uses a narrow-band (500 kHz Gauss) filter.

The narrow-band *NPOWer* measurement yields the average, maximum and minimum burst power of the current burst. In addition to these *Current* values the minimum and maximum power in the entire measurement and the average of the average current values, referenced to a statistics cycle, is calculated. The entire measurement curves (arrays) are not available, and no limit check is performed. *NPOWer* is a quick and precise alternative to the *WPOWer* or *POWer* measurements if only scalar results are needed.

Note: *A Free Run trigger (`TRIGger[:SEQuence]:SOURce FRUN`) should be avoided because it delays the `NPOWer` measurement.*

INITiate:NPOWer	Start new measurement		⇒ *RUN*
ABORt:NPOWer	Abort measurement and switch off		⇒ *OFF*
STOP:NPOWer	Stop measurement		⇒ *STOP*
CONTinue:NPOWer	Next measurement step (only *counting mode*)		⇒ *RUN*
Description of command			FW vers.
These commands have no query form. They start or stop the measurement, setting it to the status given in the top right column.			V3.05

CONFigure:NPOWer:EREPorting <*Mode*>				Event Reporting
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
SRQ | **SOPC |** **SRSQ |** **OFF**	Service request Single operation complete SRQ and SOPC No reporting	OFF	–	V3.05
Description of command				
This command defines the events generated when the measurement is terminated or stopped *(event reporting,* see chapter 5 of CMU200 operating manual).				

FETCh:NPOWer:STATus?				Measurement
Return	Description of parameters	Def. value	Def. unit	FW vers.
OFF | **RUN |** **STOP |** **ERR |** **STEP |** **RDY,**	Measurement in the *OFF* state (`*RST` or `ABORt`) Running (after `INITiate, CONTinue` or `READ`) Stopped (`STOP`) *OFF* (could not be started) Stepping mode *(<stepmode>=STEP)* Stopped according to repetition mode and stop condition	OFF	–	V3.05
 1 to 10000 | **NONE**	Counter for current statistics cycle No counting mode set	 NONE	 –	
 1 to 1000 | **NONE**	Counter for current evaluation period within a cycle Statistic count set to off	 NONE	 –	
Description of command				
This command is always a query. It returns the status of the measurement (see chapters 3 and 5 of CMU manual operating manual).				

Subsystem NPOWer:CONTrol

The subsystem *NPOWer:CONTrol* defines the repetition mode, statistic count, stop condition, and stepping mode of the *NPOWer* measurement.

CONFigure:NPOWer:CONTrol <*Statistics*>, <*Repetition*>,<*StopCond*>,<*Stepmode*>	Scope of Measurement			
<Statistics>	Description of parameters	Def. value	Def. unit	
1 to 1000 | **NONE**	No. of bursts within a statistics cycle Statistics off	100	–	
<Repetition>	Description of parameters	Def. value	Def. unit	
CONTinuous | **SINGleshot |** **1 ... 10000**	Continuous measurement (until `STOP` or `ABORT`) Single shot measurement (until `Status = RDY`) Multiple measurement (*counting*, until `Status = STEP | RDY`)	SING	–	
<StopCond>	Description of parameters	Def. value	Def. unit	
SONerror | **NONE**	Start measurement in case of error *(stop on error)* Continue measurement even in case of error	NONE	–	
<Stepmode>	Description of parameters	Def. value	Def. unit	FW vers.
STEP | **NONE**	Interrupt measurement after each statistics cycle Continue measurement according to its rep. mode	NONE	–	V3.05
Description of command				
This command selects the type of measured values and determines the number of bursts forming one statistics cycle.				

CONFigure:NPOWer:CONTrol:STATistics <*Statistics*>	Scope of Measurement			
<Statistics>	Description of parameters	Def. value	Def. unit	FW vers.
1 to 1000 | **NONE**	No. of bursts within a statistics cycle Statistics off	100	–	V3.05
Description of command				
This command selects the type of measured values and determines the number of bursts forming one statistics cycle.				

CONFigure:NPOWer:CONTrol:REPetition *<Repetition>,<StopCond>,<Stepmode>*				Test cycles
<Repetition>	Description of parameters	Def. value	Def. unit	
CONTinuous | **SINGleshot |** **1 ... 10000**	Continuous measurement (until `STOP` or `ABORT`) Single shot measurement (until `Status = RDY`) Multiple measurement (*counting*, until `Status = STEP | RDY`)	SING	–	
<StopCond>	Description of parameters	Def. value	Def. unit	
SONerror | **NONE**	Start measurement in case of error *(stop on error)* Continue measurement even in case of error	NONE	–	
<Stepmode>	Description of parameters	Def. value	Def. unit	FW vers.
STEP | **NONE**	Interrupt measurement after each statistics cycle Continue measurement according to its rep. mode	NONE	–	V3.05
Description of command				
This command determines the number of statistics cycles, the stop condition and the stepping mode for the measurement. **Note:** *In the case of READ commands (`READ:...`), the <Repetition> parameter has no effect; the measurement is always stopped after a single shot.*				

Measured Values – Subsystem NPOWer?

The subsystem *NPOWer?* retrieves the results of the narrow-band power measurement.

READ[:SCALar]:NPOWer? **FETCh[:SCALar]:NPOWer?** **SAMPle[:SCALar]:NPOWer?**	Start single shot measurement and return results Read out measurement results (unsynchronized) Read out measurement results (synchronized)			
Returned values	Value range	Def. value	Def. unit	FW vers.
Avg. Power of Current evaluation period,	–137 dBm to +53 dBm	NAN	dBm	V3.05
Min. Power of Current evaluation period,	–137 dBm to +53 dBm	NAN	dBm	
Max. Power of Current evaluation period,	–137 dBm to +53 dBm	NAN	dBm	
Avg. Power ref. to the last stat. cycle,	–137 dBm to +53 dBm	NAN	dBm	
Min. Power of the entire measurement,	–137 dBm to +53 dBm	NAN	dBm	
Max. Power of the entire measurement	–137 dBm to +53 dBm	NAN	dBm	
Description of command				
These commands are always queries. They start the *NPOWer* measurement and return the results.				

Common POWer Commands

The following commands are valid for all *Power vs. Time* applications. The settings are accessible form the *Power Configuration* menu.

CONFigure:POWer:PVT:IRDTimeout <*Mode*>				Inv. Res. Det. Timeout
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
NORMal | **MEDium |** **SHORt**	Normal timeout Reduced timeout Shortest timeout	OFF	–	V3.80
Description of command				
This command defines the period of time after which a *Power vs. Time* measurement with invalid results is stopped and a new measurement can be started. .				

POWer:SLOT

The subsystem *POWer:SLOT* controls the *Power vs. Slot* measurement. It corresponds to the measurement menu *Power* with the applications *P/Slot Graph.*

Note: *The `POWer:SLOT` measurement can not be carried out with a Free Run trigger (`TRIGger[:SEQuence]:SOURce FRUN`).*

INITiate:POWer:SLOT **ABORt:POWer:SLOT** **STOP:POWer:SLOT** **CONTinue:POWer:SLOT**	Start new measurement Abort running measurement and switch off Stop measurement after current stat. cycle Next measurement step (only *stepping mode*)	⇒ *RUN* ⇒ *OFF* ⇒ *STOP* ⇒ *RUN*	
Description of command			FW vers.
These commands have no query form. They start or stop the measurement, setting it to the status indicated in the top right column.			V2.15

CONFigure:POWer:SLOT:EREPorting <*Mode*>				Event Reporting
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
SRQ | **SOPC |** **SRSQ |** **OFF**	Service request Single operation complete SRQ and SOPC No reporting	OFF	–	V2.15
Description of command				
This command defines the events generated when the measurement is terminated or stopped *(event reporting,* see chapter 5 of CMU manual).				

FETCh[:SCALar]:POWer:SLOT:STATus?		Measurement Status		
Return	Description of parameters	Def. value	Def. unit	FW vers.
OFF | **RUN |** **STOP |** **ERR |** **STEP |** **RDY,**	Measurement in the *OFF* state (`*RST` or `ABORt`) Running (after `INITiate, CONTinue` or `READ`) Stopped (`STOP`) *OFF* (could not be started) Stepping mode *(<stepmode>=STEP)* Stopped according to repetition mode and stop condition	OFF	–	V2.15
1 to 10000 | **NONE**	Counter for current statistics cycle No counting mode set	NONE	–	
Description of command				
This command is always a query. It returns the status of the measurement (see chapters 3 and 5 of CMU manual).				

POWer:SLOT:CONTrol

CONFigure:POWer:SLOT:CONTrol:REPetition *<Repetition>,<StopCondition>,<Stepmode>*		Test Cycles		
<Repetition>	Description of parameters	Def. value	Def. unit	
CONTinuous | **SINGleshot |** **1 to 10000**	Continuous measurement (*continuous*, until `STOP` or `ABORT`) Single measurement *(single shot*, `until Status = RDY`) Multiple measurement (*counting*, until `Status = STEP | RDY`)	SING	–	
<StopCond>	Description of parameters	Def. value	Def. unit	
SONerror | **NONE**	Stop measurement in case of error *(stop on error)* Continue measurement even in case of error	NONE	–	
<Stepmode>	Description of parameters	Def. value	Def. unit	FW vers.
STEP | **NONE**	Interrupt measurement after each statistics cycle Continue measurement according to its rep. mode	NONE	–	V2.15
Description of command				
This command determines the number of statistics cycles and the stepping mode for the measurement. **Note:** *In the case of READ commands (`READ:...`), the <Repetition> parameter has no effect; the measurement is always stopped after a single shot.*				

CONFigure:POWer:SLOT:CONTrol:DEFault <Enable>		Default Settings		
<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	The parameters are set to their default values The parameters differ from the default values (partially or totally)	ON	–	V2.15
Description of command				
If used as a setting command with the parameter *ON* this command sets all parameters of the subsystem to their default values (the setting *OFF* causes an error message). If used as a query the command returns whether all parameters are set to their default values *(ON)* or not *(OFF)*.				

Subsystem SUBarrays:POWer:SLOT

The subsystem *SUBarrays:POWer:SLOT* defines the measurement range and the type of output values.

CONFigure:SUBarrays:POWer:SLOT <Mode>,<Start>,<Samples>{,<Start>,<Samples>}
Definition of Subarrays

<Mode>	Description of parameters	Def. value	Def. unit	
ALL | **ARIThmetical |** **MINimum |** **MAXimum |** **IVAL,**	Return all measurement values Return arithm. mean value in every range Return minimum value in every range Return maximum value in every range Return single interpolated value at <Start>	ALL	–	
<Start>	Description of parameters	Def. value	Def. unit	
0 to 7,	Start time in current range	0	–	
<Samples>	Description of parameters	Def. value	Def. unit	FW vers.
1 to 8	Number of samples in current range	8	–	V2.15

Description of command

This command configures the `READ:SUBarrays...`, `FETCh:SUBarrays...,`, and `SAMPle:SUBarrays:POWer:SLOT` commands. It restricts the measurement to up to 32 subranges where either all measurement results (the number of which is given by the second numerical parameter) or a single statistical value is returned. The subranges are defined by the current number of the first slot and the number of slots within a subrange. If <Start> does not coincide with a test point then the range will start at the next test point that is larger than <Start>.

For <Mode> = IVAL, the <Samples> parameter is ignored and the CMU returns a single measurement value corresponding to the abscissa value <Start>. If <Start> is located beween two test points with valid results then the result is calculated from the results at these two adjacent test points by linear interpolation.

The subranges may overlap but must be within the total range of the *P/Slot Graph* measurement. Test points outside this range are not measured (result *NAN)* and do not enter into the ARIThmetical, MINimum and MAXimum values.

By default, only one range corresponding to the total measurement range is used and all measurement values are returned.

Subsystem POWer:SLOT

The subsystem *POWer:SLOT* measures power versus slot and returns the results. The subsystem corresponds to the measurement menu *P/SLOT Graph.*

READ[:SCALar]:POWer:SLOT:SPOWer<nr>? Single Result
Start single shot measurement and return results
FETCh[:SCALar]:POWer:SLOT:SPOWer<nr>? Read out measurement results (unsynchronized)
SAMPle[:SCALar]:POWer:SLOT:SPOWer<nr>?
Read out measurement results (synchronized)

Returned Values	Description of parameters	Def. value	Def. unit	FW vers.
–100 dBm to 100 dBm	Avg. power in slot <nr>	NAN	dBm	V2.15

Description of command

These commands are always queries. They start a measurement and return the average power in a particular timeslot (numbered by <nr>=1 to 8, corresponding to timeslots 0 to 7).

P/Slot Graph Results

READ:ARRay:POWer:SLOT? Start single shot measurement and return results
FETCh:ARRay:POWer:SLOT? Read out measurement results (unsynchronized)
SAMPle:ARRay:POWer:SLOT? Read out measurement results (synchronized)

Returned Values	Description of parameters	Def. value	Def. unit	FW vers.
–100 dBm to 100 dBm, **...** **–100 dBm to 100 dBm**	Avg. power in slot 0, ..., Avg. power in slot Slot 7	NAN, ..., NAN	dBm, ..., dBm	V2.15

Description of command

These commands are always queries. They start a measurement and return all measurement results. The returned list contains the average burst power of the mobile phone in eight consecutive timeslots.

Subarray Results

READ:SUBarrays:POWer:SLOT? Start single shot measurement and return results
FETCh:SUBarrays:POWer:SLOT? Read out measurement results (unsynchronized)
SAMPle:SUBarrays:POWer:SLOT? Read out measurement results (synchronized)

Ret. values per subrange	Description of parameters	Def. value	Def. unit	FW vers.
–100 dBm to 100 dBm, **...** **–100 dBm to 100 dBm**	Avg. power in first slot, ..., Avg. power in last slot	NAN ... NAN	dB ... dB	V2.15

Description of command

These commands are always queries. They return the burst power versus time in a fixed ¼- bit pattern and in the subranges defined by means of the `CONFigure:SUBarrays:POWer[:NORMal][:GMSK]:MPR` command. In the default setting of the configuration command the `READ:SUBarrays...`, `FETCh:SUBarrays...`, and `SAMPle:SUBarrays...` command group is equivalent to the `READ:ARRay...`, `FETCh:ARRay...`, and `SAMPle:ARRay...` command group described above.

The `CONFigure:SUBarrays:POWer[:NORMal][:GMSK]:MPR` command defines a maximum of 32 subranges. If one of the statistical modes `(ARIThmetical, MINimum, MAXimum)` is set, only one value is returned per subrange.

The calculation of *current, average, minimum,* and *maximum* results is explained in chapter 3 (cf. *display mode*).

POWer:XSLot

The subsystem *POWer:XSLot* controls the *Power vs. Slot* measurement. It corresponds to the measurement menu *Power* with the applications *P/Slot Table.*

Note: *The `POWer:XSLot` measurement can not be carried out with a Free Run trigger (`TRIGger[:SEQuence]:SOURce FRUN`).*

INITiate:POWer:XSLot	Start new measurement	⇒ *RUN*
ABORt:POWer:XSLot	Abort running measurement and switch off	⇒ *OFF*
STOP:POWer:XSLot	Stop measurement after current stat. cycle	⇒ *STOP*
CONTinue:POWer:XSLot	Next measurement step (only *stepping mode*)	⇒ *RUN*
Description of command		FW vers.
These commands have no query form. They start or stop the measurement, setting it to the status indicated in the top right column.		V2.15

CONFigure:POWer:XSLot:EREPorting <*Mode*>				Event Reporting
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
SRQ |	Service request	OFF	–	V2.15
SOPC |	Single operation complete			
SRSQ |	SRQ and SOPC			
OFF	No reporting			
Description of command				
This command defines the events generated when the measurement is terminated or stopped *(event reporting,* see chapter 5 of CMU manual).				

FETCh[:SCALar]:POWer:XSLot:STATus?				Measurement Status
Return	Description of parameters	Def. value	Def. unit	FW vers.
OFF |	Measurement in the *OFF* state (`*RST` or `ABORt`)	OFF	–	–
RUN |	Running (after `INITiate, CONTinue` or `READ`)			
STOP |	Stopped (`STOP`)			
ERR |	*OFF* (could not be started)			
STEP |	Stepping mode *(<stepmode>=STEP)*			
RDY,	Stopped according to repetition mode and stop condition			
1 to 10000 |	Counter for current statistics cycle			
NONE	No counting mode set	NONE	–	V2.15
Description of command				
This command is always a query. It returns the status of the measurement (see chapters 3 and 5 of CMU manual).				

Subsystem POWer:XSLot:CONTrol

CONFigure:POWer:XSLot:CONTrol:REPetition <*Repetition*>,<*StopCondition*>,<*Stepmode*>				Test Cycles
<Repetition>	Description of parameters	Def. value	Def. unit	
CONTinuous | **SINGleshot |** **1 to 10000**	Continuous measurement (*continuous*, until `STOP` or `ABORT`) Single measurement (*single shot*, until `Status = RDY`) Multiple measurement (*counting*, until `Status = STEP | RDY`)	SING	–	
<StopCond>	Description of parameters	Def. value	Def. unit	
SONerror | **NONE**	Stop measurement in case of error (*stop on error)* Continue measurement even in case of error	NONE	–	
<Stepmode>	Description of parameters	Def. value	Def. unit	FW vers.
STEP | **NONE**	Interrupt measurement after each statistics cycle Continue measurement according to its rep. mode	NONE	–	V2.15
Description of command				
This command determines the number of statistics cycles and the stepping mode for the measurement. **Note:** *In the case of READ commands (`READ:...`), the <Repetition> parameter has no effect; the measurement is always stopped after a single shot.*				

CONFigure:POWer:XSLot:CONTrol:DEFault <Enable>				Default Settings
<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	The parameters are set to their default values The parameters differ from the default values (partially or totally)	ON	–	V2.15
Description of command				
If used as a setting command with the parameter *ON* this command sets all parameters of the subsystem to their default values (the setting *OFF* causes an error message). If used as a query the command returns whether all parameters are set to their default values *(ON)* or not *(OFF)*.				

Subsystem POWer:XSLot:SCOunt

The subsystem *POWer:XSLot:SOUnt* defines the total number of slots measured. It corresponds to the *Slot Count* parameter in the *Control* tab of the *Power Configuration* menu.

CONFigure:POWer:XSLot:SCOunt *<Group>[,<Number>]*				Slot Count
<Group>	Description of parameters	Def. value	Def. unit	
S128 | S256 | S384 | S512	Number of slots measured, if an integer multiple of 128	S128	–	
<Number>	Description of parameters	Def. value	Def. unit	FW vers.
1 to 512	Number of slots measured, for FW vers. V3.05 and higher	128	–	V2.15

Description of command

This command defines the total number of slots measured. The first parameter sets the slot count in multiples of 128 (Sn where n = 1 to 4) and defines the number of returned values. The second parameter is equal to the *Slot Count* in manual control and must be used if a *Slot Count* m ≠ n*128 is desired. m supersedes n such that n ≥ m.

Examples:

- `CONF:POW:XSL:SCO S128,128` causes 128 values to be calculated and returned.
- `CONF:POW:XSL:SCO S128,129` is equivalent to `CONF:POW:XSL:SCO S256,129`. 129 values are measured. The output arrays of the `XSLot` measurement group consist of 129 valid and 127 invalid (NAN) results.

Retriggered Measurement Mode (Non Signalling only)

The following commands activate and configure the retriggered measurement mode. They correspond to the *Retriggered* section in the *Control* tab of the *Power Configuration* menu.

CONFigure:POWer:XSLot:MMODe *<Mode>*				Measure Mode
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
NORMal | RETRiggered	Normal *P/t Slot Table* or retriggered meas.	NORMal	–	V3.61

Description of command

This command sets the measurement mode to normal or retriggered.

CONFigure:POWer:XSLot:RETRiggered:PLEVel *<Level>*				Max. Power Level
<Level >	Description of parameters	Def. value	Def. unit	FW vers.
–40 dBm to +53 dBm **–54 dBm to +39 dBm** **–77 dBm to 0 dBm**	Highest transmitted power level for RF 1 Highest transmitted power level for RF 2 Highest transmitted power level for RF 4 IN	+33.0 +33.0 0.0	dBm dBm dBm	V3.61

Description of command

This command defines the (approximate) start value of the received signal power. The value range depends on the RF input used and the external attenuation set. If option R&S CMU-U99 *(RF 1 with RF 2 Level Range)* is fitted, RF 1 takes on the level range of RF2.

CONFigure:POWer:XSLot:RETRiggered:DPOWer *<Power >*				Decrease Power
<Power >	Description of parameters	Def. value	Def. unit	FW vers.
0 dB to 20 dB	Decrease Power from Burst to Burst	+2	dB	V3.61

Description of command

This command defines the (approximate) power steps between any two consecutive bursts.

CONFigure:POWer:XSLot:RETRiggered:TIMeout <*Time*>		Measurement Timeout		
<Time >	Description of parameters	Def. value	Def. unit	FW vers.
0.1 s … 100 s	Maximum Time for Measurement	+1	s	V3.61
Description of command				
This command defines the maximum time between any two consecutive bursts.				

Subsystem SUBarrays:POWer:XSLot

The subsystem *SUBarrays:POWer:XSLot* defines the measurement range and the type of output values.

CONFigure:SUBarrays:POWer:XSLot <Mode>,<Start>,<Samples>{,<Start>,<Samples>} Definition of Subarrays				
<Mode>	Description of parameters	Def. value	Def. unit	
ALL | **ARIThmetical |** **MINimum |** **MAXimum |** **IVAL,**	Return all measurement values Return arithm. mean value in every range Return minimum value in every range Return maximum value in every range Return single value at <Start>	ALL	–	
<Start>	Description of parameters	Def. value	Def. unit	
0 to 127,	First slot in current range	0	–	
<Samples>	Description of parameters	Def. value	Def. unit	FW vers.
1 to 128	Number of slots in current range	128	–	V2.15
Description of command				
This command configures the `READ:SUBarrays...`, `FETCh:SUBarrays...,`, and `SAMPle:SUBarrays:POWer:XSLot` commands. It restricts the measurement to up to 32 subranges where either all measurement results (the number of which is given by the second numerical parameter) or a single statistical value is returned. The subranges are defined by the current number of the first slot and the number of slots within a subrange. For <Mode> = IVAL, the <Samples> parameter is ignored and the CMU returns a single measurement value corresponding to the <Start> slot. The subranges may overlap but must be within the total range of the *P/Slot Table* measurement. Test points outside this range are not measured (result *NAN)* and do not enter into the ARIThmetical, MINimum and MAXimum values. By default, only one range corresponding to the total measurement range is used and all measurement values are returned.				

Subsystem POWer:XSLot?

The subsystem *POWer:XSLot* measures power versus slot and returns the results. The subsystem corresponds to the measurement menu *P/Slot Table.*

Single Result

READ[:SCALar]:POWer:XSLot:SPOWer<nr>? Start single shot measurement and return results
FETCh[:SCALar]:POWer:XSLot:SPOWer<nr>? Read out measurement results (unsynchronized)
SAMPle[:SCALar]:POWer:XSLot:SPOWer<nr>? Read out measurement results (synchronized)

Returned Values	Description of parameters	Def. value	Def. unit	FW vers.
–100 dBm to 100 dBm	Avg. power in slot <nr>	NAN	dBm	V2.15

Description of command

These commands are always queries. They start a measurement and return the average power in a particular timeslot (numbered by <nr>=1 to 128, corresponding to slot 0 to slot 127 of the graphical user interface). The number of slots measured can be incrased by means of the `CONFigure:POWer:XSLot:SCOunt` command.

P/Slot Table Results

READ:ARRay:POWer:XSLot? Start single shot measurement and return results
FETCh:ARRay:POWer:XSLot? Read out measurement results (unsynchronized)
SAMPle:ARRay:POWer:XSLot? Read out measurement results (synchronized)

Returned Values	Description of parameters	Def. value	Def. unit	FW vers.
–100 dBm to 100 dBm,	Avg. power in slot 0,	NAN,	dBm,	V2.15
...	...,	...,	...,	
–100 dBm to 100 dBm	Avg. power in slot 127	NAN	dBm	

Description of command

These commands are always queries. They start a measurement and return all measurement results. The returned list contains the average burst power of the mobile phone in 128 consecutive timeslots.

Subarray Results

READ:SUBarrays:POWer:XSLot? Start single shot measurement and return results
FETCh:SUBarrays:POWer:XSLot? Read out measurement results (unsynchronized)
SAMPle:SUBarrays:POWer:XSLot? Read out measurement results (synchronized)

Ret. values per subrange	Description of parameters	Def. value	Def. unit	FW vers.
–100 dBm to 100 dBm,	Avg. power in first slot,	NAN	dB	V2.15
...	...,	...	...	
–100 dBm to 100 dBm	Avg. power in last slot	NAN	dB	

Description of command

These commands are always queries. They return the burst power in the subranges defined by means of the `CONFigure:SUBarrays:POWer:XSLot` command. In the default setting of the configuration command the `READ:SUBarrays...`, `FETCh:SUBarrays...`, and `SAMPle:SUBarrays...` command group is equivalent to the `READ:ARRay...`, `FETCh:ARRay...`, and `SAMPle:ARRay...` command group described above.

The `CONFigure:SUBarrays:POWer[:NORMal][:GMSK]:MPR` command defines a maximum of 32 subranges. If one of the statistical modes `(ARIThmetical`, `MINimum`, `MAXimum)` is set, only one value is returned per subrange.

The calculation of *current, average, minimum,* and *maximum* results is explained in chapter 3 (cf. *display mode*).

POWer:FRAMe

The subsystem *POWer:FRAMe* controls the *Power vs. Frame* measurement. It corresponds to the measurement menu *Power* with the applications *P/Frame.*

Note: *The `POWer:FRAMe` measurement can not be carried out with a Free Run trigger (`TRIGger[:SEQuence]:SOURce FRUN`).*

INITiate:POWer:FRAMe	Start new measurement	⇒ *RUN*
ABORt:POWer:FRAMe	Abort running measurement and switch off	⇒ *OFF*
STOP:POWer:FRAMe	Stop measurement after current stat. cycle	⇒ *STOP*
CONTinue:POWer:FRAMe	Next measurement step (only *stepping mode*)	⇒ *RUN*
Description of command		FW vers.
These commands have no query form. They start or stop the measurement, setting it to the status indicated in the top right column.		V2.15

CONFigure:POWer:FRAMe:EREPorting <*Mode*>				Event Reporting
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
SRQ |	Service request	OFF	–	V2.15
SOPC |	Single operation complete			
SRSQ |	SRQ and SOPC			
OFF	No reporting			
Description of command				
This command defines the events generated when the measurement is terminated or stopped *(event reporting,* see chapter 5 of CMU manual).				

FETCh[:SCALar]:POWer:FRAMe:STATus?				Measurement Status
Return	Description of parameters	Def. value	Def. unit	FW vers.
OFF |	Measurement in the *OFF* state (`*RST` or `ABORt`)	OFF	–	–
RUN |	Running (after `INITiate, CONTinue` or `READ`)			
STOP |	Stopped (`STOP`)			
ERR |	*OFF* (could not be started)			
STEP |	Stepping mode *(<stepmode>=STEP)*			
RDY,	Stopped according to repetition mode and stop condition			
1 to 10000 |	Counter for current statistics cycle			
NONE	No counting mode set	NONE	–	V2.15
Description of command				
This command is always a query. It returns the status of the measurement (see chapters 3 and 5 of CMU manual).				

CONFigure:POWer:FRAMe:FCOunt <*No_of_Frames*>				Frame Count
<No_of_Frames>	Description of parameters	Def. value	Def. unit	FW vers.
1 to 128 |	Number of measured frames	128	–	V3.05
1 to 256	Number of measured frames	128	–	V3.40
Description of command				
This command defines the number of consecutive frames measured.				

Subsystem POWer:FRAMe:CONTrol

CONFigure:POWer:FRAMe:CONTrol:REPetition <*Repetition*>,<*StopCondition*>,<*Stepmode*> — Test Cycles

<Repetition>	Description of parameters	Def. value	Def. unit	
CONTinuous |	Continuous measurement (*continuous*, until `STOP` or `ABORT`)	SING	–	
SINGleshot |	Single measurement (*single shot*, until `Status = RDY`)			
1 to 10000	Multiple measurement (*counting*, until `Status = STEP | RDY`)			
<StopCond>	**Description of parameters**	**Def. value**	**Def. unit**	
SONerror |	Stop measurement in case of error *(stop on error)*	NONE	–	
NONE	Continue measurement even in case of error			
<Stepmode>	**Description of parameters**	**Def. value**	**Def. unit**	**FW vers.**
STEP |	Interrupt measurement after each statistics cycle	NONE	–	V2.15
NONE	Continue measurement according to its rep. mode			

Description of command

This command determines the number of statistics cycles and the stepping mode for the measurement.

Note: *In the case of READ commands (`READ:...`), the <Repetition> parameter has no effect; the measurement is always stopped after a single shot.*

CONFigure:POWer:FRAMe:CONTrol:DEFault <Enable> — Default Settings

<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON |	The parameters are set to their default values	ON	–	V2.15
OFF	The parameters differ from the default values (partially or totally)			

Description of command

If used as a setting command with the parameter *ON* this command sets all parameters of the subsystem to their default values (the setting *OFF* causes an error message).

If used as a query the command returns whether all parameters are set to their default values *(ON)* or not *(OFF)*.

Subsystem SUBarrays:POWer:FRAMe

The subsystem *SUBarrays:POWer:FRAMe* defines the measurement range and the type of return values.

CONFigure:SUBarrays:POWer:FRAMe <Mode>,<Start>,<Samples>{,<Start>,<Samples>}

Definition of Subarrays

<Mode>	Description of parameters	Def. value	Def. unit	
ALL | **ARIThmetical |** **MINimum |** **MAXimum |** **IVAL,**	Return all measurement values Return arithm. mean value in every range Return minimum value in every range Return maximum value in every range Return single interpolated value at <Start>	ALL	–	
<Start>	Description of parameters	Def. value	Def. unit	
0 to 255,	First frame in current range	0	–	
<Samples>	Description of parameters	Def. value	Def. unit	FW vers.
1 to 256	Number of frames in current range	256	–	V2.15

Description of command

This command configures the `READ:SUBarrays...`, `FETCh:SUBarrays...,`, and `SAMPle:SUBarrays:POWer:FRAMe` commands. It restricts the measurement to up to 32 subranges where either all measurement results (the number of which is given by the second numerical parameter) or a single statistical value is returned. The subranges are defined by the current number of the first frame and the number of frames within a subrange.

For <Mode> = IVAL, the <Samples> parameter is ignored and the CMU returns a single measurement value corresponding to the <Start> frame.

The subranges may overlap but must be within the total range of the *P/Frame* measurement. Test points outside this range are not measured (result *NAN)* and do not enter into the ARIThmetical, MINimum and MAXimum values. By default, only one range corresponding to the total measurement range is used and all measurement values are returned.

Subsystem POWer:FRAMe

The subsystem *POWer:FRAMe* measures the power versus frame and returns the results. The subsystem corresponds to the measurement menu *P/Frame.*

Single Result

READ[:SCALar]:POWer:FRAMe:FPOWer<nr>? Start single shot measurement and return results
FETCh[:SCALar]:POWer:FRAMe:FPOWer<nr>? Read out measurement results (unsynchronized)
SAMPle[:SCALar]:POWer:FRAMe:FPOWer<nr>? Read out measurement results (synchronized)

Returned Values	Description of parameters	Def. value	Def. unit	FW vers.
–100 dBm to 100 dBm	Avg. power in frame <nr>	NAN	dBm	V2.15

Description of command

These commands are always queries. They start a measurement and return the average power in a particular frame (numbered by <nr>=1 to 256, corresponding to frame 0 to frame 255 of the graphical user interface).

P/Slot Graph Results

READ:ARRay:POWer:FRAMe? Start single shot measurement and return results
FETCh:ARRay:POWer:FRAMe? Read out measurement results (unsynchronized)
SAMPle:ARRay:POWer:FRAMe? Read out measurement results (synchronized)

Returned Values	Description of parameters	Def. value	Def. unit	FW vers.
–100 dBm to 100 dBm, **...** **–100 dBm to 100 dBm**	Avg. power in frame 0, ..., Avg. power in frame 255	NAN, ..., NAN	dBm, ..., dBm	V2.15

Description of command

These commands are always queries. They start a measurement and return all measurement results. The returned list contains the average burst power of the mobile phone in a particular slot in 256 consecutive frames.

Subarray Results

READ:SUBarrays:POWer:FRAMe? Start single shot measurement and return results
FETCh:SUBarrays:POWer:FRAMe? Read out measurement results (unsynchronized)
SAMPle:SUBarrays:POWer:FRAMe? Read out measurement results (synchronized)

Ret. values per subrange	Description of parameters	Def. value	Def. unit	FW vers.
–100 dBm to 100 dBm, **...** **–100 dBm to 100 dBm**	Avg. power in first frame, ..., Avg. power in last frame	NAN ... NAN	dB ... dB	V2.15

Description of command

These commands are always queries. They output the average burst power in the subranges defined by means of the `CONFigure:SUBarrays:POWer:FRAMe` command. In the default setting of the configuration command the `READ:SUBarrays..., FETCh:SUBarrays..., and SAMPle:SUBarrays...` command group is equivalent to the `READ:ARRay..., FETCh:ARRay..., and SAMPle:ARRay...` command group described above.

The `CONFigure:SUBarrays:POWer[:NORMal][:GMSK]:MPR` command defines a maximum of 32 subranges. If one of the statistical modes `(ARIThmetical, MINimum, MAXimum)` is set, only one value is returned per subrange.

The calculation of *current, average, minimum,* and *maximum* results is explained in chapter 3 (cf. *display mode*).

POWer:MSLot

The subsystem *POWer:MSLot* measures the MS output carrier power versus time in up to 4 consecutive timeslots. The subsystem corresponds to the measurement menu *Power,* application *P/t Multislot,* and the associated popup menu *Power Configuration.*

Note: *The `POWer:MSLot` measurement can not be carried out with a Free Run trigger (`TRIGger[:SEQuence]:SOURce FRUN`).*

Control of Measurement – Subsystem POWer:MSLot

The subsystem *POWer:MSLot* controls the P/t multislot measurement.

INITiate:POWer:MSLot	Start new measurement	⇒	*RUN*
ABORt:POWer:MSLot	Abort measurement and switch off	⇒	*OFF*
STOP:POWer:MSLot	Stop measurement after current stat. cycle	⇒	*STOP*
CONTinue:POWer:MSLot	Next meas. step (only *stepping mode*)	⇒	*RUN*
Description of command			FW vers.
These commands have no query form. They start or stop the measurement, setting it to the status indicated in the top right column.			V3.05

CONFigure:POWer:MSLot:EREPorting <*Mode*>				Event Reporting
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
SRQ |	Service request	OFF	–	V3.05
SOPC |	Single operation complete			
SRSQ |	SRQ and SOPC			
OFF	No reporting			
Description of command				
This command defines the events generated when the measurement is terminated or stopped *(event reporting,* see chapter 5 of CMU manual).				

FETCh:POWer:MSLot:STATus?				Measurement Status
Returned values	Description of parameters	Def. value	Def. unit	FW vers.
OFF |	Measurement in the *OFF* state (`*RST` or `ABORt`)	OFF	–	V3.05
RUN |	Running (after `INITiate, CONTinue` or `READ`)			
STOP |	Stopped (`STOP`)			
ERR |	*OFF* (could not be started)			
STEP |	Stepping mode *(<stepmode>=STEP)*			
RDY,	Stopped according to repetition mode and stop condition			
	Counter for current statistics cycle			
1 to 10000 |	No counting mode set			
NONE,		NONE	–	
	Counter for current evaluation period within a cycle			
1 to 1000 |	Statistic count set to off			
NONE		NONE	–	
Description of command				
This command is always a query. It returns the status of the measurement (see chapters 3 and 5 of CMU manual of CMU manual).				

Subsystem POWer:MSLot:CONTrol

The subsystem *POWer:MSLot:CONTrol* defines the repetition mode, statistic count, and stop condition of the measurement. These settings are provided in the *Control* tab of the popup menu *Power Configuration.*

CONFigure:POWer:MSLot:CONTrol *<Mode>,<Statistics>*		Scope of Measurement		
<Mode>	Description of parameters	Def. value	Def. unit	
SCALar | **ARRay,**	Scalar values only (incl. ramp matching) Scalar measured values and arrays	ARRay	–	
<Statistics>	Description of parameters	Def. value	Def. unit	FW vers.
1 to 1000 | **NONE**	Number of bursts per statistics cycle Statistics off (equivalent to 1)	100	–	V3.05
Description of command				
This command restricts the type of measured values to accelerate the measurement and determines the number of bursts within a statistics cycle.				

CONFigure:POWer:MSLot:CONTrol:REPetition *<Repetition>,<StopCond>,<Stepmode>*		Test Cycles		
<Repetition>	Description of parameters	Def. value	Def. unit	
CONTinuous | **SINGleshot |** **1 to 10000**	Continuous measurement (until `STOP` or `ABORT`) Single shot measurement (until `Status = RDY`) Multiple measurement (*counting*, until `Status = STEP | RDY`)	SING	–	
<StopCondition>	Description of parameters	Def. value	Def. unit	
SONerror | **NONE**	Stop measurement in case of error *(stop on error)* Continue measurement even in case of error	NONE	–	
<Stepmode>	Description of parameters	Def. value	Def. unit	FW vers.
STEP | **NONE**	Interrupt measurement after each statistics cycle Continue measurement according to its rep. mode	NONE	–	V3.05
Description of command				
This command determines the number of statistics cycles, the stop condition and the stepping mode for the measurement. **Note:** *In the case of READ commands (`READ:...`), the <Repetition> parameter has no effect; the measurement is always stopped after a single shot.*				

DISPlay:POWer:MSLot:CONTrol:GRID *<Enable>*		Grid		
<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	Switch on grid lines Switch off grid lines	ON	–	V3.05
Description of command				
This command switches the grid lines in the test diagrams on or off.				

CONFigure:POWer:MSLot:CONTrol:DEFault *<Enable>*				Default Settings
<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	The parameters are set to their default values Some or all parameters are not set to default	ON	–	V3.05
Description of command				
If used as a setting command with the parameter *ON* this command sets all parameters of the subsystem to their default values (the setting *OFF* causes an error message). If used as a query the command returns whether all parameters are set to their default values *(ON)* or not *(OFF)*.				

Test Configuration

The commands of the following subsystems configure the *P/t Multislot* measurement. They correspond to some of the softkey/hotkey combinations in the graphical measurement menu and to some of the settings in the *Power Configuration* popup menu that are related to the *P/t Multislot* measurement.

CONFigure:POWer:MSLot:MVIew *<Mod_-1>,<Mod_0>, <Mod_1>, <Mod_2>*				Modulation View
<Mod_–1>, ... , <Mod_2>	Description of parameters	Def. value	Def. unit	FW vers.
GMSK | **EPSK |** **ABUR |** **ANY |** **OFF**	Normal burst, GMSK modulation required Normal burst, 8PSK modulation required Access bursts GMSK or 8PSK modulation Inactive timeslot (power off) required	ANY	–	V3.05
Description of command				
This command defines the modulation schemes, burst types and power/time templates for the Meas. Timeslot –1, Meas. Timeslot and the two following timeslots. Values for timeslots that are currently switched off (see command *CONFigure:POWer:MSLot:SCOunt*) are not taken into consideration.				

CONFigure:POWer:MSLot:SCOunt *<Slots>*				Slot Count
<Slots>	Description of parameters	Def. value	Def. unit	FW vers.
1 | **2 |** **3 |** **4**	Meas. timeslot (MTS) MTS – 1, MTS MTS – 1, MTS, MTS + 1 MTS – 1, MTS, MTS + 1, MTS + 2	2	–	V3.05
Description of command				
This command defines the number of timeslots measured and determines the length of the measurement arrays (see *READ:ARRay:POWer:MSLot*`...` commands). The measured timeslot is defined via `CONFigure:RFANalyzer:MCONtrol:TSOFfset` (Non Signalling) or `CONFigure:MSSignal:MCONtrol:MESLot` (Signalling).				

CONFigure:POWer:MSLot:TOFFset *<Offset>*				Timing Offset
<Offset>	Description of parameters	Def. value	Def. unit	FW vers.
–4.00 to +4.00	Number of bits (in ¼ symbol steps)	0	symb.	V3.05
Description of command				
This command defines an offset time by which the burst is shifted relative to the time axis and the tolerance template. The values entered are rounded to ¼ symbol steps.				

CONFigure:POWer:MSLot:TSALevel *<Level>*				2 Shot Assembly Level
<Offset>	Description of parameters	Def. value	Def. unit	FW vers.
–60.0 dB to +–10.0 dB	2 Shot Assembly Level	–50.0	dB	V3.60
Description of command				
This command defines defines a signal level relative to the *Max. Level* where the two results obtained in a two stage measurement (activated via `CONFigure:POWer:MSLot:LIMit:LINE:OTEMplate RSL`) are joined together.				

CONFigure:POWer:MSLot:FILTer *<Filter>*				Filter
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
G500 | **B600**	500 kHz Gaussian filter 600 kHz bandpass filter	G500	–	V3.05
Description of command				
This command selects the measurement filter for the measurement.				

CONFigure:POWer:MSLot:LIMit:LINE:GLEVel *<Level>*				Multislot Guard
<Level>	Description of parameters	Def. value	Def. unit	FW vers.
0.00 dB to +10.00 dB	Multislot guard level	3	dB	V3.05
Description of command				
This command defines the raising of the upper limit line in the guard period between two consecutive bursts.				

CONFigure:POWer:MSLot:LIMit:LINE:OTEMplate *<Reference>*				Off Template
<Reference>	Description of parameters	Def. value	Def. unit	FW vers.
RMAX | **RSL**	Off template relative to highest power Off template relative to slot power	RMAX	–	V3.60
Description of command				
This command defines the reference for the upper limit line in inactive slots.				

Subsystem SUBarrays:POWer:MSLot

The subsystem *SUBarrays:POWer:MSLot* defines the measurement range and the type of output values.

CONFigure:SUBarrays:POWer:MSLot <Mode>,<Start>,<Samples>{,<Start>,<Samples>} — Definition of Subarrays

<Mode>	Description of parameters	Def. value	Def. unit	
ALL | **ARIThmetical |** **MINimum |** **MAXimum |** **IVAL,**	Return all measurement values Return arithm. mean value in every range Return minimum value in every range Return maximum value in every range Return single interpolated value at <Start>	ALL	–	
<Start>	Description of parameters	Def. value	Def. unit	
–180 symbols to +520 symbols	Start time in current range, relative to symbol 0 of the meas. slot	–165	symb.	
<Samples>	Description of parameters	Def. value	Def. unit	FW vers.
1 to 2613	Number of samples in current range, depending on `SCOunt` (see commands *READ:ARRay:POWer:MSLot*`...`)	2613	–	V3.05

Description of command

This command configures the `READ:SUBarrays:POWer...`, `FETCh:SUBarrays:POWer...`, and `SAMPle:SUBarrays:POWer` commands. It restricts the measurement to up to 32 subranges where either all measurement results (the number of which is given by the second numerical parameter) or a single statistical value is returned. The subranges are defined by the start time and the number of test points which are located on a fixed, equidistant grid with a step width of ¼ symbols. If <Start> does not coincide with a test point then the range will start at the next test point that is larger than <Start>.

For <Mode> = IVAL, the <Samples> parameter is ignored and the CMU returns a single measurement value at the abscissa value <Start>. If <Start> is located beween two test points with valid results then the result is calculated from the results at these two adjacent test points by linear interpolation.

The subranges may overlap but must be within the total range of the *POWer* measurement. Test points outside this range are not measured (result *NAN)* and do not enter into the ARIThmetical, MINimum and MAXimum values.

By default, only one range corresponding to the total measurement range is used and all measurement values are returned.

Measured Values

The subsystem *POWer:MSLot...* contains the commands to measure the normal burst power, compare it with the tolerances and retrieve the results. The subsystem corresponds to the graphical measurement menu *Power.*

READ[:SCALar]:POWer:MSLot? FETCh[:SCALar]:POWer:MSLot? SAMPle[:SCALar]:POWer:MSLot?	Scalar results Start single shot measurement and return results Read out measurement results (unsynchronized) Read out measurement results (synchronized)			
Returned values per timeslot	Value range	Def. value	Def. unit	FW vers.
BurstsOutOfTolerance, **AvgBurstPowerCurrent,** **AvgBurstPwAvg** **PeakBurstPowerCurrent,** **TimingError,**	0.0 % to 100.0 % –137 dBm to +53 dBm –137 dBm to +53 dBm –137 dBm to +53 dBm –100.0 bit to+100.0 bit	NAN NAN NAN NAN NAN	% dBm dBm dBm bit	V3.05
BurstMatching	INV | MATC | NMAT | OUT | NTR | NRAM | OFF	INV	–	

Description of command

These commands are always queries.

- `READ` starts a single shot measurement and returns the results.
- `FETCh` returns the results irrespective of the measurement state.
- `SAMPle` waits until the results are valid (depending on the statistic count) and then returns the results.

For more details refer to the description of measurement control in chapter 5 of the CMU200 operating manual.

The following messages may be output for the value *BurstMatching*:

INV	*invalid*
MATC	*matching*
NMAT	*not matching*
OUT	*out of range*
NTR	*no trigger*
NRAM	*not ramping (burst not found)*
OFF	*off*

The complete list of results is repeated four times (timeslots 0, –1, +1, +2; see command *CONFigure:POWer:MSLot:SCOunt*).

CALCulate:POWer:MSLot:LIMit:MATChing?	Limit Matching			
Returned values per timeslot	Value range	Def. value	Def. unit	FW vers.
AvgBurstPowerCurrent, **AvgBurstPwAvg** **PeakBurstPowerCurrent,** **TimingError,** **BurstMatching**	NMAU | NMAL | INV | OK NMAU | NMAL | INV | OK NMAU | NMAL | INV | OK OK (no limit check) INV | MATC | NMAT | OUT | NTR | NRAM | OFF	INV INV INV INV INV	– – – —	V3.05

Description of command

This command is always a query. It indicates whether and in which way the permissible tolerances for the scalar measured values (see command above) have been exceeded.

The complete list of results is repeated four times (timeslots 0, –1, +1, +2; see command *CONFigure:POWer:MSLot:SCOunt*).

READ:ARRay:POWer:MSLot[:CURRent]? Burst Power
READ:ARRay:POWer:MSLot:AVERage?
READ:ARRay:POWer:MSLot:MAXimum?
READ:ARRay:POWer:MSLot:MINimum? Start single shot measurement and return results
FETCh:ARRay:POWer:MSLot[:CURRent]?
FETCh:ARRay:POWer:MSLot:AVERage?
FETCh:ARRay:POWer:MSLot:MAXimum?
FETCh:ARRay:POWer:MSLot:MINimum? Read measurement results (unsynchronized)
SAMPle:ARRay:POWer:MSLot[:CURRent]?
SAMPle:ARRay:POWer:MSLot:AVERage?
SAMPle:ARRay:POWer:MSLot:MAXimum?
SAMPle:ARRay:POWer:MSLot:MINimum? Read results (synchronized)

Returned values	Description of parameters	Def. value	Def. unit	FW vers.
–100.0 dB to + 20.0 dB	BurstPower[1]	NAN	dB	V3.05
...	...	...	...	
–100.0 dB to + 20.0 dB	BurstPower[n]	NAN	dB	

Description of command

These commands are always queries. They return the burst power relative to the average burst power in the measurement slot at n equidistant measurement points with a fixed ¼ symbol spacing. The time range measured corresponds to 1 to 4 entire timeslots plus 18 ¼ symbol periods before the beginning (symbol 0) of the first slot and 10 symbol periods after the end of the last slot. The resulting array lengths n are listed below.

Number of timeslots (according to *CONFigure:POWer:MSLot:SCOunt*)	1	2	3	4
n	738	1363	1988	2613

READ:SUBarrays:POWer:MSLot[:CURRent]? Subarray Results
READ:SUBarrays:POWer:MSLot:AVERage?
READ:SUBarrays:POWer:MSLot:MAXimum?
READ:SUBarrays:POWer:MSLot:MINimum?
Start single shot measurement and return results ⇒ *RUN*
FETCh:SUBarrays:POWer:MSLot[:CURRent]?
FETCh:SUBarrays:POWer:MSLot:AVERage?
FETCh:SUBarrays:POWer:MSLot:MAXimum?
FETCh:SUBarrays:POWer:MSLot:MINimum?
Read meas. results (unsynchronized) ⇒ *RUN*
SAMPle:SUBarrays:POWer:MSLot[:CURRent]?
SAMPle:SUBarrays:POWer:MSLot:AVERage?
SAMPle:SUBarrays:POWer:MSLot:MAXimum?
SAMPle:SUBarrays:POWer:MSLot:MINimum?
Read results (synchronized) ⇒ *RUN*

Ret. values per subrange	Description of parameters	Def. value	Def. unit	FW vers.
–100.0 dB to + 20.0 dB	BurstPower[1]	NAN	dB	V3.05
...	...	...	...	
–100.0 dB to + 20.0 dB	BurstPower[m]	NAN	dB	

Description of command

These commands are always queries. They return the burst power relative to the average burst power in the measurement slot in the subranges defined by means of the `CONFigure:SUBarrays:POWer` command. In the default setting of the configuration command the `READ:SUBarrays...`, `FETCh:SUBarrays...`, and `SAMPle:SUBarrays...` command group is equivalent to the `READ:ARRay...`, `FETCh:ARRay...`, and `SAMPle:ARRay...` command group described above.

The `CONFigure:SUBarrays:POWer` command defines a maximum of 32 subranges. If one of the statistical modes `(ARIThmetical, MINimum, MAXimum)` is set, only one value is returned per subrange.

The calculation of *current, average, minimum,* and *maximum* results is explained in chapter 3 (cf. *display mode*).

CALCulate:ARRay:POWer:MSLot:LIMit:MATChing[:CURRent]? Global Burst Matching

Returned values	Value range	Def. value	Def. unit	FW vers.
Matching	INV | MATC | NMAT | OUT | NTR | NRAM | OFF	INV	–	V3.05

Description of command

This command is always a query. It indicates whether and in which way the tolerances for the burst power (see command above) in all measured timeslots have been exceeded.

CALCulate:ARRay:POWer:MSLot:AREA:LIMit:MATChing[:CURRent]? Area Limit Matching

Returned value	Description of parameters	Def. value	Def. unit	FW vers.
64 bit value, **64 bit value**	Indicator for upper limit matching in area 1 to n Indicator for lower limit matching in area 1 to n	NAN NAN	– –	V3.05

Description of command

This command is always a query. A bit in the two output values is set if the corresponding section of the limit lines is exceeded. n ≤ 64 is the total number of areas in the limit lines, depending on the number of bursts measured (according to *CONFigure:POWer:MSLot:SCOunt*).

Tolerance Template

The subsystem *POWer:MSLot:AREA:LIMit...* contains the commands to return the current position of the multislot tolerance template and the curve. The subsystem has no equivalent in manual control, however, the current template is indicated in the graphical *P/t Multislot* digaram.

[SENSe:]ARRay:POWer:MSLot:AREA:LIMit:UPPer:TIME?
[SENSe:]ARRay:POWer:MSLot:AREA:LIMit:LOWer:TIME?

Time of all Areas

Returned values	Value range	Def. value	Def. unit	FW vers.
–180 symb. to +520 symb. | OFF,	Start time in area no. 1	NAN	symbols	V3.10
–180 symb. to +520 symb. | OFF,	Stop time in area no. 1	NAN		
...				
–180 symb. to +520 symb. | OFF,	Start time in area no. n	NAN		
–180 symb. to +520 symb. | OFF	Stop time in area no. n	NAN		

Description of command

These commands return the time of all areas of the multislot tolerance template, relative to the start of the measured timeslot *(Meas. Slot)*. OFF means that the limit line and limit check in an area is switched off. The number of areas and thus the number of output values varies with the number of measured slots and the definition of the single slot template. The maximum allowed number of output values is 2 x 64.

[SENSe:]ARRay:POWer:MSLot:AREA:LIMit:UPPer:LEVel?
[SENSe:]ARRay:POWer:MSLot:AREA:LIMit:LOWer:LEVel?

Level of all Areas

Returned values	Value range	Def. value	Def. unit	FW vers.
–100.0 dB to + 20.0 dB | OFF,	Start level in area no. 1	NAN	dB	V3.10
–100.0 dB to + 20.0 dB | OFF,	Stop level in area no. 1	NAN	dB	
...				
–100.0 dB to + 20.0 dB | OFF,	Start level in area no. n	NAN	dB	
–100.0 dB to + 20.0 dB | OFF	Stop level in area no. n	NAN	dB	

Description of command

These commands return the level of all areas of the multislot tolerance template, relative to the useful level of the measured timeslot *(Meas. Slot)*. OFF means that the limit line and limit check in an area is switched off. The number of areas and thus the number of output values varies with the number of measured slots and the definition of the single slot template. The maximum allowed number of output values is 2 x 64.

[SENSe:]ARRay:POWer:MSLot:AREA:LIMit:UPPer:INFO?
[SENSe:]ARRay:POWer:MSLot:AREA:LIMit:LOWer:INFO?

Timeslot of all Areas

Returned values	Value range	Def. value	Def. unit	FW vers.
–1 | 0 | 1 | 2,	Timeslot of area no. 1	NAN	dB	V3.10
...				
–1 | 0 | 1 | 2*)	Timeslot of area no. n	NAN	dB	

Description of command

These commands return the timeslot of all areas of the multislot tolerance template, relative to the measured timeslot *(Meas. Slot,* slot no. 0*)*. The number of areas and thus the number of output values varies with the number of measured slots and the definition of the single slot template. The maximum allowed number of output values is 64.

*) If the timeslots no. –2 or +3 are active and if an area overlaps to one of these slots, the query may also return –2 or +3.

[SENSe:]ARRay:POWer:MSLot:AREA:LIMit:INFO:STIMe?				Timeslot of all Areas
Returned value	Value range	Def. value	Def. unit	FW vers.
–180 symb. to +520 symb.	Start time of measurement curve	NAN	symb.	V3.10
Description of command				
This commands returns the start time of the measurement curve relative to the beginning of the measured timeslot *(Meas. Slot,* slot no. 0*)*. The start time is the relative time of the first sample of the curve; all remaining samples follow with a ¼ symbol spacing.				

Common MODulation Commands

The following commands are valid for all *Modulation* applications. The settings are accessible form the *Modulation Configuration* menu.

CONFigure:MODulation:PVT:IRDTimeout <*Mode*>		Inv. Res. Det. Timeout		
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
NORMal | **MEDium |** **SHORt**	Normal timeout Reduced timeout Shortest timeout	OFF	–	V3.80
Description of command				
This command defines the period of time after which a *Modulation* measurement with invalid results is stopped and a new measurement can be started. .				

MODulation[:PERRor]

The subsystem *MODulation[:PERRor][:GMSK]* measures the modulation parameters (frequency and phase errors) in GMSK modulation. The subsystem corresponds to the measurement menu *Modulation,* application *Ext. Phase Err. GMSK,* and the associated popup menu *Modulation Config*, however, it does not provide the I/Q Imbalance and the Origin Offset in the I/Q constellation diagram.

If results for the I/Q Imbalance and the Origin Offset are needed, the slower *MODulation:XPERror* measurement must be used; see p. 6.76 ff.

Note: *GMSK and 8PSK modulation*

The keywords `[:GMSK]` and `:EPSK` in the remote control commands denote GMSK and 8PSK modulation, respectively. The `:EPSK` commands in Signalling measurements are included in firmware versions V3.05 and higher. The firmware version numbers quoted in the command tables refer either to GMSK modulation or EPSK modulation in Non Signalling mode.

Control of Measurement – Subsystem MODulation[:PERRor][:GMSK]

The subsystem *MODulation[:PERRor][:GMSK]* controls the modulation measurement. It corresponds to the softkey *Ext. Phase Err. GMSK* in the measurement menu *Modulation*.

INITiate:MODulation[:PERRor][:GMSK]	Start new measurement	⇒ *RUN*
ABORt:MODulation[:PERRor][:GMSK]	Abort running measurement and switch off	⇒ *OFF*
STOP:MODulation[:PERRor][:GMSK]	Stop measurement after current stat. cycle	⇒ *STOP*
CONTinue:MODulation[:PERRor][:GMSK]	Next measurement step (only *stepping mode*)	⇒ *RUN*
Description of command		FW vers.
These commands have no query form. They start and stop the modulation measurement, setting it to the status indicated in the top right column.		V1.15

CONFigure:MODulation[:PERRor][:GMSK]:EREPorting <*Mode*>				Event Reporting
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
SRQ | **SOPC |** **SRSQ |** **OFF**	Service request Single operation complete SRQ and SOPC No reporting	OFF	–	V1.15
Description of command				
This command defines the events generated when the measurement is terminated or stopped *(event reporting,* see chapter 5 of CMU manualCMU manual).				

FETCh:MODulation[:PERRor][:GMSK]:STATus?				Measurement Status
Ret. values	Description of parameters	Def. value	Def. unit	FW vers.
OFF | **RUN |** **STOP |** **ERR |** **STEP |** **RDY,**	Measurement in the *OFF* state (`*RST` or `ABORt`) Running (after `INITiate, CONTinue` or `READ`) Stopped (`STOP`) *OFF* (could not be started) Stepping mode *(<stepmode>=STEP)* Stopped according to repetition mode and stop condition	OFF	–	V1.15
	Counter for current statistics cycle			
1 to 10000 | **NONE,**	No counting mode set	NONE	–	
	Counter for current evaluation period within a cycle			
1 to 1000 | **NONE**	Statistic count set to off	NONE	–	
Description of command				
This command is always a query. It returns the status of the measurement (see chapters 3 and 5 of CMU manual).				

CONFigure:MODulation[:PERRor][:GMSK]:FILTer <*Filter*>				Filter
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
G500 | **B600**	500 kHz Gaussian filter 600 kHz bandpass filter	G500	–	V3.05
Description of command				
This command selects the measurement filter for the `XPERror[:GMSK]` modulation measurement.				

Subsystem MODulation[:PERRor][:GMSK]:CONTrol

The subsystem *MODulation[:PERRor][:GMSK]:CONTrol* configures the modulation measurement. It corresponds to the *Control* tab in the popup menu *Modulation Config*.

CONFigure:MODulation[:PERRor][:GMSK]:CONTrol *<Mode>, <Statistics>*				Scope of Measurement
<Mode>	Description of parameters	Def. value	Def. unit	
SCALar | **ARRay**	Only scalar measured values (incl. tolerance matching) Scalar measured values and arrays	ARRay	–	
<Statistics>	Description of parameters	Def. value	Def. unit	FW vers.
1 to 1000 | **NONE**	No. of bursts within a statistics cycle Statistics off	100	–	V1.15
Description of command				
This command selects the type of measured values and determines the number of bursts forming one statistics cycle.				

CONFigure:MODulation[:PERRor][:GMSK]:CONTrol:REPetition *<Repetition> ,<StopCond>,<Stepmode>*				Test Cycles
<Repetition>	Description of parameters	Def. value	Def. unit	
CONTinuous | **SINGleshot |** **1 to 10000**	Continuous measurement (until `STOP` or `ABORT`) Single shot measurement (until `Status = RDY`) Multiple measurement (*counting*, until `Status = STEP | RDY`)	SING	–	
<StopCond>	Description of parameters	Def. value	Def. unit	
SONerror | **NONE**	Stop measurement in case of error *(stop on error)* Continue measurement even in case of error	NONE	–	
<Stepmode>	Description of parameters	Def. value	Def. unit	FW vers.
STEP | **NONE**	Interrupt measurement after each statistics cycle Continue measurement according to its rep. mode	NONE	–	V1.15
Description of command				
This command determines the number of statistics cycles, the stop condition and the stepping mode for the measurement. **Note:** *In the case of READ commands (`READ:...`), the <Repetition> parameter has no effect; the measurement is always stopped after a single shot.*				

CONFigure:MODulation[:PERRor][:GMSK]:CONTrol:DEFault *<Enable>*				Default Settings
<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	The parameters are set to their default values Some or all parameters differ from the default values	ON	–	V1.15
Description of command				
If used as a setting command with the parameter *ON* this command sets all parameters of the subsystem to their default values (the setting *OFF* causes an error message). If used as a query the command returns whether all parameters are set to their default values *(ON)* or not *(OFF)*.				

Tolerance values – Subsystem MODulation[:PERRor][:GMSK]:LIMit

The subsystem *MODulation[:PERRor][:GMSK]:LIMit* defines tolerance values for the modulation measurement. The subsystem corresponds to the tab *Limits* in the popup menu *Modulation Configuration.*

CONFigure:MODulation[:PERRor][:GMSK]:LIMit[:CURRent] *<PhaseErrorPeak>,<PhaseErrorRMS>,<FrequencyError>* — Upper Modulation Errors

Parameter	Description of parameters	Def. value	Def. unit	FW vers.
0.0 deg to +50.0 deg	PhaseErrorPeak	+20.0	deg	V1.15
0.0 deg to +50.0 deg	PhaseErrorRMS	+5.0	deg	
0.0 Hz to +999 Hz	FrequencyError	+90	Hz	

Description of command

This command defines limits for the peak and RMS phase error as well as for the frequency error in the current or maximum trace. The default frequency error is 49 Hz for GSM400, 90 Hz for GSM850, GSM GT800, and GSM900, 180 Hz for GSM1800, 190 Hz for GSM1900. Besides, the ranges and default values for the upper and lower *PhaseErrorPeak* and *FrequencyError* limits have equal magnitude but different sign.

CONFigure:MODulation[:PERRor][:GMSK]:LIMit:UPPer:MODE *<Mode>* — Upper Limit Check on/off

<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
ON |	Upper limit check on	ON	–	V2.00
OFF	Upper limit check off			

Description of command

This command switches on or off the tolerance check with respect to the upper limit lines (current and average).

CONFigure:MODulation[:PERRor][:GMSK]:LIMit:LOWer:MODE <Mode> — Lower Limit Check on/off

<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
ON |	Lower limit check on	ON	–	V2.00
OFF	Lower limit check off			

Description of command

This command switches on or off the tolerance check with respect to the lower limit lines (current and average).

CONFigure:MODulation[:PERRor][:GMSK]:LIMit:AVERage *<PhaseErrorPeak>, <PhaseErrorRMS>,<FrequencyError>* — Upper Average Limits

Parameter	Description of parameters	Def. value	Def. unit	FW vers.
0.0 to +50.0 deg	PhaseErrorPeak	+20.0	deg	V1.15
0.0 to +50.0 deg	PhaseErrorRMS	+5.0	deg	
0.0 to +999 Hz	FrequencyError	+90	Hz	

Description of command

This command defines limits for the peak and RMS phase error as well as for the frequency error in the average trace. The default frequency error is 49 Hz for GSM400, 90 Hz for GSM850, GSM GT 800, and GSM900, 180 Hz for GSM1800, 190 Hz for GSM1900. Besides, the ranges and default values for the upper and lower *PhaseErrorPeak* and *FrequencyError* limits have equal magnitude but different sign.

CONFigure:MODulation[:PERRor][:GMSK]:LIMit:DEFault <*Enable*>	Default Settings			
<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	The parameters are set to their default values Some or all parameters differ from the default values	ON	–	V1.15
Description of command				
If used as a setting command with the parameter *ON* this command sets all parameters of the subsystem to their default values (the setting *OFF* causes an error message). If used as a query the command returns whether all parameters are set to their default values *(ON)* or not *(OFF)*.				

Subsystem MODulation...:TIME

The subsystem *MODulation...:TIME* defines the decoding for the *Modulation* measurement. The subsystem corresponds to the *Decode* hotkey in the graphical measurement menu *Modulation.*

CONFigure:MODulation[:PERRor][:GMSK]:TIME:DECode <*Mode*>	Decode			
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
STANdard | **GTBits**	The standard bit range is decoded The guard and tail bits are also decoded	GTBits	–	V2.15
Description of command				
This command selects the type of decoding applied for the determination of phase and frequency errors.				

Subsystem SUBarrays:MODulation[:PERRor][:GMSK]

The subsystem *SUBarrays:MODulation[:PERRor][:GMSK]* defines the measurement range and the type of returned values.

CONFigure:SUBarrays:MODulation[:PERRor][:GMSK] <Mode>,<Start>,<Samples>{,<Start>,<Samples>}
Definition of Subarrays

<Mode>	Description of parameters	Def. value	Def. unit	
ALL | **ARIThmetical |** **MINimum |** **MAXimum |** **IVAL,**	Return all measurement values Return arithm. mean value in every range Return minimum value in every range Return maximum value in every range Return single interpolated value at <Start>	ALL	–	
<Start>	Description of parameters	Def. value	Def. unit	
0 bit to 146 ¾ bit,	Start time in current range	0	bit	
<Samples>	Description of parameters	Def. value	Def. unit	FW vers.
1 to 588	Number of samples in current range	588	–	V2.00

Description of command

This command configures the `READ:SUBarrays...`, `FETCh:SUBarrays...`, and `SAMPle:SUBarrays:MODulation[:PERRor][:GMSK]` commands. It restricts the measurement to up to 32 subranges where either all measurement results (the number of which is given by the second numerical parameter) or a single statistical value is returned. The subranges are defined by the start time and the number of test points which are located on a fixed, equidistant grid with a step width of ¼ bit. If <Start> does not coincide with a test point then the range will start at the next test point that is larger than <Start>.

For <Mode> = IVAL, the <Samples> parameter is ignored and the CMU returns a single measurement value corresponding to the abscissa value <Start>. If <Start> is located beween two test points with valid results then the result is calculated from the results at these two adjacent test points by linear interpolation.

The subranges may overlap but must be within the total range of the *MODulation[:PERRor][:GMSK]* measurement. Test points outside this range are not measured (result *NAN)* and do not enter into the ARIThmetical, MINimum and MAXimum values.

By default, only one range corresponding to the total measurement range is used and all measurement values are returned.

Measured Values – Subsystem MODulation[:PERRor][:GMSK]?

The subsystem *MODulation[:PERRor][:GMSK]* measures and returns the modulation results and compares them with the tolerance values. The subsystem corresponds to the various output elements in the graphical measurement menu *MODulation[:PERRor][:GMSK].*

				Scalar Results:
READ[:SCALar]:MODulation[:PERRor][:GMSK]?	Start single shot meas. and return results			
FETCh[:SCALar]:MODulation[:PERRor][:GMSK]?	Read out meas. results (unsynchronized)			
SAMPle[:SCALar]:MODulation[:PERRor][:GMSK]?	Read out meas. results (synchronized)			
Returned values	Value range	Def. value	Def. unit	FW vers.
PhErrPeakCurrent,	–100.0 ° to +100.0 °	NAN	deg	V1.15
PhErrPeakAverage,	–100.0 ° to +100.0 °	NAN	deg	
PhErrPeakMaxMin,	–100.0 ° to +100.0 °	NAN	deg	
PhErrRMSCurrent,	–100.0 ° to +100.0 °	NAN	deg	
PhErrRMSAverage,	–100.0 ° to +100.0 °	NAN	deg	
PhErrRMSMaxMin,	–100.0 ° to +100.0 °	NAN	deg	
FreqErrCurrent,	–1000.0 Hz to +1000.0 Hz	NAN	Hz	
FreqErrAverage,	–1000.0 Hz to +1000.0 Hz	NAN	Hz	
FreqErrMaxMin,	–1000.0 Hz to +1000.0 Hz	NAN	Hz	
AvgBurstPowerCurr,	–137 dBm to +53 dBm	NAN	dBm	
BurstsOutOfTol	0.0 % to 100.0 %	NAN	%	

Description of command

These commands are always queries. They start a measurement and return all scalar measurement results (see chapter 5). These are:

Peak phase error of current burst	*phase error peak current*
Peak phase error of average measurement	*phase error peak average*
Peak phase error of peak measurement	*phase error peak max./min.*
Rms phase error of current burst	*phase error RMS current*
Rms phase error of average measurement	*phase error RMS average*
Rms phase error of peak measurement	*phase error RMS max./min.*
Frequency error of current burst	*frequency error current*
Frequency error of average measurement	*frequency error average*
Frequency error of peak measurement	*frequency error max./min.*
Average burst power of current burst	*avg. burst power current*
Relative portion of faulty bursts	*bursts out of tolerance*

The calculation of results in an *average* or *peak* measurement is described in chapter 3 (cf. *calculation of statistical quantities*).

CALCulate:MODulation[:PERRor][:GMSK]:LIMit:MATChing?	Bursts out of Tolerance			
Returned values	Value range	Def. value	Def. unit	FW vers.
PhErrPeakCurrent,		INV	–	V1.15
PhErrPeakAverage,		INV	–	
PhErrPeakMaxMin,	**For all measured values:**	INV	–	
PhErrRMSCurrent,		INV	–	
PhErrRMSAverage,		INV	–	
PhErrRMSMaxMin,	**NMAU | NMAL | INV | OK**	INV	–	
FreqErrCurrent,		INV	–	
FreqErrAverage,		INV	–	
FreqErrMaxMin,		INV	–	
AvgBurstPowerCurr		INV	–	

Description of command

This command is always a query. It indicates whether and in which way the error limits for the scalar measured values (see above command) have been exceeded.

The following messages may be returned for all measured values:

NMAU — Underflow of tolerance value
not matching, underflow
NMAL — Tolerance value exceeded
not matching, overflow
INV — Measurement invalid
invalid
OK — all tolerances matched

READ:ARRay:MODulation[:PERRor][:GMSK][:CURRent]? Phase Error in Burst
READ:ARRay:MODulation[:PERRor][:GMSK]:AVERage?
READ:ARRay:MODulation[:PERRor][:GMSK]:MMAXimum?
Start single shot measurement and return results ⇒ *RUN*
FETCh:ARRay:MODulation[:PERRor][:GMSK][:CURRent]?
FETCh:ARRay:MODulation[:PERRor][:GMSK]:AVERage?
FETCh:ARRay:MODulation[:PERRor][:GMSK]:MMAXimum?
Read measurement results (unsynchronized) ⇒ *RUN*
SAMPle:ARRay:MODulation[:PERRor][:GMSK][:CURRent]? SAMPle:ARRay:MODulation[:PERRor][:GMSK]:AVERage?
SAMPle:ARRay:MODulation[:PERRor][:GMSK]:MMAXimum?
Read measurement results (synchronized) ⇒ *RUN*

Returned values	Description of parameters	Def. value	Def. unit	FW vers.
–100.0 deg to+ 100.0 deg,	1st value for phase error	NAN	dB	V1.15
... ,	...	...	...	
–100.0 deg to+ 100.0 deg	xth value for phase error	NAN	dB	

Description of command

These commands are always queries. They return the phase error of the burst vs. time in a fixed ¼ bit pattern. The number of measured values is 588, corresponding to a time range of 0 bit to 146 ¾ bit.

The calculation of *current, average, and mmax* (Min./Max.) results is explained in chapter 3 (cf. *display mode*).

READ:SUBarrays:MODulation[:PERRor][:GMSK][:CURRent]? **READ:SUBarrays:MODulation[:PERRor][:GMSK]:AVERage?** **READ:SUBarrays:MODulation[:PERRor][:GMSK]:MMAXimum?**	Subarray Results
Start single shot measurement and return results	⇒ *RUN*
FETCh:SUBarrays:MODulation[:PERRor][:GMSK][:CURRent]? **FETCh:SUBarrays:MODulation[:PERRor][:GMSK]:AVERage?** **FETCh:SUBarrays:MODulation[:PERRor][:GMSK]:MMAXimum?**	
Read meas. results (unsynchronized)	⇒ *RUN*
SAMPle:SUBarrays:MODulation[:PERRor][:GMSK][:CURRent]? SAMPle:SUBarrays:MODulation[:PERRor][:GMSK]:AVERage? **SAMPle:SUBarrays:MODulation[:PERRor][:GMSK]:MMAXimum?**	
Read results (synchronized)	⇒ *RUN*

Ret. values per subrange	Description of parameters	Def. value	Def. unit	FW vers.
–100.0 deg to+ 100.0 deg,	1st value for phase error	NAN	dB	V2.00
... ,	...	...	...	
–100.0 deg to+ 100.0 deg	xth value for phase error	NAN	dB	

Description of command

These commands are always queries. They output the phase error versus time in a fixed ¼- bit pattern and in the subranges defined by means of the `CONFigure:SUBarrays:MODulation[:PERRor][:GMSK]` command. In the default setting of the configuration command the `READ:SUBarrays...`, `FETCh:SUBarrays...`, and `SAMPle:SUBarrays...` command group is equivalent to the `READ:ARRay...`, `FETCh:ARRay...`, and `SAMPle:ARRay...` command group described above.

The `CONFigure:SUBarrays:MODulation[:PERRor][:GMSK]` command defines a maximum of 32 subranges. If one of the statistical modes `(ARIThmetical, MINimum, MAXimum)` is set, only one value is returned per subrange.

The calculation of *current, average, minimum,* and *maximum* results is explained in chapter 3 (cf. *display mode*).

MODulation:XPERror

The subsystem *MODulation:XPERror[:GMSK]* measures the modulation parameters (frequency and phase errors) in GMSK modulation including the I/Q Imbalance and the Origin Offset in the I/Q constellation diagram. The subsystem corresponds to the measurement menu *Modulation,* application *Ext. Phase Err. GMSK,* and the associated popup menu *Modulation Configuration.*

If no results for the I/Q Imbalance and the Origin Offset are needed, it is recommended to use the faster *MODulation[:PERRor]* measurement; see p.6.67 ff.

Control of Measurement – Subsystem MODulation:XPERror[:GMSK]

The subsystem *MODulation:XPERror[:GMSK]* controls the modulation measurement. It corresponds to the softkey *Ext. Phase Err. GMSK* in the measurement menu *Modulation*.

INITiate:MODulation:XPERror[:GMSK]	Start new measurement	⇒ *RUN*
ABORt:MODulation:XPERror[:GMSK]	Abort running measurement and switch off	⇒ *OFF*
STOP:MODulation:XPERror[:GMSK]	Stop measurement after current stat. cycle	⇒ *STOP*
CONTinue:MODulation:XPERror[:GMSK]	Next measurement step (only *stepping mode*)	⇒ *RUN*
Description of command		FW vers.
These commands have no query form. They start and stop the modulation measurement, setting it to the status indicated in the top right column.		V2.15

CONFigure:MODulation:XPERror[:GMSK]:EREPorting <*Mode*>				Event Reporting
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
SRQ | **SOPC |** **SRSQ |** **OFF**	Service request Single operation complete SRQ and SOPC No reporting	OFF	–	V2.15
Description of command				
This command defines the events generated when the measurement is terminated or stopped *(event reporting,* see chapter 5 of CMU manual).				

FETCh:MODulation:XPERror[:GMSK]:STATus?				Measurement Status
Ret. values	Description of parameters	Def. value	Def. unit	FW vers.
OFF | **RUN |** **STOP |** **ERR |** **STEP |** **RDY,**	Measurement in the *OFF* state (`*RST` or `ABORt`) Running (after `INITiate, CONTinue` or `READ`) Stopped (`STOP`) *OFF* (could not be started) Stepping mode *(<stepmode>=STEP)* Stopped according to repetition mode and stop condition	OFF	–	V2.15
1 to 10000 | **NONE,**	Counter for current statistics cycle No counting mode set	NONE	–	
1 to 1000 | **NONE**	Counter for current evaluation period within a cycle Statistic count set to off	NONE	–	
Description of command				
This command is always a query. It returns the status of the measurement (see chapters 3 and 5 of CMU manual).				

CONFigure:MODulation:XPERror[:GMSK]:TIME:DECode *<Mode>*				Decode
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
STANdard | **GTBits**	The standard bit range is decoded The guard and tail bits are also decoded	GTBits	–	V2.15
Description of command				
This command selects the type of decoding applied for the determination of phase and frequency errors.				

CONFigure:MODulation:XPERror[:GMSK]:FILTer *<Filter>*				Filter
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
G500 | **B600**	500 kHz Gaussian filter 600 kHz bandpass filter	G500	–	V3.05
Description of command				
This command selects the measurement filter for the `XPERror[:GMSK]` modulation measurement.				

CONFigure:MODulation:XPERror[:GMSK]:RSTRecovery *<Mode>*				Raw Symb. Timing Recovery
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
NON | **TSC**	Non data aided Data aided	NON	–	V3.60
Description of command				
This command specifies how the R&S CMU determines the raw symbol timing in order to demodulate the signal and calculate the modulation results.				

Subsystem MODulation:XPERror[:GMSK]:CONTrol

The subsystem *MODulation:XPERror[:GMSK]:CONTrol* configures the modulation measurement. It corresponds to the *Control* tab in the popup menu *Modulation Config*.

CONFigure:MODulation:XPERror[:GMSK]:CONTrol *<Mode>, <Statistics>*				Scope of Measurement
<Mode>	Description of parameters	Def. value	Def. unit	
SCALar | **ARRay**	Only scalar measured values (incl. tolerance matching) Scalar measured values and arrays	ARRay	–	
<Statistics>	Description of parameters	Def. value	Def. unit	FW vers.
1 to 1000 | **NONE**	No. of bursts within a statistics cycle Statistics off	100	–	V2.15
Description of command				
This command selects the type of measured values and determines the number of bursts forming one statistics cycle.				

CONFigure:MODulation:XPERror[:GMSK]:CONTrol:REPetition ***<Repetition>, <StopCond>, <Stepmode>***				Test Cycles
<Repetition>	Description of parameters	Def. value	Def. unit	
CONTinuous | **SINGleshot |** **1 to 10000,**	Continuous measurement (until `STOP` or `ABORT`) Single shot measurement (until `Status = RDY`) Multiple measurement (*counting*, until `Status = STEP | RDY`)	SING	–	
<StopCond>	Description of parameters	Def. value	Def. unit	
SONerror | **NONE,**	Stop measurement in case of error *(stop on error)* Continue measurement even in case of error	NONE	–	
<Stepmode>	Description of parameters	Def. value	Def. unit	FW vers.
STEP | **NONE**	Interrupt measurement after each statistics cycle Continue measurement according to its rep. mode	NONE	–	V2.15
Description of command				
This command determines the number of statistics cycles, the stop condition and the stepping mode for the measurement. **Note:** *In the case of READ commands (`READ:...`), the <Repetition> parameter has no effect; the measurement is always stopped after a single shot.*				

CONFigure:MODulation:XPERror[:GMSK]:CONTrol:DEFault *<Enable>*				Default Settings
<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	The parameters are set to their default values Some or all parameters differ from the default values	ON	–	V2.15
Description of command				
If used as a setting command with the parameter *ON* this command sets all parameters of the subsystem to their default values (the setting *OFF* causes an error message). If used as a query the command returns whether all parameters are set to their default values *(ON)* or not *(OFF)*.				

Tolerance values – Subsystem MODulation:XPERror[:GMSK]:LIMit

The subsystem *MODulation:XPERror[:GMSK]:LIMit* defines tolerance values for the modulation measurement. The subsystem corresponds to the tab *Limits* in the popup menu *Modulation.*

CONFigure:MODulation:XPERror[:GMSK]:LIMit[:CURRent] ***<PhaseErrorPeak>,<PhaseErrorRMS>,<OrigOffs>,<IQImb>,<FrequencyError>***				Current & Max. Errors
Parameter	Description of parameters	Def. value	Def. unit	FW vers.
0.0 deg to +50.0 deg **0.0 deg to +50.0 deg** **–100.0 dB to 0 dB** **–100.0 dB to 0 dB** **0.0 Hz to +999 Hz**	Phase Error Peak Phase Error RMS Origin Offset I/Q Imbalance Frequency Error	+20.0 +5.0 –20 –20 +90	deg deg dB dB Hz	V2.15
Description of command				
This command defines limits for the modulation parameters in the *Current* or *Max./Min.* trace. For quantities with alternating sign (the *Phase Error Peak* and the *Frequency Error),* the absolute value must fall below the specified limit. The default frequency error is 49 Hz for GSM400, 90 Hz for GSM850, GSM GT800, and GSM900, 180 Hz for GSM1800, 190 Hz for GSM1900.				

CONFigure:MODulation:XPERror[:GMSK]:LIMit:AVERage ***<PhaseErrorPeak>,<PhaseErrorRMS>,<OrigOffs>,<IQImb>,<FrequencyError>***				Average Errors
Parameter	Description of parameters	Def. value	Def. unit	FW vers.
0.0 deg to +50.0 deg	Phase Error Peak	+20.0	deg	V2.15
0.0 deg to +50.0 deg	Phase Error RMS	+5.0	deg	
–100.0 dB to 0 dB	Origin Offset	–20	dB	
–100.0 dB to 0 dB	I/Q Imbalance	–20	dB	
0.0 Hz to +999 Hz	Frequency Error	+90	Hz	
Description of command				
This command defines limits for the modulation parameters in the *Average* trace. For quantities with alternating sign (the *Phase Error Peak* and the *Frequency Error),* the absolute value must fall below the specified limit. The default frequency error is 49 Hz for GSM400, 90 Hz for GSM850, GSM GT800, and GSM900, 180 Hz for GSM1800, 190 Hz for GSM1900.				

CONFigure:MODulation:XPERror[:GMSK]:LIMit:UPPer:MODE *<Mode>*				Upper Limit Check on/off
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
ON |	Upper limit check on	ON	–	V2.15
OFF	Upper limit check off			
Description of command				
This command switches on or off the tolerance check with respect to the upper limit lines (current and average).				

CONFigure:MODulation:XPERror[:GMSK]:LIMit:LOWer:MODE <Mode>				Lower Limit Check on/off
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
ON |	Lower limit check on	ON	–	V2.15
OFF	Lower limit check off			
Description of command				
This command switches on or off the tolerance check with respect to the lower limit lines (current and average).				

CONFigure:MODulation:XPERror[:GMSK]:LIMit:DEFault *<Enable>*				Default Settings
<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON |	The parameters are set to their default values	ON	–	V2.15
OFF	Some or all parameters differ from the default values			
Description of command				
If used as a setting command with the parameter *ON* this command sets all parameters of the subsystem to their default values (the setting *OFF* causes an error message). If used as a query the command returns whether all parameters are set to their default values *(ON)* or not *(OFF)*.				

Subsystem SUBarrays:MODulation:XPERror[:GMSK]

The subsystem *SUBarrays:MODulation:XPERror[:GMSK]* defines the measurement range and the type of output values.

CONFigure:SUBarrays:MODulation:XPERror[:GMSK] <Mode>,<Start>,<Samples>{,<Start>,<Samples>}			Definition of Subarrays	
<Mode>	Description of parameters	Def. value	Def. unit	
ALL | **ARIThmetical |** **MINimum |** **MAXimum |** **IVAL,**	Return all measurement values Return arithm. mean value in every range Return minimum value in every range Return maximum value in every range Return single interpolated value at <Start>	ALL	–	
<Start>	Description of parameters	Def. value	Def. unit	
0 bit to 146 ¾ bit,	Start time in current range	0	bit	
<Samples>	Description of parameters	Def. value	Def. unit	FW vers.
1 to 588	Number of samples in current range	588	–	V2.15

Description of command

This command configures the `READ:SUBarrays...`, `FETCh:SUBarrays...`, and `SAMPle:SUBarrays:MODulation:XPERror[:GMSK]` commands. It restricts the measurement to up to 32 subranges where either all measurement results (the number of which is given by the second numerical parameter) or a single statistical value is returned. The subranges are defined by the start time and the number of test points which are located on a fixed, equidistant grid with a step width of ¼ bit. If <Start> does not coincide with a test point then the range will start at the next test point that is larger than <Start>.

For <Mode> = IVAL, the <Samples> parameter is ignored and the CMU returns a single measurement value corresponding to the abscissa value <Start>. If <Start> is located beween two test points with valid results then the result is calculated from the results at these two adjacent test points by linear interpolation.

The subranges may overlap but must be within the total range of the *MODulation:XPERror[:GMSK]* measurement. Test points outside this range are not measured (result *NAN)* and do not enter into the ARIThmetical, MINimum and MAXimum values.

By default, only one range corresponding to the total measurement range is used and all measurement values are returned.

Measured Values – Subsystem MODulation:XPERror[:GMSK]

The subsystem *MODulation:XPERror[:GMSK]* measures and returns the modulation results and compares them with the tolerance values. The subsystem corresponds to the various output elements in the graphical measurement menu *MODulation:XPERror[:GMSK].*

Scalar Results:

READ[:SCALar]:MODulation:XPERror[:GMSK]? Start single shot meas. and return results
FETCh[:SCALar]:MODulation:XPERror[:GMSK]? Read out meas. results (unsynchronized)
SAMPle[:SCALar]:MODulation:XPERror[:GMSK]? Read out meas. results (synchronized)

Returned values	Value range	Def. value	Def. unit	FW vers.
Phase Err. Peak Current,	–100.0° to +100.0°	NAN	deg	V2.15
Phase Err. Peak Average,	–100.0° to +100.0°	NAN	deg	
Phase Err. Peak MaxMin,	–100.0° to +100.0°	NAN	deg	
Phase Err. RMS (x3),	–100.0° to +100.0°	NAN	deg	
Origin Offset (x3),	–100.0 dB to +100.0 dB	NAN	dB	
I/Q Imbalance (x3),	–100.0 dB to +100.0 dB	NAN	dB	
Frequency Error (x3),	–1000.0 Hz to +1000.0 Hz	NAN	deg	
AvgBurstPowerCurr,	–137 dBm to +53 dBm	NAN	dBm	
BurstsOutOfTol,	0.0 % to 100.0 %	NAN	%	
Phase of Origin Offset Vector,	–180° to +180°	NAN	deg	
Timing Error	–100.0 bit to+100.0 bit (in Signalling mode only)	NAN	bit	

Description of command

These commands are always queries. They start a measurement and return all scalar measurement results (see chapter 5). The symbol (x3) behind a value indicates that the list contains three results corresponding to the *Current*, the *Average,* and the *MMAX* curve.

The phase of the origin offset vector, which is measured relative to the phase of the 3rd test point in the *Modulation* trace (bit ½), can be retrieved in remote control only. The origin offset vector in the I/Q plane is thus completely determined by its phase and its magnitude (i.e. the quantity *Origin Offset)*.

The calculation of results in an *average* or *peak* measurement is described in chapter 3 (cf. *calculation of statistical quantities*).

CALCulate:MODulation:XPERror[:GMSK]:LIMit:MATChing?				Bursts out of Tolerance
Returned values	Value range	Def. value	Def. unit	FW vers.
Phase Err. Peak Current,		INV	–	V2.15
Phase Err. Peak Average,		INV	–	
Phase Err. Peak MaxMin,	**For all measured values:**	INV	–	
Phase Err. RMS (x3),		INV	–	
Origin Offset (x3),		INV	–	
I/Q Imbalance (x3),		INV	–	
Frequency Error (x3),	**NMAU | NMAL | INV | OK**	INV	–	
AvgBurstPowerCurr		INV	–	

Description of command

This command is always a query. It indicates whether and in which way the error limits for the scalar measured values (see above command) have been exceeded.

The following messages may be returned for all measured values:

NMAU	Underflow of tolerance value	*not matching, underflow*
NMAL	Tolerance value exceeded	*not matching, overflow*
INV	Measurement invalid	*invalid*
OK	all tolerances matched	

READ:ARRay:MODulation:XPERror[:GMSK][:CURRent]? Phase Error in Burst
READ:ARRay:MODulation:XPERror[:GMSK]:AVERage?
READ:ARRay:MODulation:XPERror[:GMSK]:MMAXimum?
Start single shot measurement and return results ⇒ *RUN*
FETCh:ARRay:MODulation:XPERror[:GMSK][:CURRent]?
FETCh:ARRay:MODulation:XPERror[:GMSK]:AVERage?
FETCh:ARRay:MODulation:XPERror[:GMSK]:MMAXimum?
Read measurement results (unsynchronized) ⇒ *RUN*
SAMPle:ARRay:MODulation:XPERror[:GMSK][:CURRent]? SAMPle:ARRay:MODulation:XPERror[:GMSK]:AVERage?
SAMPle:ARRay:MODulation:XPERror[:GMSK]:MMAXimum?
Read measurement results (synchronized) ⇒ *RUN*

Returned values	Description of parameters	Def. value	Def. unit	FW vers.
–100.0 deg to+ 100.0 deg,	1st value for phase error	NAN	dB	V2.15
... ,	...	...	...	
–100.0 deg to+ 100.0 deg	xth value for phase error	NAN	dB	

Description of command

These commands are always queries. They return the phase error of the burst vs. time in a fixed ¼-bit pattern. The number of measured values is 588, corresponding to a time range of 0 bit to 146 ¾ bit. The calculation of *current, average, and mmax* (Min./Max.) results is explained in chapter 3 (cf. *display mode*).

READ:SUBarrays:MODulation:XPERror[:GMSK][:CURRent]? Subarray Results
READ:SUBarrays:MODulation:XPERror[:GMSK]:AVERage?
READ:SUBarrays:MODulation:XPERror[:GMSK]:MMAXimum?
Start single shot measurement and return results ⇒ *RUN*
FETCh:SUBarrays:MODulation:XPERror[:GMSK][:CURRent]?
FETCh:SUBarrays:MODulation:XPERror[:GMSK]:AVERage?
FETCh:SUBarrays:MODulation:XPERror[:GMSK]:MMAXimum?
Read meas. results (unsynchronized) ⇒ *RUN*
SAMPle:SUBarrays:MODulation:XPERror[:GMSK][:CURRent]?
SAMPle:SUBarrays:MODulation:XPERror[:GMSK]:AVERage?
SAMPle:SUBarrays:MODulation:XPERror[:GMSK]:MMAXimum?
Read results (synchronized) ⇒ *RUN*

Ret. values per subrange	Description of parameters	Def. value	Def. unit	FW vers.
–100.0 deg to+ 100.0 deg,	1st value for phase error	NAN	dB	V2.15
... ,	...	...	...	
–100.0 deg to+ 100.0 deg	xth value for phase error	NAN	dB	

Description of command

These commands are always queries. They return the phase error versus time in a fixed ¼- bit pattern and in the subranges defined by means of the `CONFigure:SUBarrays:MODulation:XPERror[:GMSK]` command. In the default setting of the configuration command the `READ:SUBarrays...`, `FETCh:SUBarrays...`, and `SAMPle:SUBarrays...` command group is equivalent to the `READ:ARRay...`, `FETCh:ARRay...`, and `SAMPle:ARRay...` command group described above.

The `CONFigure:SUBarrays:MODulation:XPERror[:GMSK]` command defines a maximum of 32 subranges. If one of the statistical modes `(ARIThmetical, MINimum, MAXimum)` is set, only one value is returned per subrange.

The calculation of *current, average, minimum,* and *maximum* results is explained in chapter 3 (cf. *display mode*).

MODulation[:OVERview]

The subsystem *MODulation[:OVERview]:EPSK* measures general scalar modulation parameters in 8PSK modulation. The subsystem corresponds to the measurement menu *Modulation,* application *Overview 8PSK,* and the associated popup menu *Modulation Configuration.*

Control of Measurement – Subsystem MODulation:OVERview:EPSK

The subsystem *MODulation:OVERview:EPSK* controls the modulation measurement. It corresponds to the softkey *Overview 8PSK* in the measurement menu *Modulation*.

INITiate:MODulation:OVERview:EPSK	Start new measurement	⇒ *RUN*
ABORt:MODulation:OVERview:EPSK	Abort running measurement and switch off	⇒ *OFF*
STOP:MODulation:OVERview:EPSK	Stop measurement after current stat. cycle	⇒ *STOP*
CONTinue:MODulation:OVERview:EPSK	Next measurement step (only *stepping mode*)	⇒ *RUN*
Description of command		FW vers.
These commands have no query form. They start and stop the modulation measurement, setting it to the status indicated in the top right column.		V2.15

CONFigure:MODulation:OVERview:EPSK:EREPorting <*Mode*>				Event Reporting
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
SRQ | **SOPC |** **SRSQ |** **OFF**	Service request Single operation complete SRQ and SOPC No reporting	OFF	–	V2.15
Description of command				
This command defines the events generated when the measurement is terminated or stopped *(event reporting,* see chapter 5 of CMU manual).				

FETCh:MODulation:OVERview:EPSK:STATus?				Measurement Status
Ret. values	Description of parameters	Def. value	Def. unit	FW vers.
OFF | **RUN |** **STOP |** **ERR |** **STEP |** **RDY,**	Measurement in the *OFF* state (`*RST` or `ABORt`) Running (after `INITiate, CONTinue` or `READ`) Stopped (`STOP`) *OFF* (could not be started) Stepping mode *(<stepmode>=STEP)* Stopped according to repetition mode and stop condition	OFF	–	V2.15
 1 to 10000 | **NONE,**	Counter for current statistics cycle No counting mode set	 NONE	 –	
 1 to 1000 | **NONE**	Counter for current evaluation period within a cycle Statistic count set to off	 NONE	 –	
Description of command				
This command is always a query. It returns the status of the measurement (see chapters 3 and 5 of CMU manual).				

Test Configuration

The commands of the following subsystems configure the *Modulation* measurement. They correspond to the sections in the *Modulation Configuration* menu that are related to the *Overview* application.

Subsystem MODulation:OVERview:EPSK:CONTrol

The subsystem *MODulation:OVERview:EPSK:CONTrol* configures the modulation measurement. It corresponds to the*Control* tab in the popup menu *Modulation Configuration*.

CONFigure:MODulation:OVERview:EPSK:CONTrol *<Mode>, <Statistics>* — Scope of Measurement

<Mode>	Description of parameters	Def. value	Def. unit	
SCALar | **ARRay**	Only scalar measured values (incl. tolerance matching) Scalar measured values and arrays	SCALar	–	
<Statistics>	Description of parameters	Def. value	Def. unit	FW vers.
1 to 1000 | **NONE**	No. of bursts within a statistics cycle Statistics off	100	–	V2.15

Description of command

This command selects the type of measured values and determines the number of bursts forming one statistics cycle.

CONFigure:MODulation:OVERview:EPSK:CONTrol:REPetition *<Repetition> ,<StopCond>,<Stepmode>* — Test Cycles

<Repetition>	Description of parameters	Def. value	Def. unit	
CONTinuous | **SINGleshot |** **1 to 10000**	Continuous measurement (until `STOP` or `ABORT`) Single shot measurement (until `Status = RDY`) Multiple measurement (*counting*, until `Status = STEP | RDY`)	SING	–	
<StopCond>	Description of parameters	Def. value	Def. unit	
SONerror | **NONE**	Stop measurement in case of error *(stop on error)* Continue measurement even in case of error	NONE	–	
<Stepmode>	Description of parameters	Def. value	Def. unit	FW vers.
STEP | **NONE**	Interrupt measurement after each statistics cycle Continue measurement according to its rep. mode	NONE	–	V2.15

Description of command

This command determines the number of statistics cycles, the stop condition and the stepping mode for the measurement.

Note: *In the case of READ commands (`READ:...`), the <Repetition> parameter has no effect; the measurement is always stopped after a single shot.*

CONFigure:MODulation:OVERview:EPSK:CONTrol:DEFault *<Enable>*				Default Settings
<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	The parameters are set to their default values Some or all parameters differ from the default values	ON	–	V2.15
Description of command				
If used as a setting command with the parameter *ON* this command sets all parameters of the subsystem to their default values (the setting *OFF* causes an error message). If used as a query the command returns whether all parameters are set to their default values *(ON)* or not *(OFF)*.				

Tolerance values – Subsystem MODulation:OEMP:EPSK:…

The subsystem *MODulation:OEMP:EPSK:…* defines settings for the modulation measurement **in all four 8PSK applications**, in particular the limits and the *Ref. Power Mode*. The limit settings are provided in the *Limits* tab in the popup menu *Modulation Configuration.*

CONFigure:MODulation:OEMP:EPSK:LIMit[:CURRent] ***<PhaseErrorPeak>, <PhaseErrorRMS>, <MagnErrorPeak>, <MagnErrorRMS>, <EVMErrorPeak>, <EVMErrorRMS>, <OriginOffset>, <IQImbalance>, <FreqError>***				Limits Current & Max
Parameter	Description of parameters	Def. value	Def. unit	FW vers.
0.0 % to +50.0 %,	EVMErrorPeak	+30.0	%	V2.15
0.0 % to +50.0 %,	EVMErrorRMS	+9.0	%	
0.0 % to +50.0 %,	MagnErrorPeak	+17.7	%	
0.0 % to +50.0 %,	MagnErrorRMS	+12.5	%	
0.0 deg to +180.0 deg,	PhaseErrorPeak	+20.0	deg	
0.0 deg to +180.0 deg,	PhaseErrorRMS	+5.0	deg	
–100.0 dB to +0.0 dB,	OriginOffset	–30.0	dB	
0 Hz to 999 Hz	FrequencyError	+90	Hz	
Description of command				
This command defines upper limits for the *Current* and *Max./Min*. traces and for the scalar modulation parameters derived from them.				

CONFigure:MODulation:OEMP:EPSK:LIMit:AVERage ***<PhaseErrorPeak>, <PhaseErrorRMS>, <MagnErrorPeak>, <MagnErrorRMS>, <EVMErrorPeak>, <EVMErrorRMS>, <OriginOffset>, <IQImbalance>, <FreqError>***				Limits Average
Parameter	Description of parameters	Def. value	Def. unit	FW vers.
0.0 % to +50.0 %,	EVMErrorPeak	+30.0	%	V2.15
0.0 % to +50.0 %,	EVMErrorRMS	+9.0	%	
0.0 % to +50.0 %,	MagnErrorPeak	+17.7	%	
0.0 % to +50.0 %,	MagnErrorRMS	+12.5	%	
0.0 deg to +180.0 deg,	PhaseErrorPeak	+20.0	deg	
0.0 deg to +180.0 deg,	PhaseErrorRMS	+5.0	deg	
–100.0 dB to +0.0 dB,	OriginOffset	–30.0	dB	
0 Hz to 999 Hz	FrequencyError	+90	Hz	
Description of command				
This command defines upper limits for the *Average* traces and for the scalar modulation parameters derived from them.				

CONFigure:MODulation:OEMP:EPSK:LIMit:P95Th *<EVM95%>, <MError95%>, <PError95%>*				95th Percentile
Parameter	Description of parameters	Def. value	Def. unit	FW vers.
0% to 50.0%,	95th percentile EVM	+5.0	%	V2.15
0% to 50.0%,	95th percentile modulation error	+5.0	%	
0° to +180°	95th percentile phase error	+5.0	deg	

Description of command

This command defines upper limits for the 95th percentile of the three quantities *error vector magnitude*, *modulation error*, and *phase error*. The 95th percentile is the limit below which 95% of the measured errors are located.

CONFigure:MODulation:OEMP:EPSK:LIMit:DEFault ***<Enable>***				Default Settings
<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON |	The parameters are set to their default values	ON	–	V2.15
OFF	Some or all parameters differ from the default values			

Description of command

If used as a setting command with the parameter *ON* this command sets all parameters of the subsystem to their default values (the setting *OFF* causes an error message).

If used as a query the command returns whether all parameters are set to their default values *(ON)* or not *(OFF)*.

CONFigure:MODulation:OEMP:EPSK:CONTrol:RPMode ***<Mode>***				Ref. Power Mode
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
CURRent |	Avg. Burst Power calculated from current burst	AVER	–	V3.60
AVERage |	Avg. Burst Power calculated from average curve			
DCOMpens	Avg. Burst compensated/corrected reference power			

Description of command

This command determines how the *Avg. Burst Power* for 8PSK-modulated signals is calculated.

NOTE

With firmware version V3.80 the default setting has been changed from CURR to AVER in order to comply with the current conformance test specification 51.010.

Measured Values – Subsystem MODulation:OVERview:EPSK

The subsystem *MODulation:OVERview:EPSK* measures and returns the modulation parameters and compares them with the tolerance values. The subsystem corresponds to the various output elements in the measurement menu *MODulation,* application *Overview 8PSK.*

READ[:SCALar]:MODulation:OVERview:EPSK?	Scalar Results: Start single shot measurement and return results			
FETCh[:SCALar]:MODulation:OVERview:EPSK?	Read out meas. results (unsynchronized)			
SAMPle[:SCALar]:MODulation:OVERview:EPSK?	Read out measurement results (synchronized)			
Returned values	Value range	Def. value	Def. unit	FW vers.
95thPercentileEVM,	0.0 % to 100.0 %	NAN	%	V2.15
95thPercentileMagErr,	0.0 % to 100.0 %	NAN	%	
95thPercentilePhErr,	–100.0 deg to +100.0 deg	NAN	deg	
EVMPeak (x3),	0.0 % to 100.0 %	NAN	%	
EVMRMS (x3),	0.0 % to 100.0 %	NAN	%	
MagnErrorPeak (x3),	–100.0 % to 100.0 %	NAN	%	
MagnErrorRMS (x3),	0.0 % to 100.0 %	NAN	%	
PhErrorPeak(x3),	–100.0 deg to +100.0 deg	NAN	deg	
PhErrorRMS (x3),	0.0 deg to +100.0 deg	NAN	deg	
OriginOffset (x3),	–100.0 dB to +100.0 dB	NAN	dB	
FrequencyError (x3),	–1000.0 Hz to +1000.0 Hz	NAN	Hz	
AvgBurstPowerCurr,	–137 dBm to +53 dBm	NAN	dBm	
BurstsOutOfTol,	0.0 % to 100.0 %	NAN	%	
Timing Advance Error *(Signalling* only)	–100 symbols to +100 symbols	NAN	(symb.)	

Description of command

These commands are always queries. They start a modulation measurement and output all scalar measurement results (see chapter 4). The calculation of results in an *average* or *peak* measurement is described in chapter 3 (see *calculation of statistical quantities*). The symbol (x3) behind a value indicates that the list contains three results corresponding to the *Current*, the *Average,* and the *MMax* value.

CALCulate:MODulation:OVERview:EPSK:LIMit:MATChing?				Bursts out of Tolerance
Returned values	Value range	Def. value	Def. unit	FW vers.
95thPercentileEVM,		INV	–	V2.15
95thPercentileMagErr,		INV	–	
95thPercentilePhErr,		INV	–	
EVMPeak (x3),	**For all measured values:**	INV	–	
EVMRMS (x3),		INV	–	
MagnErrorPeak (x3),		INV	–	
MagnErrorRMS (x3),		INV	–	
PhErrorPeak(x3),	**NMAU | NMAL | INV | OK**	INV	–	
PhErrorRMS (x3),		INV	–	
OriginOffset (x3),		INV	–	
FrequencyError (x3),		INV	–	
AvgBurstPowerCurr		INV	–	

Description of command

This command is always a query. It indicates whether and in which way the error limits for the scalar measured values (see above command) have been exceeded. The symbol (x3) behind a value indicates that the list contains three results corresponding to the *Current*, the *Average,* and the *MMax* value.

The following messages may be output for all measured values:

NMAU	Underflow of tolerance value	*not matching, underflow*
NMAL	Tolerance value exceeded	*not matching, overflow*
INV	Measurement invalid	*invalid*
OK	all tolerances matched	

MODulation:EVMagnitude

The subsystem *MODulation:EVMagnitude* measures the error vector magnitude as well as general scalar modulation parameters. The subsystem corresponds to the measurement menu *Modulation,* application *EVM 8PSK,* and the associated popup menu *Modulation Configuration.*

Control of Measurement – Subsystem MODulation:EVMagnitude

The subsystem *MODulation:EVMagnitude* controls the modulation measurement. It corresponds to the softkey *EVM 8PSK* in the measurement menu *Modulation*.

INITiate:MODulation:EVMagnitude:EPSK	Start new measurement	⇒ *RUN*
ABORt:MODulation:EVMagnitude:EPSK	Abort running measurement and switch off	⇒ *OFF*
STOP:MODulation:EVMagnitude:EPSK	Stop measurement after current stat. cycle	⇒ *STOP*
CONTinue:MODulation:EVMagnitude:EPSK	Next meas. step (only *stepping mode*)	⇒ *RUN*
Description of command		FW vers.
These commands have no query form. They start and stop the modulation measurement, setting it to the status indicated in the top right column.		V2.15

CONFigure:MODulation:EVMagnitude:EPSK:EREPorting <*Mode*>				Event Reporting
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
SRQ | **SOPC |** **SRSQ |** **OFF**	Service request Single operation complete SRQ and SOPC No reporting	OFF	–	V2.15
Description of command				
This command defines the events generated when the measurement is terminated or stopped *(event reporting,* see chapter 5 of CMU manual).				

FETCh:MODulation:EVMagnitude:EPSK:STATus?				Measurement Status
Ret. values	Description of parameters	Def. value	Def. unit	FW vers.
OFF | **RUN |** **STOP |** **ERR |** **STEP |** **RDY,**	Measurement in the *OFF* state (`*RST` or `ABORt`) Running (after `INITiate, CONTinue` or `READ`) Stopped (`STOP`) *OFF* (could not be started) Stepping mode *(<stepmode>=STEP)* Stopped according to repetition mode and stop condition	OFF	–	V2.15
	Counter for current statistics cycle			
1 to 10000 | **NONE,**	No counting mode set	NONE	–	
	Counter for current evaluation period within a cycle			
1 to 1000 | **NONE**	Statistic count set to off	NONE	–	
Description of command				
This command is always a query. It returns the status of the measurement (see chapters 3 and 5 of CMU manual).				

Test Configuration

The commands of the following subsystems configure the *Modulation* measurement. They correspond to the sections in the *Modulation Configuration* menu that are related to the *Error Vector Magnitude* application.

Subsystem MODulation:EVMagnitude:EPSK:CONTrol

The subsystem *MODulation:EVMagnitude:EPSK:CONTrol* configures the modulation measurement. It corresponds to the *Control* tab in the popup menu *Modulation Configuration*.

CONFigure:MODulation:EVMagnitude:EPSK:CONTrol <*Mode*>, <*Statistics*>				Scope of Measurement
<Mode>	Description of parameters	Def. value	Def. unit	
SCALar | ARRay	Only scalar measured values (incl. tolerance matching) Scalar measured values and arrays	ARRay	–	
<Statistics>	Description of parameters	Def. value	Def. unit	FW vers.
1 to 1000 | NONE	No. of bursts within a statistics cycle Statistics off	100	–	V2.15
Description of command				
This command selects the type of measured values and determines the number of bursts forming one statistics cycle.				

CONFigure:MODulation:EVMagnitude:EPSK:CONTrol:REPetition *<Repetition> ,<StopCond>,<Stepmode>*				Test Cycles
<Repetition>	Description of parameters	Def. value	Def. unit	
CONTinuous | SINGleshot | 1 to 10000	Continuous measurement (until `STOP` or `ABORT`) Single shot measurement (until `Status = RDY`) Multiple measurement (*counting*, until `Status = STEP | RDY`)	SING	–	
<StopCond>	Description of parameters	Def. value	Def. unit	
SONerror | NONE	Stop measurement in case of error *(stop on error)* Continue measurement even in case of error	NONE	–	
<Stepmode>	Description of parameters	Def. value	Def. unit	FW vers.
STEP | NONE	Interrupt measurement after each statistics cycle Continue measurement according to its rep. mode	NONE	–	V2.15
Description of command				
This command determines the number of statistics cycles, the stop condition and the stepping mode for the measurement. **Note:** *In the case of READ commands (`READ:...`), the <Repetition> parameter has no effect; the measurement is always stopped after a single shot.*				

CONFigure:MODulation:EVMagnitude:EPSK:CONTrol:DEFault *<Enable>*				Default Settings
<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	The parameters are set to their default values Some or all parameters differ from the default values	ON	–	V2.15
Description of command				
If used as a setting command with the parameter *ON* this command sets all parameters of the subsystem to their default values (the setting *OFF* causes an error message). If used as a query the command returns whether all parameters are set to their default values *(ON)* or not *(OFF)*.				

Tolerance values – Subsystem MODulation:OEMP:EPSK:LIMit

The subsystem *MODulation:OEMP:EPSK:LIMit* (see p. 6.86 ff) defines tolerance values for the modulation measurement **in all four applications**. The subsystem corresponds to the *Limits* tab in the popup menu *Modulation Configuration.*

Subsystem SUBarrays:MODulation

The subsystem *SUBarrays:MODulation* defines the measurement range and the type of output values.

CONFigure:SUBarrays:MODulation:EVMagnitude:EPSK <Mode>,<Start>,<Samples>{,<Start>,<Samples>}				Definition of Subarrays
<Mode>	Description of parameters	Def. value	Def. unit	
ALL | **ARIThmetical |** **MINimum |** **MAXimum |** **IVAL,**	Return all measurement values Return arithm. mean value in every range Return minimum value in every range Return maximum value in every range Return single interpolated value at <Start>	ALL	–	
<Start>	Description of parameters	Def. value	Def. unit	
3 bit to 144 bit,	Start time in current range	0	bit	
<Samples>	Description of parameters	Def. value	Def. unit	FW vers.
1 to 142	Number of samples in current range	142	–	V2.15
Description of command				
This command configures the `READ:SUBarrays...`, `FETCh:SUBarrays...`, and `SAMPle:SUBarrays:MODulation:EVMagnitude:EPSK` commands. It restricts the measurement to up to 32 subranges where either all measurement results (the number of which is given by the second numerical parameter) or a single statistical value is returned. The subranges are defined by the start time and the number of test points which are located on a fixed, equidistant grid with a step width of 1 bit. If <Start> does not coincide with a test point then the range will start at the next test point that is larger than <Start>. For <Mode> = IVAL, the <Samples> parameter is ignored and the CMU returns a single measurement value corresponding to the abscissa value <Start>. If <Start> is located beween two test points with valid results then the result is calculated from the results at these two adjacent test points by linear interpolation. The subranges may overlap but must be within the total range of the *Modulation* measurement. Test points outside this range are not measured (result *NAN)* and do not enter into the ARIThmetical, MINimum and MAXimum values. By default, only one range corresponding to the total measurement range is used and all measurement values are returned.				

Measured Values – Subsystem MODulation:EVMagnitude:EPSK

The subsystem *MODulation:EVMagnitude:EPSK* measures and returns the modulation parameters and compares them with the tolerance values. The subsystem corresponds to the various output elements in the measurement menu *MODulation,* application *EVM 8PSK.*

				Scalar Results:
READ[:SCALar]:MODulation:EVMagnitude:EPSK?				Start single shot meas. and return results
FETCh[:SCALar]:MODulation:EVMagnitude:EPSK?				Read out meas. results (unsynchronized)
SAMPle[:SCALar]:MODulation:EVMagnitude:EPSK?				Read out meas. results (synchronized)
Returned values	Value range	Def. value	Def. unit	FW vers.
95th Percentile EVM	0.0 % to 100.0 %	NAN	%	V2.15
EVM Peak (x3),	0.0 % to 100.0 %	NAN	%	
EVM RMS (x3),	0.0 % to 100.0 %	NAN	%	
Origin Offset (x3),	–100.0 dB to +100.0 dB	NAN	dB	
Frequency Error (x3),	–1000.0 Hz to +1000.0 Hz	NAN	Hz	
Avg Burst Power Curr,	–137 dBm to +53 dBm	NAN	dBm	
Bursts Out Of Tol,	0.0 % to 100.0 %	NAN	%	
Timing Advance Error *(Signalling* only)	–100 symbols to +100 symbols	NAN	(symb.)	

Description of command

These commands are always queries. They start a modulation measurement and output all scalar measurement results (see chapter 4). The calculation of results in an *average* or *peak* measurement is described in chapter 3 (see *calculation of statistical quantities*). The symbol (x3) behind a value indicates that the list contains three results corresponding to the *Current*, the *Average,* and the *MMax* value.

CALCulate:MODulation:EVMagnitude:EPSK:LIMit:MATChing?				Bursts out of Tolerance
Returned values	Value range	Def. value	Def. unit	FW vers.
95th Percentile EVM		INV	–	V2.15
Ph Error Peak (x3),		INV	–	
Ph Error RMS (x3),	**For all measured values:**	INV	–	
Origin Offset (x3),	**NMAU | NMAL | INV | OK**	INV	–	
Frequency Error(x3)		INV	–	

Description of command

This command is always a query. It indicates whether and in which way the error limits for the scalar measured values (see above command) have been exceeded. The symbol (x3) behind a value indicates that the list contains three results corresponding to the *Current*, the *Average,* and the *MMax* value. The limits are defined with the `CONFigure:MODulation:OEMP`... commands.

The following messages may be output for all measured values:

NMAU	Underflow of tolerance value	*not matching, underflow*
NMAL	Tolerance value exceeded	*not matching, overflow*
INV	Measurement invalid	*invalid*
OK	all tolerances matched	

READ:ARRay:MODulation:EVMagnitude:EPSK[:CURRent]? Phase Error in Burst
READ:ARRay:MODulation:EVMagnitude:EPSK:AVERage?
READ:ARRay:MODulation:EVMagnitude:EPSK:MMAXimum?
Start single shot measurement and return results ⇒ *RUN*
FETCh:ARRay:MODulation:EVMagnitude:EPSK[:CURRent]?
FETCh:ARRay:MODulation:EVMagnitude:EPSK:AVERage?
FETCh:ARRay:MODulation:EVMagnitude:EPSK:MMAXimum?
Read measurement results (unsynchronized) ⇒ *RUN*
SAMPle:ARRay:MODulation:EVMagnitude:EPSK[:CURRent]? SAMPle:ARRay:MODulation:EVMagnitude:EPSK:AVERage?
SAMPle:ARRay:MODulation:EVMagnitude:EPSK:MMAXimum?
Read measurement results (synchronized) ⇒ *RUN*

Returned values	Description of parameters	Def. value	Def. unit	FW vers.
0.0 % to+ 100.0 %,	1st value for error vector magnitude	NAN	%	V2.15
... ,	...	...	...	
0.0 % to+ 100.0 %	xth value for error vector magnitude	NAN	%	

Description of command

These commands are always queries. They return the error vector magnitude vs. time at fixed, equidistant test points. The number of measured values is 142, corresponding to a time range of 3 bit to 144 bit.

The calculation of *current, average, and mmax* (Min./Max.) results is explained in chapter 3 (see *display mode*).

READ:SUBarrays:MODulation:EVMagnitude:EPSK[:CURRent]? Subarray Results
READ:SUBarrays:MODulation:EVMagnitude:EPSK:AVERage?
READ:SUBarrays:MODulation:EVMagnitude:EPSK:MMAXimum?
Start single shot measurement and return results ⇒ *RUN*
FETCh:SUBarrays:MODulation:EVMagnitude:EPSK[:CURRent]?
FETCh:SUBarrays:MODulation:EVMagnitude:EPSK:AVERage?
FETCh:SUBarrays:MODulation:EVMagnitude:EPSK:MMAXimum?
Read meas. results (unsynchronized) ⇒ *RUN*
SAMPle:SUBarrays:MODulation:EVMagnitude:EPSK[:CURRent]? SAMPle:SUBarrays:MODulation:EVMagnitude:EPSK:AVERage?
SAMPle:SUBarrays:MODulation:EVMagnitude:EPSK:MMAXimum?
Read results (synchronized) ⇒ *RUN*

Ret. values per subrange	Description of parameters	Def. value	Def. unit	FW vers.
0.0 % to+ 100.0 %,	1st value for error vector magnitude	NAN	%	V2.15
... ,	...	...	...	
0.0 % to+ 100.0 %	xth value for error vector magnitude	NAN	%	

Description of command

These commands are always queries. They measure and return the error vector magnitude versus time in the subranges defined by means of the `CONFigure:SUBarrays:MODulation:EVMagnitude:EPSK` command. In the default setting of the configuration command the `READ:SUBarrays...`, `FETCh:SUBarrays...`, and `SAMPle:SUBarrays...` command group is equivalent to the `READ:ARRay...`, `FETCh:ARRay...`, and `SAMPle:ARRay...` command group described above.

The `CONFigure:SUBarrays:MODulation:EVMagnitude:EPSK` command defines a maximum of 32 subranges. If one of the statistical modes `(ARIThmetical, MINimum, MAXimum)` is set, only one value is returned per subrange.

The calculation of *current, average, minimum,* and *maximum* results is explained in chapter 3 (see *display mode*).

Demodulated Bits (MODulation:EVMagnitude:EPSK:DBITs…)

The following commands select the symbol range and control the readout of the demodulated bits. In manual control the symbol range is selected via marker functions; the demodulated bits are displayed in a bar below the test diagram.

NOTE

The demodulation of symbols must be disabled explicitly using `CONFigure:MODulation:EVMagnitude:EPSK:DBITs ON`, *otherwise the remaining commands in this section return invalid results.*

CONFigure:MODulation:EVMagnitude:EPSK:DBITs *<Enable>*		Enable/Disable Demodulation		
<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	Demodulation enabled Demodulated disabled, no valid results	OFF	–	V3.80
Description of command				
This command enables or disables the demodulation of symbols in the *EVM 8PSK* application.				

Peak Values				
READ[:SCALar]:MODulation:EVMagnitude:EPSK:DBITS:PEAK? Start single shot meas. and return results **FETCh[:SCALar]:MODulation:EVMagnitude:EPSK:DBITS:PEAK?** Read out meas. results (unsynchronized) **SAMPle[:SCALar]:MODulation:EVMagnitude:EPSK:DBITS:PEAK?** Read out meas. results (synchronized)				
Returned values	Value range	Def. value	Def. unit	FW vers.
3 to 144, **0 to 7**	Symbol no. with the peak EVM Demod. bits at the EVM peak	NAN NAN	(symb.) –	V3.80
Description of command				
These commands are always queries. They start a modulation measurement (`READ…`) and/or return the number of the symbol with the peak EVM and the demodulated bits at this position. The demodulated bits are returned as a decimal value, 1 corresponding to 001 in the measurement menu.				

Single Value				
READ[:SCALar]:MODulation:EVMagnitude:EPSK:DBITS? *<Symbol>* Start single shot meas. and return results **FETCh[:SCALar]:MODulation:EVMagnitude:EPSK:DBITS? *<Symbol>*** Read out meas. results (unsynchronized) **SAMPle[:SCALar]:MODulation:EVMagnitude:EPSK:DBITS? *<Symbol>*** Read out meas. results (synchronized)				
<Symbol>	Value range	Def. value	Def. unit	
3 to 144	Evaluated symbol number	NAN	(symb.)	
Returned values	Value range	Def. value	Def. unit	FW vers.
0 to 7	Demod. bits at the specified symbol	NAN	–	V3.80
Description of command				
These commands are always queries. They start a modulation measurement (`READ…`) and/or return the demodulated bits for a specific symbol. The demodulated bits are returned as a decimal value, 1 corresponding to 001 in the measurement menu.				

Single Value

READ:ARRay:MODulation:EVMagnitude:EPSK:DBITS?	Start single shot meas. and return results
FETCh:ARRay:MODulation:EVMagnitude:EPSK:DBITS?	Read out meas. results (unsynchronized)
SAMPle:ARRay:MODulation:EVMagnitude:EPSK:DBITS?	Read out meas. results (synchronized)

Returned values	Value range	Def. value	Def. unit	FW vers.
0 to 7,	Demod. bits at symbol no. 3	NAN	–	V3.80
…			–	
0 to 7	Demod. bits at symbol no. 144	NAN	–	

Description of command

These commands are always queries. They start a modulation measurement (`READ…`) and/or return the demodulated bits at all symbols (142 returned values). The demodulated bits are returned as decimal values, 1 corresponding to 001 in the measurement menu.

MODulation:PERRor

The subsystem *MODulation:PERRor* measures the phase error as well as general scalar modulation parameters. The subsystem corresponds to the measurement menu *Modulation,* application *Phase Error 8PSK,* and the associated popup menu *Modulation Configuration.*

Control of Measurement – Subsystem MODulation:PERRor

The subsystem *MODulation:PERRor* controls the modulation measurement. It corresponds to the softkey *Phase Error 8PSK* in the measurement menu *Modulation*.

INITiate:MODulation[:PERRor]:EPSK	Start new measurement	⇒ *RUN*
ABORt:MODulation[:PERRor]:EPSK	Abort running measurement and switch off	⇒ *OFF*
STOP:MODulation[:PERRor]:EPSK	Stop measurement after current stat. cycle	⇒ *STOP*
CONTinue:MODulation[:PERRor]:EPSK	Next measurement step (only *stepping mode*)	⇒ *RUN*
Description of command		FW vers.
These commands have no query form. They start and stop the modulation measurement, setting it to the status indicated in the top right column.		V2.15

CONFigure:MODulation[:PERRor]:EPSK:EREPorting <*Mode*>				Event Reporting
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
SRQ |	Service request	OFF	–	V2.15
SOPC |	Single operation complete			
SRSQ |	SRQ and SOPC			
OFF	No reporting			
Description of command				
This command defines the events generated when the measurement is terminated or stopped *(event reporting,* see chapter 5 of CMU manual).				

FETCh:MODulation[:PERRor]:EPSK:STATus?				Measurement Status
Ret. values	Description of parameters	Def. value	Def. unit	FW vers.
OFF |	Measurement in the *OFF* state (`*RST` or `ABORt`)	OFF	–	V2.15
RUN |	Running (after `INITiate, CONTinue` or `READ`)			
STOP |	Stopped (`STOP`)			
ERR |	*OFF* (could not be started)			
STEP |	Stepping mode *(<stepmode>=STEP)*			
RDY,	Stopped according to repetition mode and stop condition			
	Counter for current statistics cycle			
1 to 10000 |	No counting mode set			
NONE,		NONE	–	
	Counter for current evaluation period within a cycle			
1 to 1000 |	Statistic count set to off			
NONE		NONE	–	
Description of command				
This command is always a query. It returns the status of the measurement (see chapters 3 and 5 of CMU manual).				

Test Configuration

The commands of the following subsystems configure the *Modulation* measurement. They correspond to the sections in the *Modulation Configuration* menu that are related to the *Phase Error* application.

Subsystem MODulation[:PERRor]:EPSK:CONTrol

The subsystem *MODulation[:PERRor]:EPSK:CONTrol* configures the modulation measurement. It corresponds to the *Control* tab in the popup menu *Modulation Configuration*.

CONFigure:MODulation[:PERRor]:EPSK:CONTrol <Mode>, <Statistics>				Scope of Measurement
<Mode>	Description of parameters	Def. value	Def. unit	
SCALar | **ARRay**	Only scalar measured values (incl. tolerance matching) Scalar measured values and arrays	ARRay	–	
<Statistics>	Description of parameters	Def. value	Def. unit	FW vers.
1 to 1000 | **NONE**	No. of bursts within a statistics cycle Statistics off	100	–	V2.15
Description of command				
This command selects the type of measured values and determines the number of bursts forming one statistics cycle.				

CONFigure:MODulation[:PERRor]:EPSK:CONTrol:REPetition *<Repetition> ,<StopCond>,<Stepmode>*				Test Cycles
<Repetition>	Description of parameters	Def. value	Def. unit	
CONTinuous | **SINGleshot |** **1 to 10000**	Continuous measurement (until `STOP` or `ABORT`) Single shot measurement (until `Status = RDY`) Multiple measurement (*counting*, until `Status = STEP | RDY`)	SING	–	
<StopCond>	Description of parameters	Def. value	Def. unit	
SONerror | **NONE**	Stop measurement in case of error *(stop on error)* Continue measurement even in case of error	NONE	–	
<Stepmode>	Description of parameters	Def. value	Def. unit	FW vers.
STEP | **NONE**	Interrupt measurement after each statistics cycle Continue measurement according to its rep. mode	NONE	–	V2.15
Description of command				
This command determines the number of statistics cycles, the stop condition and the stepping mode for the measurement. **Note:** *In the case of READ commands (`READ:...`), the <Repetition> parameter has no effect; the measurement is always stopped after a single shot.*				

CONFigure:MODulation[:PERRor]:EPSK:CONTrol:DEFault *<Enable>*				Default Settings
<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	The parameters are set to their default values Some or all parameters differ from the default values	ON	–	V2.15
Description of command				
If used as a setting command with the parameter *ON* this command sets all parameters of the subsystem to their default values (the setting *OFF* causes an error message). If used as a query the command returns whether all parameters are set to their default values *(ON)* or not *(OFF)*.				

Tolerance values – Subsystem MODulation:OEMP:EPSK:LIMit

The subsystem *MODulation:OEMP:EPSK:LIMit* (see p. 6.86 ff) defines tolerance values for the modulation measurement **in all four applications**. The subsystem corresponds to the *Limits* tab in the popup menu *Modulation Configuration.*

Subsystem SUBarrays:MODulation[:PERRor]:EPSK

The subsystem *SUBarrays:MODulation* defines the measurement range and the type of output values.

CONFigure:SUBarrays:MODulation[:PERRor]:EPSK <Mode>,<Start>,<Samples>{,<Start>,<Samples>}				Definition of Subarrays
<Mode>	Description of parameters	Def. value	Def. unit	
ALL | **ARIThmetical |** **MINimum |** **MAXimum |** **IVAL,**	Return all measurement values Return arithm. mean value in every range Return minimum value in every range Return maximum value in every range Return single interpolated value at <Start>	ALL	–	
<Start>	Description of parameters	Def. value	Def. unit	
3 bit to 144 bit,	Start time in current range	0	bit	
<Samples>	Description of parameters	Def. value	Def. unit	FW vers.
1 to 142	Number of samples in current range	142	–	V2.15
Description of command				
This command configures the `READ:SUBarrays...`, `FETCh:SUBarrays...`, and `SAMPle:SUBarrays:MODulation[:PERRor]:EPSK` commands. It restricts the measurement to up to 32 subranges where either all measurement results (the number of which is given by the second numerical parameter) or a single statistical value is returned. The subranges are defined by the start time and the number of test points which are located on a fixed, equidistant grid with a step width of 1 bit. If <Start> does not coincide with a test point then the range will start at the next test point that is larger than <Start>. For <Mode> = IVAL, the <Samples> parameter is ignored and the CMU returns a single measurement value corresponding to the abscissa value <Start>. If <Start> is located beween two test points with valid results then the result is calculated from the results at these two adjacent test points by linear interpolation. The subranges may overlap but must be within the total range of the *Modulation* measurement. Test points outside this range are not measured (result *NAN)* and do not enter into the ARIThmetical, MINimum and MAXimum values. By default, only one range corresponding to the total measurement range is used and all measurement values are returned.				

Measured Values – Subsystem MODulation[:PERRor]:EPSK

The subsystem *MODulation[:PERRor]:EPSK* measures and returns the modulation parameters and compares them with the tolerance values. The subsystem corresponds to the various output elements in the measurement menu *MODulation,* application *Phase Error 8PSK.*

				Scalar Results:
READ[:SCALar]:MODulation[:PERRor]:EPSK?	Start single shot meas. and return results			
FETCh[:SCALar]:MODulation[:PERRor]:EPSK?	Read out meas. results (unsynchronized)			
SAMPle[:SCALar]:MODulation[:PERRor]:EPSK?	Read out measurement results (synchronized)			
Returned values	Value range	Def. value	Def. unit	FW vers.
95thPercentilePhase Error	0.0 % to 100.0 %	NAN	%	V2.15
PhErrorPeak (x3),	–100.0 deg to +100.0 deg	NAN	%	
PhErrorRMS (x3),	0.0 deg to +100.0 deg	NAN	%	
OriginOffset (x3),	–100.0 dB to +100.0 dB	NAN	dB	
FrequencyError (x3),	–1000.0 Hz to +1000.0 Hz	NAN	Hz	
AvgBurstPowerCurr,	–137 dBm to +53 dBm	NAN	dBm	
BurstsOutOfTol,	0.0 % to 100.0 %	NAN	%	
Timing Advance Error *(Signalling* only)	–100 symbols to +100 symbols	NAN	(symb.)	
Description of command				

These commands are always queries. They start a modulation measurement and output all scalar measurement results (see chapter 4), either for the whole burst or for the 1st ten valid symbols in the burst. The calculation of results in an *average* or *peak* measurement is described in chapter 3 (see *calculation of statistical quantities*). The symbol (x3) behind a value indicates that the list contains three results corresponding to the *Current*, the *Average,* and the *MMax* value.

CALCulate:MODulation[:PERRor]:EPSK:LIMit:MATChing?				Bursts out of Tolerance
Returned values	Value range	Def. value	Def. unit	FW vers.
95thPercentilePhError		INV	–	V2.15
PhErrorPeak (x3),		INV	–	
PhErrorRMS (x3),	**For all measured values:**	INV	–	
OriginOffset (x3),	**NMAU | NMAL | INV | OK**	INV	–	
FrequencyError(x3)		INV	–	
Description of command				

This command is always a query. It indicates whether and in which way the error limits for the scalar measured values (see above command) have been exceeded. The symbol (x3) behind a value indicates that the list contains three results corresponding to the *Current*, the *Average,* and the *MMax* value. The limits are defined with the `CONFigure:MODulation:OEMP`... commands.

The following messages may be output for all measured values:

NMAU	Underflow of tolerance value	*not matching, underflow*
NMAL	Tolerance value exceeded	*not matching, overflow*
INV	Measurement invalid	*invalid*
OK	all tolerances matched	

READ:ARRay:MODulation[:PERRor]:EPSK[:CURRent]? Phase Error in Burst
READ:ARRay:MODulation[:PERRor]:EPSK:AVERage?
READ:ARRay:MODulation[:PERRor]:EPSK:MMAXimum?
Start single shot measurement and return results ⇒ *RUN*
FETCh:ARRay:MODulation[:PERRor]:EPSK[:CURRent]?
FETCh:ARRay:MODulation[:PERRor]:EPSK:AVERage?
FETCh:ARRay:MODulation[:PERRor]:EPSK:MMAXimum?
Read measurement results (unsynchronized) ⇒ *RUN*
SAMPle:ARRay:MODulation[:PERRor]:EPSK[:CURRent]? SAMPle:ARRay:MODulation[:PERRor]:EPSK:AVERage?
SAMPle:ARRay:MODulation[:PERRor]:EPSK:MMAXimum?
Read measurement results (synchronized) ⇒ *RUN*

Returned values	Description of parameters	Def. value	Def. unit	FW vers.
–100.0 deg to+ 100.0 deg,	1st value for phase error	NAN	deg	V2.15
... ,	...	...	...	
–100.0 deg to+ 100.0 deg	xth value for phase error	NAN	deg	

Description of command

These commands are always queries. They return the phase error vs. time at fixed, equidistant test points. The number of measured values is 142, corresponding to a time range of 3 bit to 142 bit.

The calculation of *current, average, and mmax* (Min./Max.) results is explained in chapter 3 (see *display mode*).

READ:SUBarrays:MODulation[:PERRor]:EPSK[:CURRent]? Subarray Results
READ:SUBarrays:MODulation[:PERRor]:EPSK:AVERage?
READ:SUBarrays:MODulation[:PERRor]:EPSK:MMAXimum?
Start single shot measurement and return results ⇒ *RUN*
FETCh:SUBarrays:MODulation[:PERRor]:EPSK[:CURRent]?
FETCh:SUBarrays:MODulation[:PERRor]:EPSK:AVERage?
FETCh:SUBarrays:MODulation[:PERRor]:EPSK:MMAXimum?
Read meas. results (unsynchronized) ⇒ *RUN*
SAMPle:SUBarrays:MODulation[:PERRor]:EPSK[:CURRent]? SAMPle:SUBarrays:MODulation[:PERRor]:EPSK:AVERage?
SAMPle:SUBarrays:MODulation[:PERRor]:EPSK:MMAXimum?
Read results (synchronized) ⇒ *RUN*

Ret. values per subrange	Description of parameters	Def. value	Def. unit	FW vers.
100.0 deg to+ 100.0 deg,	1st value for phase error	NAN	deg	V2.15
... ,	...	...	...	
–100.0 deg to+ 100.0 deg	xth value for phase error	NAN	deg	

Description of command

These commands are always queries. They measure and return the phase error versus time in the subranges defined by means of the `CONFigure:SUBarrays:MODulation[:PERRor]:EPSK` command. In the default setting of the configuration command the `READ:SUBarrays...`, `FETCh:SUBarrays...`, and `SAMPle:SUBarrays...` command group is equivalent to the `READ:ARRay...`, `FETCh:ARRay...`, and `SAMPle:ARRay...` command group described above.

The `CONFigure:SUBarrays:MODulation[:PERRor]:EPSK` command defines a maximum of 32 subranges. If one of the statistical modes (`ARIThmetical`, `MINimum`, `MAXimum`) is set, only one value is returned per subrange.

The calculation of *current, average, minimum,* and *maximum* results is explained in chapter 3 (see *display mode*).

Demodulated Bits (MODulation[:PERRor]:EPSK:DBITs…)

The following commands select the symbol range and control the readout of the demodulated bits. In manual control the symbol range is selected via marker functions; the demodulated bits are displayed in a bar below the test diagram.

NOTE

The demodulation of symbols must be disabled explicitly using `CONFigure:MODulation[:PERRor]:EPSK:DBITs ON`, otherwise the remaining commands in this section return invalid results.

CONFigure:MODulation[:PERRor]:EPSK:DBITs *<Enable>*		Enable/Disable Demodulation		
<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	Demodulation enabled Demodulated disabled, no valid results	OFF	–	V3.80
Description of command				
This command enables or disables the demodulation of symbols in the *Phase Error 8PSK* application.				

		Peak Values		
READ[:SCALar]:MODulation[:PERRor]:EPSK:DBITS:PEAK?		Start single shot meas. and return results		
FETCh[:SCALar]:MODulation[:PERRor]:EPSK:DBITS:PEAK?		Read out meas. results (unsynchronized)		
SAMPle[:SCALar]:MODulation[:PERRor]:EPSK:DBITS:PEAK?		Read out meas. results (synchronized)		
Returned values	Value range	Def. value	Def. unit	FW vers.
3 to 144, **0 to 7**	Symbol no. with the peak phase error Demod. bits at the phase error peak	NAN NAN	(symb.) –	V3.80
Description of command				
These commands are always queries. They start a modulation measurement (`READ…`) and/or return the number of the symbol with the largest absolute value of the phase error and the demodulated bits at this position. The demodulated bits are returned as a decimal value, 1 corresponding to 001 in the measurement menu.				

		Single Value		
READ[:SCALar]:MODulation[:PERRor]:EPSK:DBITS? *<Symbol>*		Start single shot meas. and return results		
FETCh[:SCALar]:MODulation[:PERRor]:EPSK:DBITS? *<Symbol>*		Read out meas. results (unsynchronized)		
SAMPle[:SCALar]:MODulation[:PERRor]:EPSK:DBITS? *<Symbol>*		Read out meas. results (synchronized)		
<Symbol>	Value range	Def. value	Def. unit	
3 to 144	Evaluated symbol number	NAN	(symb.)	
Returned values	Value range	Def. value	Def. unit	FW vers.
0 to 7	Demod. bits at the specified symbol	NAN	–	V3.80
Description of command				
These commands are always queries. They start a modulation measurement (`READ…`) and/or return the demodulated bits for a specific symbol. The demodulated bits are returned as a decimal value, 1 corresponding to 001 in the measurement menu.				

				Single Value
READ:ARRay:MODulation[:PERRor]:EPSK:DBITS?				Start single shot meas. and return results
FETCh:ARRay:MODulation[:PERRor]:EPSK:DBITS?				Read out meas. results (unsynchronized)
SAMPle:ARRay:MODulation[:PERRor]:EPSK:DBITS?				Read out meas. results (synchronized)
Returned values	Value range	Def. value	Def. unit	FW vers.
0 to 7, **…** **0 to 7**	Demod. bits at symbol no. 3 Demod. bits at symbol no. 144	NAN NAN	– – –	V3.80
Description of command				
These commands are always queries. They start a modulation measurement (`READ…`) and/or return the demodulated bits at all symbols (142 returned values). The demodulated bits are returned as decimal values, 1 corresponding to 001 in the measurement menu.				

MODulation:MERRor

The subsystem *MODulation:MERRor* measures the magnitude error as well as general scalar modulation parameters. The subsystem corresponds to the measurement menu *Modulation,* application *Magn. Error 8PSK,* and the associated popup menu *Modulation Configuration.*

Control of Measurement – Subsystem MODulation:MERRor

The subsystem *MODulation:MERRor* controls the modulation measurement. It corresponds to the softkey *Magn. Error 8PSK* in the measurement menu *Modulation*.

INITiate:MODulation:MERRor:EPSK	Start new measurement	⇒ *RUN*
ABORt:MODulation:MERRor:EPSK	Abort running measurement and switch off	⇒ *OFF*
STOP:MODulation:MERRor:EPSK	Stop measurement after current stat. cycle	⇒ *STOP*
CONTinue:MODulation:MERRor:EPSK	Next measurement step (only *stepping mode*)	⇒ *RUN*
Description of command		FW vers.
These commands have no query form. They start and stop the modulation measurement, setting it to the status indicated in the top right column.		V2.15

CONFigure:MODulation:MERRor:EPSK:EREPorting <*Mode*>				Event Reporting
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
SRQ | **SOPC |** **SRSQ |** **OFF**	Service request Single operation complete SRQ and SOPC No reporting	OFF	–	V2.15
Description of command				
This command defines the events generated when the measurement is terminated or stopped *(event reporting,* see chapter 5 of CMU manual).				

FETCh:MODulation:MERRor:EPSK:STATus?				Measurement Status
Ret. values	Description of parameters	Def. value	Def. unit	FW vers.
OFF | **RUN |** **STOP |** **ERR |** **STEP |** **RDY,**	Measurement in the *OFF* state (`*RST` or `ABORt`) Running (after `INITiate, CONTinue` or `READ`) Stopped (`STOP`) *OFF* (could not be started) Stepping mode *(<stepmode>=STEP)* Stopped according to repetition mode and stop condition	OFF	–	V2.15
1 to 10000 | **NONE,**	Counter for current statistics cycle No counting mode set	NONE	–	
1 to 1000 | **NONE**	Counter for current evaluation period within a cycle Statistic count set to off	NONE	–	
Description of command				
This command is always a query. It returns the status of the measurement (see chapters 3 and 5 of CMU manual).				

Test Configuration

The commands of the following subsystems configure the *Modulation* measurement. They correspond to the sections in the *Modulation Configuration* menu that are related to the *Magnitude Error* application.

Subsystem MODulation:MERRor:EPSK:CONTrol

The subsystem *MODulation:MERRor:EPSK:CONTrol* configures the modulation measurement. It corresponds to the *Control* tab in the popup menu *Modulation Configuration*.

CONFigure:MODulation:MERRor:EPSK:CONTrol *<Mode>, <Statistics>*				Scope of Measurement
<Mode>	Description of parameters	Def. value	Def. unit	
SCALar | **ARRay**	Only scalar measured values (incl. tolerance matching) Scalar measured values and arrays	ARRay	–	
<Statistics>	Description of parameters	Def. value	Def. unit	FW vers.
1 to 1000 | **NONE**	No. of bursts within a statistics cycle Statistics off	100	–	V2.15
Description of command				
This command selects the type of measured values and determines the number of bursts forming one statistics cycle.				

CONFigure:MODulation:MERRor:EPSK:CONTrol:REPetition *<Repetition> ,<StopCond>,<Stepmode>*				Test Cycles
<Repetition>	Description of parameters	Def. value	Def. unit	
CONTinuous | **SINGleshot |** **1 to 10000**	Continuous measurement (until `STOP` or `ABORT`) Single shot measurement (until `Status = RDY`) Multiple measurement (*counting*, until `Status = STEP | RDY`)	SING	–	
<StopCond>	Description of parameters	Def. value	Def. unit	
SONerror | **NONE**	Stop measurement in case of error *(stop on error)* Continue measurement even in case of error	NONE	–	
<Stepmode>	Description of parameters	Def. value	Def. unit	FW vers.
STEP | **NONE**	Interrupt measurement after each statistics cycle Continue measurement according to its rep. mode	NONE	–	V2.15
Description of command				
This command determines the number of statistics cycles, the stop condition and the stepping mode for the measurement. **Note:** *In the case of READ commands (`READ:...`), the <Repetition> parameter has no effect; the measurement is always stopped after a single shot.*				

CONFigure:MODulation:MERRor:EPSK:CONTrol:DEFault *<Enable>*				Default Settings
<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	The parameters are set to their default values Some or all parameters differ from the default values	ON	–	V2.15
Description of command				
If used as a setting command with the parameter *ON* this command sets all parameters of the subsystem to their default values (the setting *OFF* causes an error message). If used as a query the command returns whether all parameters are set to their default values *(ON)* or not *(OFF)*.				

Tolerance values – Subsystem MODulation:OEMP:EPSK:LIMit

The subsystem *MODulation:OEMP:EPSK:LIMit* (see p. 6.86 ff) defines tolerance values for the modulation measurement **in all four applications**. The subsystem corresponds to the *Limits* tab in the popup menu *Modulation Configuration.*

Subsystem SUBarrays:MODulation

The subsystem *SUBarrays:MODulation* defines the measurement range and the type of output values.

CONFigure:SUBarrays:MODulation:MERRor:EPSK **<Mode>,<Start>,<Samples>{,<Start>,<Samples>}**				Definition of Subarrays
<Mode>	Description of parameters	Def. value	Def. unit	
ALL | **ARIThmetical |** **MINimum |** **MAXimum |** **IVAL,**	Return all measurement values Return arithm. mean value in every range Return minimum value in every range Return maximum value in every range Return single interpolated value at <Start>	ALL	–	
<Start>	Description of parameters	Def. value	Def. unit	
3 bit to 144 bit,	Start time in current range	0	bit	
<Samples>	Description of parameters	Def. value	Def. unit	FW vers.
1 to 142	Number of samples in current range	142	–	V2.15
Description of command				
This command configures the `READ:SUBarrays...`, `FETCh:SUBarrays...`, and `SAMPle:SUBarrays:MODulation:MERRor:EPSK` commands. It restricts the measurement to up to 32 subranges where either all measurement results (the number of which is given by the second numerical parameter) or a single statistical value is returned. The subranges are defined by the start time and the number of test points which are located on a fixed, equidistant grid with a step width of 1 bit. If <Start> does not coincide with a test point then the range will start at the next test point that is larger than <Start>. For <Mode> = IVAL, the <Samples> parameter is ignored and the CMU returns a single measurement value corresponding to the abscissa value <Start>. If <Start> is located beween two test points with valid results then the result is calculated from the results at these two adjacent test points by linear interpolation. The subranges may overlap but must be within the total range of the *Modulation* measurement. Test points outside this range are not measured (result *NAN)* and do not enter into the ARIThmetical, MINimum and MAXimum values. By default, only one range corresponding to the total measurement range is used and all measurement values are returned.				

Measured Values – Subsystem MODulation:MERRor:EPSK

The subsystem *MODulation:MERRor:EPSK* measures and returns the modulation parameters and compares them with the tolerance values. The subsystem corresponds to the various output elements in the measurement menu *MODulation,* application *Magn. Error 8PSK.*

			Scalar Results:	
READ[:SCALar]:MODulation:MERRor:EPSK?	Start single shot meas. and return results			
FETCh[:SCALar]:MODulation:MERRor:EPSK?	Read out meas. results (unsynchronized)			
SAMPle[:SCALar]:MODulation:MERRor:EPSK?	Read out measurement results (synchronized)			
Returned values	Value range	Def. value	Def. unit	FW vers.
95thPercentileMErr	0.0 % to 100.0 %	NAN	%	V2.15
Magn. Error Peak (x3),	–100.0 % to 100.0 %	NAN	%	
Magn. Error Peak (x3),	0.0 % to 100.0 %	NAN	%	
OriginOffset (x3),	–100.0 dB to +100.0 dB	NAN	dB	
FrequencyError (x3),	–1000.0 Hz to +1000.0 Hz	NAN	Hz	
AvgBurstPowerCurr,	–137 dBm to +53 dBm	NAN	dBm	
BurstsOutOfTol,	0.0 % to 100.0 %	NAN	%	
Timing Advance Error (*Signalling* only)	–100 symbols to +100 symbols	NAN	(symb.)	

Description of command

These commands are always queries. They start a modulation measurement and output all scalar measurement results (see chapter 4), either for the whole burst or for the 1st ten valid symbols in the burst. The calculation of results in an *average* or *peak* measurement is described in chapter 3 (see *calculation of statistical quantities*).
The symbol (x3) behind a value indicates that the list contains three results corresponding to the *Current*, the *Average,* and the *MMax* value.

CALCulate:MODulation:MERRor:EPSK:LIMit:MATChing?			Bursts out of Tolerance	
Returned values	Value range	Def. value	Def. unit	FW vers.
95thPercentileMErr		INV	–	V2.15
MErrPeak (x3),		INV	–	
MErrRMS (x3),	**For all measured values:**	INV	–	
OriginOffset (x3),	**NMAU | NMAL | INV | OK**	INV	–	
FrequencyError (x3)		INV	–	

Description of command

This command is always a query. It indicates whether and in which way the error limits for the scalar measured values (see above command) have been exceeded. The symbol (x3) behind a value indicates that the list contains three results corresponding to the *Current*, the *Average,* and the *MMax* value. The limits are defined with the `CONFigure:MODulation:OEMP`... commands.

The following messages may be output for all measured values:

NMAU	Underflow of tolerance value	*not matching, underflow*
NMAL	Tolerance value exceeded	*not matching, overflow*
INV	Measurement invalid	*invalid*
OK	all tolerances matched	

READ:ARRay:MODulation:MERRor:EPSK[:CURRent]? Phase Error in Burst
READ:ARRay:MODulation:MERRor:EPSK:AVERage?
READ:ARRay:MODulation:MERRor:EPSK:MMAXimum?
Start single shot measurement and return results ⇒ *RUN*
FETCh:ARRay:MODulation:MERRor:EPSK[:CURRent]?
FETCh:ARRay:MODulation:MERRor:EPSK:AVERage?
FETCh:ARRay:MODulation:MERRor:EPSK:MMAXimum?
Read measurement results (unsynchronized) ⇒ *RUN*
SAMPle:ARRay:MODulation:MERRor:EPSK[:CURRent]? SAMPle:ARRay:MODulation:MERRor:EPSK:AVERage?
SAMPle:ARRay:MODulation:MERRor:EPSK:MMAXimum?
Read measurement results (synchronized) ⇒ *RUN*

Returned values	Description of parameters	Def. value	Def. unit	FW vers.
–100 % to +100 %,	1st value for magnitude error	NAN	%	V2.15
... ,	...	...	...	
–100 % to +100 %	xth value for magnitude error	NAN	%	

Description of command

These commands are always queries. They return the magnitude error vs. time at fixed, equidistant test points. The number of measured values is 142, corresponding to a time range of 3 bit to 144 bit.

The calculation of *current, average, and mmax* (Min./Max.) results is explained in chapter 3 (see *display mode*).

READ:SUBarrays:MODulation:MERRor:EPSK[:CURRent]? Subarray Results
READ:SUBarrays:MODulation:MERRor:EPSK:AVERage?
READ:SUBarrays:MODulation:MERRor:EPSK:MMAXimum?
Start single shot measurement and return results ⇒ *RUN*
FETCh:SUBarrays:MODulation:MERRor:EPSK[:CURRent]?
FETCh:SUBarrays:MODulation:MERRor:EPSK:AVERage?
FETCh:SUBarrays:MODulation:MERRor:EPSK:MMAXimum?
Read meas. results (unsynchronized) ⇒ *RUN*
SAMPle:SUBarrays:MODulation:MERRor:EPSK[:CURRent]? SAMPle:SUBarrays:MODulation:MERRor:EPSK:AVERage?
SAMPle:SUBarrays:MODulation:MERRor:EPSK:MMAXimum?
Read results (synchronized) ⇒ *RUN*

Ret. values per subrange	Description of parameters	Def. value	Def. unit	FW vers.
–100 % to +100 %,	1st value for magnitude error	NAN	%	V2.15
... ,	...	...	...	
–100 % to +100 %	xth value for magnitude error	NAN	%	

Description of command

These commands are always queries. They measure and return the magnitude error versus time in the subranges defined by means of the `CONFigure:SUBarrays:MODulation:MERRor:EPSK` command. In the default setting of the configuration command the `READ:SUBarrays...`, `FETCh:SUBarrays...`, and `SAMPle:SUBarrays...` command group is equivalent to the `READ:ARRay...`, `FETCh:ARRay...`, and `SAMPle:ARRay...` command group described above.

The `CONFigure:SUBarrays:MODulation:MERRor:EPSK` command defines a maximum of 32 subranges. If one of the statistical modes `(ARIThmetical`, `MINimum`, `MAXimum)` is set, only one value is returned per subrange.

The calculation of *current, average, minimum,* and *maximum* results is explained in chapter 3 (see *display mode*).

Demodulated Bits (MODulation:MERRor:EPSK:DBITs…)

The following commands select the symbol range and control the readout of the demodulated bits. In manual control the symbol range is selected via marker functions; the demodulated bits are displayed in a bar below the test diagram.

NOTE

The demodulation of symbols must be disabled explicitly using `CONFigure:MODulation:MERRor:EPSK:DBITs ON`, otherwise the remaining commands in this section return invalid results.

CONFigure:MODulation:MERRor:EPSK:DBITs <*Enable*>		Enable/Disable Demodulation		
<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	Demodulation enabled Demodulated disabled, no valid results	OFF	–	V3.80
Description of command				
This command enables or disables the demodulation of symbols in the *Magn. Error 8PSK* application.				

READ[:SCALar]:MODulation:MERRor:EPSK:DBITS:PEAK? **FETCh[:SCALar]:MODulation:MERRor:EPSK:DBITS:PEAK?** **SAMPle[:SCALar]:MODulation:MERRor:EPSK:DBITS:PEAK?**		Peak Values Start single shot meas. and return results Read out meas. results (unsynchronized) Read out meas. results (synchronized)		
Returned values	Value range	Def. value	Def. unit	FW vers.
3 to 144, **0 to 7**	Symbol no. with the peak magnitude error Demod. bits at the magnitude error peak	NAN NAN	(symb.) –	V3.80
Description of command				
These commands are always queries. They start a modulation measurement (`READ…`) and/or return the number of the symbol with the largest absolute value of the magnitude error and the demodulated bits at this position. The demodulated bits are returned as a decimal value, 1 corresponding to 001 in the measurement menu.				

READ[:SCALar]:MODulation:MERRor:EPSK:DBITS? <*Symbol*> **FETCh[:SCALar]:MODulation:MERRor:EPSK:DBITS? <*Symbol*>** **SAMPle[:SCALar]:MODulation:MERRor:EPSK:DBITS? <*Symbol*>**		Single Value Start single shot meas. and return results Read out meas. results (unsynchronized) Read out meas. results (synchronized)		
<Symbol>	Value range	Def. value	Def. unit	
3 to 144	Evaluated symbol number	NAN	(symb.)	
Returned values	Value range	Def. value	Def. unit	FW vers.
0 to 7	Demod. bits at the specified symbol	NAN	–	V3.80
Description of command				
These commands are always queries. They start a modulation measurement (`READ…`) and/or return the demodulated bits for a specific symbol. The demodulated bits are returned as a decimal value, 1 corresponding to 001 in the measurement menu.				

	Single Value
READ:ARRay:MODulation:MERRor:EPSK:DBITS?	Start single shot meas. and return results
FETCh:ARRay:MODulation:MERRor:EPSK:DBITS?	Read out meas. results (unsynchronized)
SAMPle:ARRay:MODulation:MERRor:EPSK:DBITS?	Read out meas. results (synchronized)

Returned values	Value range	Def. value	Def. unit	FW vers.
0 to 7,	Demod. bits at symbol no. 3	NAN	–	V3.80
…			–	
0 to 7	Demod. bits at symbol no. 144	NAN	–	

Description of command

These commands are always queries. They start a modulation measurement (`READ…`) and/or return the demodulated bits at all symbols (142 returned values). The demodulated bits are returned as decimal values, 1 corresponding to 001 in the measurement menu.

MODulation:IQANalyzer

The subsystem *MODulation:IQANalyzer* measures the I and Q amplitudes of the received 8PSK signal as a function of time. The subsystem corresponds to the measurement menu *Modulation,* applications *I/Q Analyzer 8PSK,* and the sections in the popup menu *Modulation Configuration* that are related to the *I/Q Analyzer 8PSK* application.

Control of Measurement – Subsystem MODulation:IQANalyzer

The subsystem *MODulation:IQANalyzer* controls the measurement. It corresponds to the softkey *I/Q Analyzer 8PSK* in the measurement menu *Modulation*.

INITiate:MODulation:IQANalyzer:EPSK	Start new measurement	⇒ *RUN*
ABORt:MODulation:IQANalyzer:EPSK	Abort running measurement and switch off	⇒ *OFF*
STOP:MODulation:IQANalyzer:EPSK	Stop measurement after current stat. cycle	⇒ *STOP*
CONTinue:MODulation:IQANalyzer:EPSK	Next measurement step (only *stepping mode*)	⇒ *RUN*
Description of command		FW vers.
These commands have no query form. They start and stop the measurement, setting it to the status indicated in the top right column.		V3.80

CONFigure:MODulation:IQANalyzer:EPSK:EREPorting <*Mode*>				Event Reporting
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
SRQ | **SOPC |** **SRSQ |** **OFF**	Service request Single operation complete SRQ and SOPC No reporting	OFF	–	V3.80
Description of command				
This command defines the events generated when the measurement is terminated or stopped *(event reporting,* see Chapter 5 of CMU200/300 operating manual).				

FETCh:MODulation:IQANalyzer:EPSK:STATus?				Measurement Status
Ret. values	Description of parameters	Def. value	Def. unit	FW vers.
OFF | **RUN |** **STOP |** **ERR |** **STEP |** **RDY,**	Measurement in the *OFF* state (`*RST` or `ABORt`) Running (after `INITiate, CONTinue` or `READ`) Stopped (`STOP`) *OFF* (could not be started) Stepping mode *(<stepmode>=STEP)* Stopped according to repetition mode and stop condition	OFF	–	V3.80
1 to 10000 | **NONE**	Counter for current statistics cycle No counting mode set	NONE	–	
Description of command				
These commands are always queries. They return the status of the measurement (see Chapters 3 and 5 of the CMU200/300 operating manual).				

Test Configuration

The following commands configure the *I/Q Analyzer* measurement. They correspond to the *I/Q Analyzer* section in the *Control* tab of the *Modulation Configuration* menu.

CONFigure:MODulation:IQANalyzer:EPSK:CONTrol:RMODe <Mode>				Result Mode
<Mode>	Desciption of parameters	Def. value	Def. unit	FW vers.
SCALar | **ARRay**	Scalar values only (incl. limit matching) Scalar measured values and arrays	ARR	–	V3.80
Description of command				
This command specifies the type of measured values.				

CONFigure:MODulation:IQANalyzer:EPSK:CONTrol:REPetition *<Repetition>, <StopCond>, <Stepmode>*				Test Cycles
<Repetition>	Description of parameters	Def. value	Def. unit	
CONTinuous | **SINGleshot |** **1 to 10000**	Continuous measurement (until `STOP` or `ABORT`) Single shot measurement (until `Status = RDY`) Multiple measurement (*counting*, until `Status = STEP | RDY`)	SING	–	
<StopCond>	Description of parameters	Def. value	Def. unit	
NONE	(No stop condition because no limit check)	NONE	–	
<Stepmode>	Description of parameters	Def. value	Def. unit	FW vers.
STEP | **NONE**	Interrupt measurement after each statistics cycle Continue measurement according to its rep. mode	NONE	–	V3.80
Description of command				
This command determines the number of statistics cycles and the stepping mode for the measurement. **Note:** *For READ commands (`READ:...`), the <Repetition> parameter has no effect; the measurement is always stopped after a single shot.*				

CONFigure:MODulation:IQANalyzer:EPSK:ROTation <Enable>				Rotation
<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
P38 | **P38R**	3 π/8 rotation conserved 3 π/8 rotation removed	P38R	–	V3.80
Description of command				
This command qualifies whether or not the 3π/8 rotation is subtracted off before the symbols are displayed in the constellation diagram.				

CONFigure:MODulation:IQANalyzer:EPSK:IQFilter <Length>				Measurement Length
<Length>	Description of parameters	Def. value	Def. unit	FW vers.
ISIRemoved | **UNFiltered**	I/Q filter applied No I/Q filter applied	ISIRemoved	–	V3.80
Description of command				
This command specifies whether the I/Q data is filtered in order to eliminate the inter-symbol interference (ISI) at all constellation points.				

DEFault:MODulation:IQANalyzer:EPSK:CONTrol <Enable>				Default Settings
<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	The parameters are set to default values Some or all parameters differ from the default values	ON	–	V3.80
Description of command				
If used as a setting command with the parameter *ON* this command sets all parameters of the subsystem to default values (the setting OFF results in an error message). If used as a query the command returns whether all parameters are set to default values *(ON)* or not *(OFF)*.				

Measured Values – Subsystem MODulation:IQANalyzer:EPSK

The subsystem *MODulation:IQANalyzer:...?* measures and returns the I and Q amplitudes as a function of time. The subsystem corresponds to the various output elements in the measurement menu *MODulation,* application *I/Q Analyzer 8PSK.*

				Scalar Results:
READ[:SCALar]:MODulation:IQANalyzer:EPSK?	Start single shot measurement and return results			
FETCh[:SCALar]:MODulation:IQANalyzer:EPSK?	Read out meas. results (unsynchronized)			
SAMPle[:SCALar]:MODulation:IQANalyzer:EPSK?	Read out measurement results (synchronized)			
Returned values	Value range	Def. value	Def. unit	FW vers.
Error Vector Magnitude (RMS),	0.0 % to 100.0 %	NAN	%	V3.80
Magnitude Error (RMS)	0.0 % to 100.0 %	NAN	%	
Phase Error (RMS),	–180.0 deg to +180.0 deg	NAN	deg	
Timing Advance Error *(Signalling)*,	–100 symbols to +100 symbols	NAN	(symb.)	
Avg. Burst Power (Current)	–100.0 dBm to +60.0 dBm	NAN	dBm	
Description of command				
These commands are always queries. They start a `MODulation:IQANalyzer` measurement `(READ...)` and/or return all scalar measurement results (see Chapter 4). Values marked *Signalling* are not available in *Non Singnalling* mode; the *Non Singnalling* output string is shortened.				

READ:ARRay:MODulation:IQANalyzer:EPSK:IPHase? **READ:ARRay:MODulation:IQANalyzer:EPSK:QPHase?**	Start single shot measurement and return results			Normalized I/Q Amplitude ⇒ *RUN*
FETCh:ARRay:MODulation:IQANalyzer:EPSK:IPHase? **FETCh:ARRay:MODulation:IQANalyzer:EPSK:QPHase?**	Read measurement results (unsynchronized)			⇒ *RUN*
SAMPle:ARRay:MODulation:IQANalyzer:EPSK:IPHase? **SAMPle:ARRay:MODulation:IQANalyzer:EPSK:QPHase?**	Read measurement results (synchronized)			⇒ *RUN*
Returned values	Description of parameters	Def. value	Def. unit	FW vers.
–2.0 to +2.0,	1st value for normalized I or Q amplitude	NAN	deg	V3.80
... ,	...	...	...	
–2.0 to +2.0	568th value for normalized I or Q amplitude	NAN	deg	
Description of command				
These commands are always queries. They return the normalized I and Q amplitudes. The 568 measured values correspond to 142 symbols at an oversampling factor 4.				

SPECtrum

The subsystem *SPECtrum* provides commands for application-independent *Spectrum* measurement settings. The commands correspond to the application-independent parameters in the *Spectrum Configuration* menu.

CONFigure:SPECtrum:TMODe <*ModeModulation*>		Limit Selection (Signalling only)		
<Modulation>	Description of parameters	Def. value	Def. unit	FW vers.
NORM | **CAMS |** **CAOS**	All frames except CTRL_ACK frames CTRL_ACK frames (main slot) only CTRL_ACK frames (other slots) only	NORM	–	V3.80
Description of command				
These commands selects the burst type for a spectrum measurement on EGPRS packet data channels. The setting is only available in *Signalling* mode and with a *Signalling* trigger (`TRIGger[:SEQuence]:SOURce SIGNalling`).				

CONFigure:SPECtrum:LIMit:LINE:SELect <*Modulation*>		Limit Selection		
<Modulation>	Description of parameters	Def. value	Def. unit	FW vers.
AUTO | **GMSK |** **EPSK**	Auto-detect modulation and adjust template Use GMSK template Use EPSK template	AUTO	–	V3.50
Description of command				
These commands selects the limit line to be applied. The current template can be queried using `[SENSe:]SPECtrum:<Application>:LIMit:LINE:USED?`.				

SPECtrum:MODulation

The subsystem *SPECtrum:MODulation* measures the off-carrier power due to the modulation of the GSM signal. The subsystem corresponds to the measurement menu *Spectrum,* application *Modulation,* and the associated configuration popups.

Control of Measurement – Subsystem SPECtrum:MODulation

The subsystem *SPECtrum:MODulation* controls the spectrum due to modulation measurement.

INITiate:SPECtrum:MODulation	Start new measurement	⇒	*RUN*
ABORt:SPECtrum:MODulation	Abort running meas. and switch off	⇒	*OFF*
STOP:SPECtrum:MODulation	Stop meas. after current stat. cycle	⇒	*STOP*
CONTinue:SPECtrum:MODulation	Next meas. step (only *stepping mode*)	⇒	*RUN*
Description of command			FW vers.
These commands have no query form. They start or stop the measurement, setting it to the status indicated in the top right column.			V1.20

CONFigure:SPECtrum:MODulation:EREPorting <*Mode*>				Event Reporting
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
SRQ | **SOPC |** **SRSQ |** **OFF**	Service request Single operation complete SRQ and SOPC No reporting	OFF	–	V1.20
Description of command				
This command defines the events generated when the measurement is terminated or stopped *(event reporting,* see chapter 5 of CMU manual).				

FETCh:SPECtrum:MODulation:STATus?				Measurement Status
Returned values	Description of parameters	Def. value	Def. unit	FW vers.
OFF | **RUN |** **STOP |** **ERR |** **STEP |** **RDY,**	Measurement in the *OFF* state (`*RST` or `ABORt`) Running (after `INITiate, CONTinue` or `READ`) Stopped (`STOP`) *OFF* (could not be started) Stepping mode *(<stepmode>=STEP)* Stopped according to repetition mode and stop condition	OFF	–	V1.20
1 to 10000 | **NONE,**	Counter for current statistics cycle No counting mode set	NONE	–	
1 to 1000 | **NONE**	Counter for current evaluation period within a cycle Statistic count set to off	NONE	–	
Description of command				
This command is always a query. It returns the status of the measurement (see chapters 3 and 5 of CMU manual).				

Subsystem SPECTrum:MODulation:CONTrol

The subsystem *SPECtrum:MODulation:CONTrol* defines the repetition mode, statistic count, and stop condition of the measurement. These settings are provided in the *Control* and *Meas X* tabs of the popup menu *Spectrum Configuration*.

CONFigure:SPECtrum:MODulation:CONTrol <Mode>,<Statistics>				Scope of Measurement
<Mode>	Description of parameters	Def. value	Def. unit	
SCALar | **ARRay**	Only scalar measured values Scalar measured values and arrays	ARRay	–	
<Statistics>	Description of parameters	Def. value	Def. unit	FW vers.
1 to 1000 | **NONE**	Number of bursts per statistics cycle Statistics off (equivalent to 1)	200	–	V1.20
Description of command				
This command restricts the type of measured values and determines the number of bursts within a statistics cycle.				

CONFigure:SPECtrum:MODulation:CONTrol:REPetition *<Repetition>,<StopCondition>,<Stepmode>*				Test cycles
<Repetition>	Description of parameters	Def. value	Def. unit	
CONTinuous | **SINGleshot |** **1 to 10000**	Continuous measurement (until `STOP` or `ABORT`) Single shot measurement (until `Status = RDY`) Multiple measurement (*counting*, until `Status = STEP | RDY`)	SING	–	
<StopCondition>	Description of parameters	Def. value	Def. unit	
SONerror | **NONE**	Stop measurement in case of error *(stop on error)* Continue measurement even in case of error	NONE	–	
<Stepmode>	Description of parameters	Def. value	Def. unit	FW vers.
STEP | **NONE**	Interrupt measurement after each statistics cycle Continue measurement according to its rep. mode	NONE	–	V1.20
Description of command				
This command defines the number of test cycles, the stepping mode and, if required, a stop condition for the measurement. **Note:** *In the case of READ commands (`READ:...`), the <Repetition> parameter has no effect; the measurement is always stopped after a single shot.*				

CONFigure:SPECtrum:MODulation:CONTrol:MPOint<nr>:ENABle <Enable>				Fixed Measurement Points
<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	Switch on measurement point <nr> Switch off measurement point <nr>	ON	–	V1.20
Description of command				
This command switches the measurement at the fixed frequency points no. 1 to 11 (numbered by the numeric suffix <nr>) on or off. Each number denotes a pair of frequency points symmetric to the carrier, <nr>=1 corresponding to ±0.1 MHz, <nr>=11 to ±1.8 MHz. A measurement point which is selected for the time domain measurement (`CONFigure:SPECtrum:MODulation:TDFSelect`) can not be switched off. On the other hand, a measurement point is switched on automatically when it is selected for the time domain measurement.				

CONFigure:SPECtrum:MODulation:CONTrol:VMPoint<nr> *<Frequency>*	Variable Measurement Points			
<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
0.0 MHz to 2.5 MHz | **0.0 MHz to 1.8 MHz |** **ON | OFF**	Variable meas. point with R&S CMU-U65 Var04 Variable meas. point with oder versions Switch on or off measurement point <nr>	0.9 (<nr> = 1) 1.1 (<nr> = 2) 1.3 (<nr> = 3) 1.5 (<nr> = 4)	MHz MHz MHz MHz	V3.50
Description of command				
This command sets and enables additional pairs of measurement points at up to 4 variable offset frequencies (numbered by the numeric suffix <nr> = 1 to 4). The variable measurement points are switched off after a reset; the parameter `ON` activates the default values quoted above. A measurement point which is selected for the time domain measurement `(CONFigure:SPECtrum:MODulation:TDFSelect)` can not be switched off. On the other hand, a measurement point is switched on automatically when it is selected for the time domain measurement.				

Test Configuration

The commands of the following subsystems configure the spectrum due to modulation. They correspond to the *Modulation* sections in the *Spectrum Configuration* menu.

Subsystem SPECTrum:MODulation:…

The following commands correspond to various settings in the *Control* tab of the popup menu *Spectrum Configuration.*

CONFigure:SPECtrum:MODulation:TDFSelect *<Frequency>*	Time D. @ Freq.			
<Frequency>	Description of parameters	Def. value	Def. unit	FW vers.
N180 | N160 | N140 | N120 | N100 | N080 | **N060 | N040 | N025 | N020 | N010 |** **REF |** **P010 | P020 | P025 | P040 | P060 | P080 |** **P100 | P120 | P140 | P160 | P180 |** **NV4 | NV3 | NV2 | NV1 |** **PV1 | PV2 | PV3 | PV4 |** **OFF | ON**	Fixed measurement points at negative frequencies Carrier frequency (0 Hz offset) Fixed measurement points at positive frequencies Variable measurement points at negative or positive frequencies Switch time domain measurement off or on	OFF	–	V3.50
Description of command				
These commands selects the measurement frequency for the time domain (power vs. time) measurement results, to be retrieved by means of `READ:ARRay:SPECtrum:MODulation:TDOMain?` etc. The time domain measurement can be performed at all enabled fixed and variable measurement points `(CONFigure:SPECtrum:MODulation:CONTrol:MPOint<nr>:ENABle, CONFigure:SPECtrum:MODulation:CONTrol:VMPOint<nr>)`. OFF disables the time domain measurement so that `READ:ARRay:SPECtrum:MODulation:TDOMain?` etc. return NAN results.				

CONFigure:SPECtrum:MODulation:AVGareas *<Area>*				Averaging Areas
<Area>	Description of parameters	Def. value	Def. unit	FW vers.
A | B | **AB**	Use averaging area A (before training sequence) or B (after TS) Use averaging area A and B	B	–	V3.50
Description of command				
These commands selects one or two 40-bit sections of the burst which are measured and averaged in order to calculate the *Modulation* results.				

Subsystem SPECTrum:MODulation:LIMit:LINE

The subsystem *SPECtrum:MODulation:LIMit:LINE* defines the limit lines, i.e. the tolerance values for the spectrum due to modulation measurement The subsystem corresponds to the *Modulation* sections in the tab *Limit Lines* in the popup menu *Spectrum Configuration.*

[SENSe:]SPECtrum:MODulation:LIMit:LINE:USED?				Current Limit Template
Response	Description of parameters	Def. value	Def. unit	FW vers.
GMSK | **EPSK**	Use GMSK template Use EPSK template	–	–	V3.50
Description of command				
These commands is always a query and returns the current limit line template. The template can be selected using `CONFigure:SPECtrum:LIMit:LINE:SELect`.				

CONFigure:SPECtrum:MODulation[:GMSK]:LIMit:LINE:UPPer<nr>:ENABle **CONFigure:SPECtrum:MODulation:EPSK:LIMit:LINE:UPPer<nr>:ENABle** **<Enable>** **CONFigure:SPECtrum:MODulation[:GMSK]:LIMit:LINE:UPPer<nr>** **CONFigure:SPECtrum:MODulation:EPSK:LIMit:LINE:UPPer<nr>** ***<MinPwLevelRel>, <MaxPwLevelRel>, <AbsPwLevel>, <Enable>***			Limits
Numeric Suffix	Value range	Description of parameters	Def. value
<nr>	1 to11	Measurement point (frequency) no.	
Parameters	Value range	Description of parameters	Def. value
<Enable>	ON | OFF	Defined frequency on/off	ON
<MinPwLevelRel>,	–99.9 dB to 99.9 dB	Limit for relative power below the interpolation range	See below
<MaxPwLevelRel>,	–99.9 dB to 99.9 dB	Limit for relative power above the interpolation range	See below
<AbsPwLevel>,	–99.9 dBm to 99.9 dBm	Alternative absolute power limit	
<Enable>	ON | OFF	Enable or disable limit check for frequency point <nr>	See below
Description of command			FW vers.
These commands activate and define limit lines for the spectrum due to modulation measurement. Each number <nr> denotes a pair of frequency points symmetric to the carrier, <nr>=1 corresponding to ±0.1 MHz, <nr>=11 to ±1.8 MHz.			V1.20

The limits are defined at up to 11 fixed frequencies numbered by the numeric suffix <nr> and as a function of the MS output power level. Outside the interpolation range defined via `CONFigure:SPECtrum:MODulation:LIMit:LINE :REFPower[:UPPer]`, the fixed relative power limits *<MinPwLevelRel> and <MaxPwLevelRel>* apply. Inside this range, the limits are derived from these values by linear interpolation. As an alternative, an absolute power limit is set. For a more detailed explanation see chapter 4.

To switch on or off the complete limit check please use the command

`CONFigure:SPECtrum:MODulation:LIMit:LINE:MODE[:UPPer] <Mode>`

Default values for GSM400/GT800/850/900 in both modulation schemes:

Frequency	Min.P. Lev.rel.	Max.P. Lev.rel.	Level abs.
± 0.10 MHz	+0.5 dB	+ 0.5 dB	– 36.0 dBm
± 0.20 MHz	–30.0 dB	– 30.0 dB	– 36.0 dBm
± 0.25 MHz	–33.0 dB	– 33.0 dB	– 36.0 dBm
± 0.40 MHz	–60.0 dB	– 60.0 dB	– 36.0 dBm
± 0.60 MHz	–60.0 dB	– 66.0 dB	– 51.0 dBm
± 0.80 MHz	–60.0 dB	– 66.0 dB	– 51.0 dBm
± 1.00 MHz	–60.0 dB	– 66.0 dB	– 51.0 dBm
± 1.20 MHz	–60.0 dB	– 66.0 dB	– 51.0 dBm
± 1.40 MHz	–60.0 dB	– 66.0 dB	– 51.0 dBm
± 1.60 MHz	–60.0 dB	– 66.0 dB	– 51.0 dBm
± 1.80 MHz	–60.0 dB	– 66.0 dB	– 51.0 dBm

Default values for GSM1800/1900 in both modulation schemes:

Frequency	Min.P. Lev.rel.	Max.P. Lev.rel.	Level abs.
± 0.10 MHz	+0.5 dB	+ 0.5 dB	– 36.0 dBm
± 0.20 MHz	–30.0 dB	– 30.0 dB	– 36.0 dBm
± 0.25 MHz	–33.0 dB	– 33.0 dB	– 36.0 dBm
± 0.40 MHz	–60.0 dB	– 60.0 dB	– 36.0 dBm
± 0.60 MHz	–60.0 dB	– 60.0 dB	– 56.0 dBm
± 0.80 MHz	–60.0 dB	– 60.0 dB	– 56.0 dBm
± 1.00 MHz	–60.0 dB	– 60.0 dB	– 56.0 dBm
± 1.20 MHz	–60.0 dB	– 60.0 dB	– 56.0 dBm
± 1.40 MHz	–60.0 dB	– 60.0 dB	– 56.0 dBm
± 1.60 MHz	–60.0 dB	– 60.0 dB	– 56.0 dBm
± 1.80 MHz	–60.0 dB	– 60.0 dB	– 56.0 dBm

CONFigure:SPECtrum:MODulation[:GMSK]:LIMit:LINE:REFPower[:UPPer]
CONFigure:SPECtrum:MODulation:EPSK:LIMit:LINE:REFPower[:UPPer] Reference Power
<Minimum>, <Maximum>

<Minimum>	Description of parameters	Def. value	Def. unit	
–99.9 dBm to +38.0 dBm	Ref. power for min. power level	33	dBm	
<Maximum>	Description of parameters	Def. value	Def. unit	FW vers.
+34.0 dBm to +99.9 dBm	Ref. power for max. power level	39	dBm	V1.25

Description of command

This command defines the MS output power range where the relative limit lines are given by linear interpolation between a minimum and a maximum relative power level. See command `CONFigure:SPECtrum:MODulation[:GMSK]:LIMit:LINE [:ASYMmetical]:UPPer<nr>` and detailed explanation in chapter 4. The value range applies with the additional condition `<Minimum> ≤ <Maximum> – 1dB.`

CONFigure:SPECtrum:MODulation[:GMSK]:LIMit:LINE:MODE[:UPPer] *<Mode>* CONFigure:SPECtrum:MODulation:EPSK:LIMit:LINE:MODE[:UPPer] *<Mode>*				Limits on/off
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	Switch on limit lines Switch off limit lines	ON	–	V1.20
Description of command				
This command switches all limit lines for the spectrum due to modulation measurement on or off.				

Subsystem SUBarrays:SPECtrum:MODulation

The subsystem *SUBarrays:SPECtrum:MODulation* defines the measurement range and the type of output values.

CONFigure:SUBarrays:SPECtrum:MODulation[:FDOMain] <Mode>,<Start>,<Samples>{,<Start>,<Samples>}				Definition of Subarrays: Frequency Domain
<Mode>	Description of parameters	Def. value	Def. unit	
ALL | **ARIThmetical |** **MINimum |** **MAXimum |** **IVAL,**	Return all measurement values Return arithm. mean value in every range Return minimum value in every range Return maximum value in every range Return single interpolated value at <Start>	ALL	–	
<Start>	Description of parameters	Def. value	Def. unit	
–1.8 MHz to 1.8 MHz,	Frequency of first point in current range	–1.8	MHz	
<Samples>	Description of parameters	Def. value	Def. unit	FW vers.
1 to 23	Number of samples in current range	23	–	V2.00
Description of command				

This command configures the `READ:SUBarrays..`, `FETCh:SUBarrays..`, and `SAMPle:SUBarrays:SPECtrum:MODulation[:FDOMain]` commands. It restricts the measurement to up to 32 subranges where either all measurement results (the number of which is given by the second numerical parameter) or a single statistical value is returned. The subranges are defined by the start time and the number of test points which are located at fixed frequencies (see command `CONFigure:SPECtrum:MODulation…:LIMit:LINE<nr>`). If <Start> does not coincide with a test point then the range will start at the next test point that is larger than <Start>.

For <Mode> = IVAL, the <Samples> parameter is ignored and the CMU returns a single measurement value corresponding to the abscissa value <Start>. If <Start> is located beween two test points with valid results then the result is calculated from the results at these two adjacent test points by linear interpolation.

The subranges may overlap but must be within the total range of the *spectrum due to modulation* measurement. Test points outside this range are not measured (result *NAN)* and do not enter into the ARIThmetical, MINimum and MAXimum values.

By default, only one range corresponding to the total measurement range is used and all measurement values are returned.

CONFigure:SUBarrays:SPECtrum:MODulation:TDOMain <Mode>,<Start>,<Samples>{,<Start>,<Samples>}	Definition of Subarrays: Time Domain			
<Mode>	Description of parameters	Def. value	Def. unit	
ALL | **ARIThmetical |** **MINimum |** **MAXimum |** **IVAL,**	Return all measurement values Return arithm. mean value in every range Return minimum value in every range Return maximum value in every range Return single interpolated value at <Start>	ALL	–	
<Start>	Description of parameters	Def. value	Def. unit	
–30 to +175,	First symbol point in current range	–30	(symb)	
<Samples>	Description of parameters	Def. value	Def. unit	FW vers.
1 to 618	Number of samples in current range	618	–	V3.50
Description of command				
This command configures the `READ:SUBarrays..`, `FETCh:SUBarrays..`, and `SAMPle:SUBarrays:SPECtrum:MODulation:TDOMain` commands. It is analogous to the subarray command for the frequency domain (`CONFigure:SUBarrays:SPECtrum:MODulation[:FDOMain]`).				

Measured Values

The commands of the following subsystems determine and return the results of the spectrum due to modulation measurement. They correspond to the graphical menu *Spectrum* with its various display elements.

Subsystem SPECtrum:MODulation

The subsystem *SPECtrum:MODulation* measures and returns the *Modulation* spectrum and compares it with tolerance values. The subsystem corresponds to the graphical measurement menu *Spectrum.*

	Scalar Results:			
READ[:SCALar]:SPECtrum:MODulation? **FETCh[:SCALar]:SPECtrum:MODulation?** **SAMPle[:SCALar]:SPECtrum:MODulation?**	Start single shot measurement and return results Read measurement results (unsynchronized) Read measurement results (synchronized)			
Returned values	Value range	Def. value	Def. unit	FW vers.
Reference Power, **Matching**	–100.0 dBm to +100.0 dBm INV | MATC | NMAT | OUT | NTR | NRAM | OFLW | UFLW | NTSC | OFF	NAN INV	dBm –	V1.20
Description of command				
These commands are always queries. - `READ` starts a single shot measurement and returns the results. - `FETCh` outputs the current results regardless of the measurement state. - `SAMPle` waits until the results are valid for the first time (depending on the chosen statistic count) and then outputs the results. For more details refer to the description of measurement control in chapter 5 of the CMU200 operating manual.				

The reference power is the absolute carrier power measured as specified in the GSM standard. The following messages may be output for the value *Matching*:

INV	*invalid*
MATC	*matching*
NMAT	*not matching*
OUT	*out of range*
NTR	*no trigger*
NRAM	*not ramping (burst not found)*
OFLW	*overflow*
UFLW	*underflow*
NTSC	*no training sequence code*
OFF	*off*

Spectrum Results: Frequency Domain, Fixed Meas. Points

READ:ARRay:SPECtrum:MODulation[:FDOMain]? Start single shot measurement and return results
FETCh:ARRay:SPECtrum:MODulation[:FDOMain]? Read measurement results (unsynchronized)
SAMPle:ARRay:SPECtrum:MODulation[:FDOMain]? Read results (synchronized)

Returned values	Description of parameters	Def. value	Def. unit	FW vers.
–100.0 dB to + 20.0 dB,	Power at measurement point 1 (–1.8 MHz)	NAN	dB	V1.20
...,	...	...	...	
–100.0 dB to + 20.0 dB,	Power at measurement point 12 (0 MHz)	NAN	dB...	
…,		...		
–100.0 dB to + 20.0 dB	Power at measurement point 23 (+1.8 MHz)	NAN	dB	

Description of command

These commands are always queries. They return the off-carrier power due to modulation at all enabled fixed measurement points `(CONFigure:SPECtrum:MODulation:CONTrol:MPOint<nr>:ENABle)`. NAN is returned at the disabled points.

Spectrum Results: Frequency Domain, Variable Meas. Points

READ:ARRay:SPECtrum:MODulation[:FDOMain]:VMPoint? Start single shot measurement and return results
FETCh:ARRay:SPECtrum:MODulation[:FDOMain]:VMPoint? Read measurement results (unsynchronized)
SAMPle:ARRay:SPECtrum:MODulation[:FDOMain]:VMPoint? Read results (synchronized)

Returned values	Description of parameters	Def. value	Def. unit	FW vers.
–100.0 dB to + 20.0 dB,	Power at measurement point 4 (neg. freq. offset)	NAN	dB	V3.50
...,	...	...	...	
–100.0 dB to + 20.0 dB,	Power at measurement point 1 (neg. freq. offset)	NAN	dB...	
–100.0 dB to + 20.0 dB,	Power at measurement point 1 (pos. freq. offset)	NAN	dB	
…,	...	...		
–100.0 dB to + 20.0 dB	Power at measurement point 4 (pos. freq. offset)	NAN	dB	

Description of command

These commands are always queries. They return the off-carrier power due to modulation at all enabled variable measurement points `(CONFigure:SPECtrum:MODulation:CONTrol:VMPOint<nr>)`. NAN is returned at the disabled points.

Subarray Results: Frequency Domain

READ:SUBarrays:SPECtrum:MODulation[:FDOMain]? Start single shot meas. and return results ⇒ *RUN*
FETCh:SUBarrays:SPECtrum:MODulation[:FDOMain]? Read meas. results (unsynchronized) ⇒ *RUN*
SAMPle:SUBarrays:SPECtrum:MODulation[:FDOMain]? Read results (synchronized) ⇒ *RUN*

Ret. values per subrange	Description of parameters	Def. value	Def. unit	FW vers.
–100.0 dB to + 20.0 dB	Power[1], 1st value for power	NAN	dB	V2.00
...	...	...	...	
–100.0 dB to + 20.0 dB	Power[x], xth value for power	NAN	dB	

Description of command

These commands are always queries. They output the off-carrier power due to modulation in the subranges defined by means of the `CONFigure:SUBarrays:SPECtrum:MODulation[:FDOMain]` command. In the default setting of the configuration command the `READ:SUBarrays..., FETCh:SUBarrays..., and SAMPle:SUBarrays...` command group is equivalent to the `READ:ARRay..., FETCh:ARRay..., and SAMPle:ARRay...` command group described above.

The `CONFigure:SUBarrays:SPECtrum:MODulation[:FDOMain]` command defines a maximum of 32 subranges. If one of the statistical modes `(ARIThmetical, MINimum, MAXimum)` is set, only one value is returned per subrange.

CALCulate:ARRay:SPECtrum:MODulation[:FDOMain]:AREA:LIMit:MATChing? Limit Matching

Returned value	Description of parameters	Def. value	Def. unit	FW vers.
32 bit value	Indicator for limit matching at fixed meas. points 1 to 23 (least significant bits)	NAN	–	V3.50

Description of command

This command is always a query. A bit in the output value is set if the corresponding fixed measurement point exceeds the limit.

Spectrum Results: Time Domain

READ:ARRay:SPECtrum:MODulation:TDOMain? Start single shot measurement and return results
FETCh:ARRay:SPECtrum:MODulation:TDOMain? Read measurement results (unsynchronized)
SAMPle:ARRay:SPECtrum:MODulation:TDOMain? Read results (synchronized)

Returned values	Description of parameters	Def. value	Def. unit	FW vers.
–100.0 dB to + 20.0 dB,	Power at measurement point 1	NAN	dB	V3.50
...,	…	...	...	
–100.0 dB to + 20.0 dB	Power at measurement point 618	NAN	dB	

Description of command

These commands are always queries. They return the off-carrier power vs. time at a definite offset frequency from the carrier `(CONFigure:SPECtrum:MODulation:TDFSelect)`. The position of the measurement points is as reported in the `CONFigure:SUBarrays:SPECtrum:MODulation:TDOMain` command description.

Subarray Results: Time Domain

READ:SUBarrays:SPECtrum:MODulation:TDOMain?	Start single shot meas. and return results	⇒ *RUN*
FETCh:SUBarrays:SPECtrum:MODulation:TDOMain?	Read meas. results (unsynchronized)	⇒ *RUN*
SAMPle:SUBarrays:SPECtrum:MODulation:TDOMain?	Read results (synchronized)	⇒ *RUN*

Ret. values per subrange	Description of parameters	Def. value	Def. unit	FW vers.
–100.0 dB to + 20.0 dB	Power[1], 1st value for power	NAN	dB	V3.50
...	...	...	...	
–100.0 dB to + 20.0 dB	Power[x], xth value for power	NAN	dB	

Description of command

These commands are always queries. They output the off-carrier power due to modulation in the subranges defined by means of the `CONFigure:SUBarrays:SPECtrum:MODulation:TDOMain` command. In the default setting of the configuration command the `READ:SUBarrays..., FETCh:SUBarrays..., and SAMPle:SUBarrays...` command group is equivalent to the `READ:ARRay..., FETCh:ARRay..., and SAMPle:ARRay...` command group described above.

The `CONFigure:SUBarrays:SPECtrum:MODulation:TDOMain` command defines a maximum of 32 subranges. If one of the statistical modes `(ARIThmetical, MINimum, MAXimum)` is set, only one value is returned per subrange.

SPECtrum:SWITching

The subsystem *SPECtrum:SWITching* measures the off-carrier power due to the bursty nature of the GSM signal. The subsystem corresponds to the measurement menu *Spectrum,* application *Switching,* and the associated configuration popups.

Control of Measurement – Subsystem SPECtrum:SWITching

The subsystem *SPECtrum:SWITching* controls the spectrum due to switching measurement.

INITiate:SPECtrum:SWITching	Start new measurement	⇒	*RUN*
ABORt:SPECtrum:SWITching	Abort running measurement and switch off	⇒	*OFF*
STOP:SPECtrum:SWITching	Stop measurement after current stat. cycle	⇒	*STOP*
CONTinue:SPECtrum:SWITching	Next measurement step (only *stepping mode*)	⇒	*RUN*
Description of command			FW vers.
These commands have no query form. They start or stop the measurement, setting it to the status indicated in the top right column.			V1.20

CONFigure:SPECtrum:SWITching:EREPorting <*Mode*>				Event Reporting
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
SRQ | **SOPC |** **SRSQ |** **OFF**	Service request Single operation complete SRQ and SOPC No reporting	OFF	–	V1.20
Description of command				
This command defines the events generated when the measurement is terminated or stopped *(event reporting,* see chapter 5 of CMU manual).				

FETCh:SPECtrum:SWITching:STATus?				Measurement Status
Returned values	Description of parameters	Def. value	Def. unit	FW vers.
OFF | **RUN |** **STOP |** **ERR |** **STEP |** **RDY,**	Measurement in the *OFF* state (`*RST` or `ABORt`) Running (after `INITiate, CONTinue` or `READ`) Stopped (`STOP`) *OFF* (could not be started) Stepping mode *(<stepmode>=STEP)* Stopped according to repetition mode and stop condition	OFF	–	V1.20
1 to 10000 | **NONE,**	Counter for current statistics cycle No counting mode set	NONE	–	
1 to 1000 | **NONE**	Counter for current evaluation period within a cycle Statistic count set to off	NONE	–	
Description of command				
This command is always a query. It returns the status of the measurement (see chapters 3 and 5 of CMU manual).				

CONFigure:SPECtrum:SWITching:CSMODE *<Mode>*				Cont. Stat. Mode
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
PHOL | **SCO**	Peak Hold Statistic Count	PHOL	–	V3.10
Description of command				
This command defines the continuous statistical mode for the spectrum due to switching measurement.				

Subsystem SPECTrum:SWITching:CONTrol

The subsystem *SPECtrum:SWITching:CONTrol* defines the repetition mode, statistic count, and stop condition of the measurement. These settings are provided in the *Control* and *Meas X* tabs of the popup menu *Spectrum Configuration*.

CONFigure:SPECtrum:SWITching:CONTrol *<Mode>,<Statistics>*				Scope of Measurement
<Mode>	Description of parameters	Def. value	Def. unit	
SCALar | **ARRay**	Only scalar measured values Scalar measured values and arrays	ARRay	–	
<Statistics>	Description of parameters	Def. value	Def. unit	FW vers.
1 to 1000 | **NONE**	Number of bursts per statistics cycle Statistics off (equivalent to 1)	10	–	V1.20
Description of command				
This command restricts the type of measured values and determines the number of bursts within a statistics cycle.				

CONFigure:SPECtrum:SWITching:CONTrol:REPetition *<Repetition>,<StopCondition>, <Stepmode>*				Test Cycles
<Repetition>	Description of parameters	Def. value	Def. unit	FW vers.
CONTinuous | **SINGleshot |** **1 to 10000**	Continuous measurement (until `STOP` or `ABORT`) Single shot measurement (until `Status = RDY`) Multiple measurement (*counting*, until `Status = STEP | RDY`)	SING	–	
<StopCondition>	Description of parameters	Def. value	Def. unit	
SONerror | **NONE**	Stop measurement in case of error *(stop on error)* Continue measurement even in case of error	NONE	–	
<Stepmode>	Description of parameters	Def. value	Def. unit	FW vers.
STEP | **NONE**	Interrupt measurement after each statistics cycle Continue measurement according to its rep. mode	NONE	–	V1.20
Description of command				
This command defines the number of test cycles, the stepping mode and, if required, a stop condition for the measurement. **Note:** *In the case of READ commands (`READ:...`), the <Repetition> parameter has no effect; the measurement is always stopped after a single shot.*				

CONFigure:SPECtrum:SWITching:CONTrol:MPOint<nr>:ENABle <Enable>		Fixed Measurement Points		
<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	Switch on measurement point <nr> Switch off measurement point <nr>	ON	–	V1.20
Description of command				
This command switches the measurement at the fixed frequency points no. 1 to 4 (numbered by the numeric suffix <nr>) on or off. Each number denotes a pair of frequency points symmetric to the carrier, <nr>=1 corresponding to ±0.4 MHz, <nr>=4 to ±1.8 MHz. A measurement point which is selected for the time domain measurement `(CONFigure:SPECtrum:SWITching:TDFSelect)` can not be switched off. On the other hand, a measurement point is switched on automatically when it is selected for the time domain measurement.				

CONFigure:SPECtrum:SWITching:CONTrol:VMPOint<nr> *<Frequency>*		Variable Measurement Points		
<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
0.0 MHz to 2.5 MHz | **0.0 MHz to 1.8 MHz |** **ON | OFF**	Variable meas. point with R&S CMU-U65 Var04 Variable meas. point with oder versions Switch on or off measurement point <nr>	0.8 (<nr> = 1) 1.0 (<nr> = 2) 1.4 (<nr> = 3) 1.6 (<nr> = 4)	MHz MHz MHz MHz	V3.50
Description of command				
This command sets and enables additional pairs of measurement points at up to 4 variable offset frequencies (numbered by the numeric suffix <nr> = 1 to 4). The variable measurement points are switched off after a reset; the parameter `ON` activates the default values quoted above. A measurement point which is selected for the time domain measurement `(CONFigure:SPECtrum:SWITching:TDFSelect)` can not be switched off. On the other hand, a measurement point is switched on automatically when it is selected for the time domain measurement.				

Test Configuration

The commands of the following subsystems configure the spectrum due to switching. They correspond to the *Switching* sections in the *Spectrum Configuration* menu.

Subsystem SPECTrum:SWITching:…

The following commands correspond to various settings in the *Control* tab of the popup menu *Spectrum Configuration.*

CONFigure:SPECtrum:SWITching:TDFSelect *<Frequency>*		Time D. @ Freq.		
<Frequency>	Description of parameters	Def. value	Def. unit	FW vers.
N180 | N120 | N060 | N040 | **REF |** **P040 | P060 | P120 | P180 |** **NV4 | NV3 | NV2 | NV1 |** **PV1 | PV2 | PV3 | PV4 |** **OFF | ON**	Fixed meas. points at negative frequencies Carrier frequency (0 Hz offset) Fixed meas. points at positive frequencies Variable measurement points at negative or positive frequencies	OFF	–	V3.50
Description of command				
These commands selects the measurement frequency for the time domain (power vs. time) measurement results, to be retrieved by means of `READ:ARRay:SPECtrum:SWITching:TDOMain?` etc. The time domain measurement can be performed at all enabled fixed and variable measurement points (`CONFigure:SPECtrum:SWITching:CONTrol:MPOint<nr>:ENABle`, `CONFigure:SPECtrum:SWITching:CONTrol:VMPOint<nr>`). OFF disables the time domain measurement so that `READ:ARRay:SPECtrum:SWITching:TDOMain?` etc. return NAN results.				

CONFigure:SPECtrum:SWITching:NOSLots *<Slots>*		Slot Count		
<Slots>	Description of parameters	Def. value	Def. unit	FW vers.
1 to 8	Number of slots per TDMA frame measured	1	–	V3.50
Description of command				
These commands defines the number of timeslots which are considered for the *Spectrum due to Switching* measurement.				

Subsystem SPECTrum:SWITching:LIMit:LINE

The subsystem *SPECtrum:SWITching:LIMit:LINE* defines the limit lines, i.e. the tolerance values for the spectrum due to switching measurement. The subsystem corresponds to the *Switching* sections in the tab *Limit Lines* in the popup menu *Spectrum Configuration.*

[SENSe:]SPECtrum:SWITching:LIMit:LINE:USED?		Current Limit Template		
Response	Description of parameters	Def. value	Def. unit	FW vers.
GMSK | **EPSK**	Use GMSK template Use EPSK template	–	–	V3.50
Description of command				
These commands is always a query and returns the current limit line template. The template can be selected using `CONFigure:SPECtrum:LIMit:LINE:SELect`.				

Limits

CONFigure:SPECtrum:SWITching[:GMSK]:LIMit:LINE:UPPer<nr>:ENABle
CONFigure:SPECtrum:SWITching:EPSK:LIMit:LINE:UPPer<nr>:ENABle
<Enable>
CONFigure:SPECtrum:SWITching[:GMSK]:LIMit:LINE:UPPer<nr>
CONFigure:SPECtrum:SWITching:EPSK:LIMit:LINE:UPPer<nr>
<Power level>, <Limit at 0.4 MHz>, <Limit at 0.6 MHz>, <Limit at 1.2 MHz>, <Limit at 1.8 MHz>,<Enable>

Numeric Suffix	Value range	Description of parameters	Def. value
<nr>	1 to10	Power level no.	
Parameters	Value range	Description of parameters	Def. value
<Enable>	ON | OFF	Defined section on/off	ON
<Power level>,	–100 dBm to 30 dBm	MS output power for power level <nr> Limit for the measurement point at:	See below
<Limit at 0.4 MHz>,	–100 dBm to 30 dBm	0.4 MHz from carrier frequency	
<Limit at 0.6 MHz>,	–100 dBm to 30 dBm	0.6 MHz from carrier frequency	See below
<Limit at 1.2 MHz>,	–100 dBm to 30 dBm	1.2 MHz from carrier frequency	
<Limit at 1.8 MHzl>,	–100 dBm to 30 dBm	1.8 MHz from carrier frequency	
<Enable>	ON | OFF| DEFault	Enable or disable limit check for power level <nr>	See below

Description of command	FW vers.
These commands activate and define limit lines for the spectrum due to switching measurement.	V1.20

The value range for the individual power levels <nr> at the same frequency applies with the additional conditions `<PowerLevel(n+1)> ≤ <PowerLevel(n)> – 1 dB` and `|<PowerLevel(n+1)> – <PowerLevel(n)>| ≤ 100 dB`.

The limits are defined depending on 10 definable MS output power levels numbered by the numeric suffix <nr> and four fixed frequency offsets from the carrier. The first parameter defines the power of level no. <nr>. For the 1st and the 10th level, limit values are entered: The levels then comprise all powers greater than or less than the specified limits.

To switch one measurement point over all power levels on or off, please use the command

```
CONFigure:SPECtrum:SWITching:LIMit:LINE:ENABle[:UPPer]
```

To switch on or off the limit check altogether please use the command

```
CONFigure:SPECtrum:SWITching:LIMit:LINE:MODE[:UPPer] <Mode>
```

Default values for GSM400/GT800/850/900 (both modulation schemes):

Level <nr>	Level / [dBm]	0.4 MHz / [dBc]	0.6 MHz / [dBc]	1.2 MHz / [dBc]	1.8 MHz / [dBc]
1	≥ 39.0	–13.0	–21.0	–21.0	–24.0
2	37.0	–15.0	–21.0	–21.0	–24.0
3	35.0	–17.0	–21.0	–21.0	–24.0
4	33.0	–19.0	–21.0	–21.0	–24.0
5	31.0	–21.0	–23.0	–23.0	–26.0
6	29.0	–23.0	–25.0	–25.0	–28.0
7	27.0	–23.0	–26.0	–27.0	–30.0
8	25.0	–23.0	–26.0	–29.0	–32.0
9	23.0	–23.0	–26.0	–31.0	–34.0
10	≤ 21.0	–23.0	–26.0	–32.0	–36.0

Default values for GSM1800 (both modulation schemes):

Level <nr>	Level / [dBm]	0.4 MHz / [dBc]	0.6 MHz / [dBc]	1.2 MHz / [dBc]	1.8 MHz / [dBc]
1	≥ 36.0	–16.0	–21.0	–21.0	–24.0
2	34.0	–18.0	–21.0	–21.0	–24.0
3	32.0	–20.0	–22.0	–22.0	–25.0
4	30.0	–22.0	–24.0	–24.0	–27.0
5	28.0	–23.0	–25.0	–26.0	–29.0
6	26.0	–23.0	–26.0	–28.0	–31.0
7	24.0	–23.0	–26.0	–30.0	–33.0
8	22.0	–23.0	–26.0	–31.0	–35.0
9	≤ 20.0	–23.0	–26.0	–32.0	–36.0

Default values for GSM1900 (both modulation schemes):

Level <nr>	Level / [dBm]	0.4 MHz / [dBc]	0.6 MHz / [dBc]	1.2 MHz / [dBc]	1.8 MHz / [dBc]
1	≥ 33.0	–19.0	–22.0	–22.0	–25.0
2	32.0	–20.0	–22.0	–22.0	–25.0
3	30.0	–22.0	–24.0	–24.0	–27.0
4	28.0	–23.0	–25.0	–26.0	–29.0
5	26.0	–23.0	–26.0	–28.0	–31.0
6	24.0	–23.0	–26.0	–30.0	–33.0
7	22.0	–23.0	–26.0	–31.0	–35.0
8	≤ 20.0	–23.0	–26.0	–32.0	–36.0

CONFigure:SPECtrum:SWITching[:GMSK]:LIMit:LINE:MODE[:UPPer] <*Mode*>
CONFigure:SPECtrum:SWITching:EPSK:LIMit:LINE:MODE[:UPPer] <*Mode*> Limit Check on/off

<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	Switch on limit lines Switch off limit lines	ON	–	V1.20

Description of command

This command switches all limits for the spectrum due to switching measurement on or off.

CONFigure:SPECtrum:SWITching[:GMSK]:LIMit:LINE:DEFault <*Enable*>
CONFigure:SPECtrum:SWITching:EPSK:LIMit:LINE:DEFault <*Enable*> Default Settings

<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	All the parameters of the subsystem are set to default values At least one parameter of the subsystem differs from its default value	ON	–	V2.00

Description of command

If used as a setting command with *ON*, this command sets all the parameters of the subsystem to their default values (*OFF* causes an error message). In the query format, the command returns *ON* if all the parameters of the subsystem correspond to their default values, otherwise it returns *OFF*.

Subsystem SUBarrays:SPECtrum:SWITching

The subsystem *SUBarrays:SPECtrum:SWITching* defines the measurement range and the type of output values.

CONFigure:SUBarrays:SPECtrum:SWITching[:FDOMain] Definition of Subarrays: Frequency Domain
<Mode>,<Start>,<Samples>{,<Start>,<Samples>}

<Mode>	Description of parameters	Def. value	Def. unit	
ALL | **ARIThmetical |** **MINimum |** **MAXimum |** **IVAL,**	Return all measurement values Return arithm. mean value in every range Return minimum value in every range Return maximum value in every range Return single interpolated value at <Start>	ALL	–	
<Start>	Description of parameters	Def. value	Def. unit	
–1.8 MHz to 1.8 MHz,	Start frequency in current range	–1.8	MHz	
<Samples>	Description of parameters	Def. value	Def. unit	FW vers.
1 to 9	Number of samples in current range	9	–	V2.00

Description of command

This command configures the `READ:SUBarrays..`, `FETCh:SUBarrays..`, and `SAMPle:SUBarrays:SPECtrum:SWITching[:FDOMain]` commands. It restricts the measurement to up to 32 subranges where either all measurement results (the number of which is given by the second numerical parameter) or a single statistical value is returned. The subranges are defined by the start time and the number of test points which are located at fixed frequencies (see command `CONFigure:SPECtrum:SWITching…:LIMit:LINE<nr>`). If <Start> does not coincide with a test point then the range will start at the next test point that is larger than <Start>.

For <Mode> = IVAL, the <Samples> parameter is ignored and the CMU returns a single measurement value corresponding to the abscissa value <Start>. If <Start> is located beween two test points with valid results then the result is calculated from the results at these two adjacent test points by linear interpolation.

The subranges may overlap but must be within the total range of the spectrum due to switching measurement. Test points outside this range are not measured (result *NAN)* and do not enter into the ARIThmetical, MINimum and MAXimum values. By default, only one range corresponding to the total measurement range is used and all measurement values are returned.

CONFigure:SUBarrays:SPECtrum:SWITching:TDOMain <Mode>,<Start>,<Samples>{,<Start>,<Samples>}	Definition of Subarrays: Time Domain			
<Mode>	Description of parameters	Def. value	Def. unit	
ALL |	Return all measurement values	ALL	–	
ARIThmetical |	Return arithm. mean value in every range			
MINimum |	Return minimum value in every range			
MAXimum |	Return maximum value in every range			
IVAL,	Return single interpolated value at <Start>			
<Start>	Description of parameters	Def. value	Def. unit	
–30 to 175	First symbol point in current range, Slot Count = 1	–30	(symb)	
–186 to 175	First symbol point in current range, Slot Count = 2	–186	(symb)	
–186 to 331	First symbol point in current range, Slot Count = 3	–186	(symb)	
–186 to 587	First symbol point in current range, Slot Count = 4	–186	(symb)	
–186 to 643	First symbol point in current range, Slot Count = 5	–186	(symb)	
–186 to 799	First symbol point in current range, Slot Count = 6	–186	(symb)	
–186 to 955	First symbol point in current range, Slot Count = 7	–186	(symb)	
–186 to 1111	First symbol point in current range, Slot Count = 8	–186	(symb)	
<Samples>	Description of parameters	Def. value	Def. unit	FW vers.
1 to 618	Number of samples in current range, Slot Count = 1	618	–	V3.50
1 to 1086	Number of samples in current range, Slot Count = 2	1086	–	
1 to 1554	Number of samples in current range, Slot Count = 3	1554	–	
1 to 2022	Number of samples in current range, Slot Count = 4	2022	–	
1 to 2490	Number of samples in current range, Slot Count = 5	2490	–	
1 to 2958	Number of samples in current range, Slot Count = 6	2958	–	
1 to 3426	Number of samples in current range, Slot Count = 7	3426	–	
1 to 3894	Number of samples in current range, Slot Count = 8	3894	–	
Description of command				
This command configures the `READ:SUBarrays..`, `FETCh:SUBarrays..`, and `SAMPle:SUBarrays:SPECtrum:SWITching:TDOMain` commands. It is analogous to the subarray command for the frequency domain (`CONFigure:SUBarrays:SPECtrum:SWITching[:FDOMain]`). The number of samples and the start value depends on the slot count (`CONFigure:SPECtrum:SWITching:NOSLots`)				

Measured Values

The commands of the following subsystems determine and return the results of the spectrum due to switching measurement. They correspond to the graphical menu *Spectrum* with its various display elements.

Subsystem SPECtrum:SWITching

The subsystem *SPECtrum:SWITching* measures and returns the *Switching* spectum and compares it with tolerance values. The subsystem corresponds to the graphical measurement menu *Spectrum.*

Scalar Results:

READ[:SCALar]:SPECtrum:SWITching? Start single shot measurement and return results
FETCh[:SCALar]:SPECtrum:SWITching? Read measurement results (unsynchronized)
SAMPle[:SCALar]:SPECtrum:SWITching? Read measurement results (synchronized)

Returned values	Value range	Def. value	Def. unit	FW vers.
Reference Power,	–100.0 dBm to +100.0 dBm	NAN	dBm	V1.20
Matching	INV | MATC | NMAT | OUT | NTR | NRAM | OFLW | UFLW | NTSC | OFF	INV	–	

Description of command

These commands are always queries. They start a measurement and return the results. For more details refer to the description of measurement control in chapter 5 of the CMU200 operating manual.

The reference power is the absolute carrier power measured as specified in the GSM standard. The following messages may be output for the value *Matching*:

INV	*invalid*
MATC	*matching*
NMAT	*not matching*
OUT	*out of range*
NTR	*no trigger*
NRAM	*not ramping (burst not found)*
OFLW	*overflow*
UFLW	*underflow*
NTSC	*no training sequence code*
OFF	*off*

Spectrum Results: Frequency Domain, Fixed Meas. Points

READ:ARRay:SPECtrum:SWITching[:FDOMain]? Start single shot measurement and return results
FETCh:ARRay:SPECtrum:SWITching[:FDOMain]? Read measurement results (unsynchronized)
SAMPle:ARRay:SPECtrum:SWITching[:FDOMain]? Read results (synchronized)

Returned values	Description of parameters	Def. value	Def. unit	FW vers.
–100.0 dBm to + 100.0 dBm,	Power at measurement point 1 (–1.8 MHz)	NAN	dBm	V1.20
...,	...	...	...	
–100.0 dBm to + 100.0 dBm,	Power at measurement point 5 (0 MHz)	NAN	dBm	
...,		...	...	
–100.0 dBm to + 100.0 dBm	Power at measurement point 9 (+1.8 MHz)	NAN	dBm	

Description of command

These commands are always queries. They return the off-carrier power due to switching at all enabled fixed measurement points `(CONFigure:SPECtrum:SWITching:CONTrol:MPOint<nr>:ENABle)`. NAN is returned at the disabled points.

Spectrum Results: Frequency Domain, Variable Meas. Points

READ:ARRay:SPECtrum:SWITching[:FDOMain]:VMPoint? Start single shot measurement and return results
FETCh:ARRay:SPECtrum:SWITching[:FDOMain]:VMPoint? Read measurement results (unsynchronized)
SAMPle:ARRay:SPECtrum:SWITching[:FDOMain]:VMPoint? Read results (synchronized)

Returned values	Description of parameters	Def. value	Def. unit	FW vers.
–100.0 dBm to + 20.0 dBm,	Power at meas. point 4 (neg. freq. offset)	NAN	dBm	V3.50
...,	...	...	...	
–100.0 dBm to + 20.0 dBm,	Power at meas. point 1 (neg. freq. offset)	NAN	dBm	
–100.0 dBm to + 20.0 dBm,	Power at meas. point 1 (pos. freq. offset)	NAN	dBm	
…,	...	...		
–100.0 dBm to + 20.0 dBm	Power at meas. point 4 (pos. freq. offset)	NAN	dBm	

Description of command

These commands are always queries. They return the off-carrier power due to switching at all enabled variable measurement points (`CONFigure:SPECtrum:SWITching:CONTrol:VMPOint<nr>`). NAN is returned at the disabled points.

Subarray Results: Frequency Domain

READ:SUBarrays:SPECtrum:SWITching[:FDOMain]? Start meas. and return results ⇒ *RUN*
FETCh:SUBarrays:SPECtrum:SWITching[:FDOMain]? Read meas. results (unsynchronized) ⇒ *RUN*
SAMPle:SUBarrays:SPECtrum:SWITching[:FDOMain]? Read results (synchronized) ⇒ *RUN*

Ret. values per subrange	Description of parameters	Def. value	Def. unit	FW vers.
–100.0 dBm to + 100.0 dBm,	Power[1], 1st value for power	NAN	dBm	V2.00
...,	...	...	...	
–100.0 dBm to + 100.0 dBm	Power[x], xth value for power	NAN	dBm	

Description of command

These commands are always queries. They output the off-carrier power due to switching in the subranges defined by means of the `CONFigure:SUBarrays:SPECtrum:SWITching[:FDOMain]` command. In the default setting of the configuration command the `READ:SUBarrays...`, `FETCh:SUBarrays...`, `and SAMPle:SUBarrays...` command group is equivalent to the `READ:ARRay...`, `FETCh:ARRay...`, `and SAMPle:ARRay...` command group described above.

The `CONFigure:SUBarrays:SPECtrum:SWITching[:FDOMain]` command defines a maximum of 32 subranges. If one of the statistical modes (`ARIThmetical`, `MINimum`, `MAXimum`) is set, only one value is returned per subrange.

CALCulate:ARRay:SPECtrum:SWITching[:FDOMain]:AREA:LIMit:MATChing? Limit Matching

Returned value	Description of parameters	Def. value	Def. unit	FW vers.
32 bit value	Indicator for limit matching at fixed meas. points (9 least significant bits)	NAN	–	V3.50

Description of command

This command is always a query. A bit in the output value is set if the corresponding fixed measurement point exceeds the limit.

Spectrum Results: Time Domain

READ:ARRay:SPECtrum:SWITching:TDOMain? Start single shot measurement and return results
FETCh:ARRay:SPECtrum:SWITching:TDOMain? Read measurement results (unsynchronized)
SAMPle:ARRay:SPECtrum:SWITching:TDOMain? Read results (synchronized)

Returned values	Description of parameters	Def. value	Def. unit	FW vers.
–100.0 dBm to +100.0 dBm,	Power at measurement point 1	NAN	dBm	V3.50
...,	…	...	...	
–100.0 dBm to +100.0 dBm	Power at measurement point n	NAN	dBm	

Description of command

These commands are always queries. They return the off-carrier power vs. time at a definite offset frequency from the carrier `(CONFigure:SPECtrum:SWITching:TDFSelect)`. The number of results depends on the slot count (`CONFigure:SPECtrum:SWITching:NOSLots`):

Slot count	1	2	3	4	5	6	7	8
n	618	1086	1554	2022	2490	2958	3426	3894

The position of the measurement points is as reported in the `CONFigure:SUBarrays:SPECtrum: SWITching:TDOMain` command description.

Subarray Results: Time Domain

READ:SUBarrays:SPECtrum:SWITching:TDOMain? Start single shot meas. and return results ⇒ *RUN*
FETCh:SUBarrays:SPECtrum:SWITching:TDOMain? Read meas. results (unsynchronized) ⇒ *RUN*
SAMPle:SUBarrays:SPECtrum:SWITching:TDOMain? Read results (synchronized) ⇒ *RUN*

Ret. values per subrange	Description of parameters	Def. value	Def. unit	FW vers.
–100.0 dBm to + 20.0 dBm,	Power[1], 1st value for power	NAN	dBm	V3.50
...,	...	...	...	
–100.0 dBm to + 20.0 dBm	Power[x], xth value for power	NAN	dBm	

Description of command

These commands are always queries. They output the off-carrier power due to modulation in the subranges defined by means of the `CONFigure:SUBarrays:SPECtrum:SWITching:TDOMain` command. In the default setting of the configuration command the `READ:SUBarrays...`, `FETCh:SUBarrays...`, and `SAMPle:SUBarrays...` command group is equivalent to the `READ:ARRay...`, `FETCh:ARRay...`, and `SAMPle:ARRay...` command group described above.

The `CONFigure:SUBarrays:SPECtrum:SWITching:TDOMain` command defines a maximum of 32 subranges. If one of the statistical modes `(ARIThmetical, MINimum, MAXimum)` is set, only one value is returned per subrange.

SPECtrum:MSWitching

The subsystem *SPECtrum:MSWitching* measures the spectrum due to modulation and the spectrum due to switching in a single measurement shot. The subsystem corresponds to the measurement menu *Spectrum,* application *Modulation & Switching,* and the associated configuration popups.

Note: *The combined `MSWitching` measurement takes longer than a single `MODulation` or `SWITching` measurement, however, all results can be retrieved with a single command.*

Control of Measurement – Subsystem SPECtrum:MSWitching

The subsystem *SPECtrum:MSWitching* controls the spectrum due to modulation and switching measurement.

INITiate:SPECtrum:MSWitching	Start new measurement	⇒	*RUN*
ABORt:SPECtrum:MSWitching	Abort running measurement and switch off	⇒	*OFF*
STOP:SPECtrum:MSWitching	Stop measurement after current stat. cycle	⇒	*STOP*
CONTinue:SPECtrum:MSWitching	Next measurement step (only *stepping mode*)	⇒	*RUN*
Description of command			FW vers.
These commands have no query form. They start or stop the measurement, setting it to the status indicated in the top right column.			V3.50

CONFigure:SPECtrum:MSWitching:EREPorting <*Mode*>				Event Reporting
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
SRQ | **SOPC |** **SRSQ |** **OFF**	Service request Single operation complete SRQ and SOPC No reporting	OFF	–	V3.50
Description of command				
This command defines the events generated when the measurement is terminated or stopped *(event reporting,* see chapter 5 of CMU manual).				

FETCh:SPECtrum:MSWitching:STATus?				Measurement Status
Returned values	Description of parameters	Def. value	Def. unit	FW vers.
OFF | **RUN |** **STOP |** **ERR |** **STEP |** **RDY,**	Measurement in the *OFF* state (`*RST` or `ABORt`) Running (after `INITiate, CONTinue` or `READ`) Stopped (`STOP`) *OFF* (could not be started) Stepping mode *(<stepmode>=STEP)* Stopped according to repetition mode and stop condition	OFF	–	V3.50
1 to 1000 | **NONE,**	Counter for current evaluation period within a cycle Statistic count set to off	NONE	–	
1 to 10000 | **NONE,**	Counter for current statistics cycle for Modulation (→`CONFigure:SPECtrum:Modulation:CONTrol`) Statistic count set to off	NONE	–	
1 to 10000 | **NONE**	Counter for current statistics cycle for Switching (→`CONFigure:SPECtrum:SWITching:CONTrol`) Statistic count set to off	NONE	–	
Description of command				
This command is always a query. It returns the status of the measurement (see chapters 3 and 5 of CMU manual).				

Subsystem SPECTrum:MSWitching:CONTrol

The subsystem *SPECtrum:MSWitching:CONTrol* defines the repetition mode, statistic count, and stop condition of the measurement. These settings are provided in the *Control* and *Meas X* tabs of the popup menu *Spectrum Configuration*.

CONFigure:SPECtrum:MSWitching:CONTrol <*Mode*>				Scope of Measurement
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
SCALar | **ARRay**	Only scalar measured values Scalar measured values and arrays	ARRay	–	V3.50
Description of command				
This command restricts the type of measured values and determines the number of bursts within a statistics cycle.				

CONFigure:SPECtrum:MSWitching:CONTrol:REPetition *<Repetition>,<StopCondition>, <Stepmode>*				Test Cycles
<Repetition>	Description of parameters	Def. value	Def. unit	FW vers.
CONTinuous | **SINGleshot |** **1 to 10000**	Continuous measurement (until `STOP` or `ABORT`) Single shot measurement (until `Status = RDY`) Multiple measurement (*counting*, until `Status = STEP | RDY`)	SING	–	V3.50
<StopCondition>	Description of parameters	Def. value	Def. unit	FW vers.
SONerror | **NONE**	Stop measurement in case of error *(stop on error)* Continue measurement even in case of error	NONE	–	V3.50
<Stepmode>	Description of parameters	Def. value	Def. unit	FW vers.
STEP | **NONE**	Interrupt measurement after each statistics cycle Continue measurement according to its rep. mode	NONE	–	V3.50
Description of command				
This command defines the number of test cycles, the stepping mode and, if required, a stop condition for the measurement. **Note:** *For READ commands (`READ:...`), the <Repetition> parameter has no effect; the measurement is always stopped after a single shot.*				

Test Configuration

The commands of the following subsystems configure the spectrum due to switching. They correspond to the *Switching* sections in the *Spectrum Configuration* menu.

Subsystem SPECTrum:MSWitching:LIMit:LINE

The subsystem *SPECtrum:MSWitching:LIMit:LINE* defines the limit lines, i.e. the tolerance values for the spectrum due to switching measurement. The subsystem corresponds to the *Switching* sections in the tab *Limit Lines* in the popup menu *Spectrum Configuration.*

[SENSe:]SPECtrum:MSWitching:LIMit:LINE:USED?				Current Limit Template
Response	Description of parameters	Def. value	Def. unit	FW vers.
GMSK | **EPSK**	Use GMSK template Use EPSK template	–	–	V3.50
Description of command				
These commands is always a query and returns the current limit line template. The template can be selected using `CONFigure:SPECtrum:LIMit:LINE:SELect`.				

Measured Values

The commands of the following subsystems determine and return the results of the spectrum due to switching measurement. They correspond to the graphical menu *Spectrum* with its various display elements.

Subsystem SPECtrum:MSWitching

The subsystem *SPECtrum:MSWitching* measures and returns the *Switching* spectum and compares it with tolerance values. The subsystem corresponds to the graphical measurement menu *Spectrum.*

Scalar Results:

READ[:SCALar]:SPECtrum:MSWitching? Start single shot measurement and return results
FETCh[:SCALar]:SPECtrum:MSWitching? Read measurement results (unsynchronized)
SAMPle[:SCALar]:SPECtrum:MSWitching? Read measurement results (synchronized)

Returned values	Value range	Def. value	Def. unit	FW vers.
Reference Power (Modulation),	–100.0 dBm to +100.0 dBm	NAN	dBm	V3.50
Reference Power (Switching),	–100.0 dBm to +100.0 dBm	NAN	dBm	
Matching (Modulation),	INV | MATC | NMAT | OUT | NTR | NRAM | OFLW | UFLW | NTSC | OFF	INV	–	
Matching (Switching)	INV | MATC | NMAT | OUT | NTR | NRAM | OFLW | UFLW | NTSC | OFF	INV	–	

Description of command

These commands are always queries. They start a measurement and return the results. For more details refer to the description of measurement control in Chapter 5 of the R&S CMU operating manual.

The reference powers are absolute carrier powers measured according to GSM conformance test specification for the spectrum due to modulation and spectrum due to switching (see Chapter 4). The following messages may be output for the values *Matching*:

INV	*invalid*
MATC	*matching*
NMAT	*not matching*
OUT	*out of range*
NTR	*no trigger*
NRAM	*not ramping (burst not found)*
OFLW	*overflow*
UFLW	*underflow*
NTSC	*no training sequence code*
OFF	*off*

Spectrum Results: Frequency Domain, Fixed Meas. Points

READ:ARRay:SPECtrum:MSWitching? Start single shot measurement and return results
FETCh:ARRay:SPECtrum:MSWitching? Read measurement results (unsynchronized)
SAMPle:ARRay:SPECtrum:MSWitching? Read results (synchronized)

Returned values	Description of parameters	Def. value	Def. unit	FW vers.
–100.0 dB to + 20.0 dB,	1st modulation result (at –1.8 MHz)	NAN	dB	V3.50
...,	...	...	...	
–100.0 dB to + 20.0 dB,	23rd modulation result (at +1.8 MHz)	NAN	dB	
–100.0 dBm to + 100.0 dBm,	1st switching result (at –1.8 MHz)	NAN	dBm	
...,	...	...	...	
–100.0 dBm to + 100.0 dBm	9th switching result (at +1.8 MHz)	NAN	dBm	

Description of command

These commands are always queries. They return the off-carrier power due to modulation and switching at all enabled fixed measurement points (`CONFigure:SPECtrum:<Application>:CONTrol:MPOint<nr>: ENAble`). NAN is returned at the disabled points.

Spectrum Results: Frequency Domain, Variable Meas. Points

READ:ARRay:SPECtrum:MSWitching:VMPoint? Start single shot measurement and return results
FETCh:ARRay:SPECtrum:MSWitching:VMPoint? Read measurement results (unsynchronized)
SAMPle:ARRay:SPECtrum:MSWitching:VMPoint? Read results (synchronized)

Returned values	Description of parameters	Def. value	Def. unit	FW vers.
–100.0 dB to + 20.0 dB,	1st modulation result	NAN	dBm	V3.50
...,	...	...	...	
–100.0 dB to + 20.0 dB,	8th modulation result	NAN	dBm	
–100.0 dBm to + 100.0 dBm,	1st switching result	NAN	dBm	
...,	...	...		
–100.0 dBm to + 100.0 dBm	8th switching result	NAN	dBm	

Description of command

These commands are always queries. They return the off-carrier power due to modulation and switching at all enabled variable measurement points `(CONFigure:SPECtrum:<Application>:CONTrol:VMPOint<nr>).` NAN is returned at the disabled points.

CALCulate:ARRay:SPECtrum:MSWitching:AREA:LIMit:MATChing? Limit Matching

Returned value	Description of parameters	Def. value	Def. unit	FW vers.
32 bit value,	Indicator for modulation limit matching at fixed meas. Points (23 least significant bits)	NAN, NAN	–	V3.50
32 bit value	Indicator for switching limit matching at fixed meas. points (9 least significant bits)			

Description of command

This command is always a query. A bit in the output values is set if the corresponding fixed measurement point exceeds the limit.

Measurement Groups (Signalling only)

The measurement groups in this section are either provided in *Signalling* mode only or implemented with major differences in the two test modes.

POWer[:NORMal]

The subsystem *POWer[:NORMal]* measures the MS transmitter output power versus time for normal bursts. The subsystem corresponds to the measurement menu *Power,* application *P/t Normal...,* and the associated popup menu *Power Configuration.*

Note1: Measurements and signalling states

To perform any kind of measurement and obtain a meaningful result, an appropriate test setup is required (see application examples in chapter 2 of this manual). Consequently, for the measurements reported in the following sections, the Call Established (CEST) signalling state must be reached before any of the commands retrieving test results (READ...?, FETCh...?, SAMPle...?, or CALCulate...LIMit?) can be used. Test configurations, however, can be defined any time.

Note2: GMSK and 8PSK modulation

The keywords [:GMSK] and :EPSK in the remote control commands denote GMSK and 8PSK modulation, respectively. The :EPSK commands in Signalling measurements are included in firmware versions V3.05 and higher. The firmware version numbers quoted in the command tables refer to GMSK modulation.

Control of Measurement – Subsystem Power[:NORMal]

The subsystem *POWer[:NORMal]* controls the normal burst power measurement.

INITiate:POWer[:NORMal][:GMSK] **INITiate:POWer[:NORMal]:EPSK**	Start new measurement	⇒ RUN
ABORt:POWer[:NORMal][:GMSK] **ABORt:POWer[:NORMal]:EPSK**	Abort running measurement and switch off	⇒ OFF
STOP:POWer[:NORMal][:GMSK] **STOP:POWer[:NORMal]:EPSK**	Stop measurement after current stat. cycle	⇒ STOP
CONTinue:POWer[:NORMal][:GMSK] **CONTinue:POWer[:NORMal]:EPSK**	Next measurement step (only stepping mode)	⇒ RUN

Description of command	FW vers.
These commands have no query form. They start or stop the measurement, setting it to the status indicated in the top right column.	V1.15

CONFigure:POWer[:NORMal][:GMSK]:EREPorting <*Mode*>
CONFigure:POWer[:NORMal]:EPSK:EREPorting <*Mode*>
Event Reporting

<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
SRQ | **SOPC |** **SRSQ |** **OFF**	Service request Single operation complete SRQ and SOPC No reporting	OFF	–	V1.15

Description of command

This command defines the events generated when the measurement is terminated or stopped *(event reporting,* see chapter 5 of CMU manual).

FETCh:POWer[:NORMal][:GMSK]:STATus?
FETCh:POWer[:NORMal]:EPSK:STATus?
Measurement Status

Returned values	Description of parameters	Def. value	Def. unit	FW vers.
OFF | **RUN |** **STOP |** **ERR |** **STEP |** **RDY,**	Measurement in the *OFF* state (`*RST` or `ABORt`) Running (after `INITiate, CONTinue` or `READ`) Stopped (`STOP`) *OFF* (could not be started) Stepping mode *(<stepmode>=STEP)* Stopped according to repetition mode and stop condition	OFF	–	V1.15
1 to 10000 | **NONE,**	Counter for current statistics cycle No counting mode set	NONE	–	
1 to 1000 | **NONE**	Counter for current evaluation period within a cycle Statistic count set to off	NONE	–	

Description of command

This command is always a query. It returns the status of the measurement (see chapters 3 and 5 of CMU manual).

CONFigure:POWer[:NORMal][:GMSK]:TOFFset <*Offset*>
CONFigure:POWer[:NORMal]:EPSK:TOFFset <*Offset*>
Bit Offset

<Offset>	Description of parameters	Def. value	Def. unit	FW vers.
–4.00 to +4.00	Number of bits	0	bit	V2.15

Description of command

This command defines an offset time in ¼ bit units by which the burst is shifted relative to the time axis and the tolerance template.

CONFigure:POWer[:NORMal][:GMSK]:FILTer <*Filter*>
CONFigure:POWer[:NORMal]:EPSK:FILTer <*Filter*>
Filter

<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
G500 | **B600**	500 kHz Gaussian filter 600 kHz bandpass filter	G500 for GMSK modulation B600 for 8PSK modulation	–	V3.05

Description of command

This command selects the measurement filter for the *P/t* measurement. The default filter setting differs for the two modulation schemes.

Test Configuration

The commands of the following subsystems configure the power measurement. They correspond to the sections in the *Power Configuration* popup menu that are related to the normal burst power measurement. For a detailed explanation of the power tolerance template defined in the GSM standard see Chapter 4.

Subsystem POWer[:NORMal]:CONTrol

The subsystem *POWer[:NORMal]:CONTrol* defines the repetition mode, statistic count, and stop condition of the measurement. These settings are provided in the *Control* tab of the popup menu *Power Configuration.*

CONFigure:POWer[:NORMal][:GMSK]:CONTrol <*Mode*>, <*Statistics*> — Scope of Measurement
CONFigure:POWer[:NORMal]:EPSK:CONTrol <*Mode*>, <*Statistics*>

<Mode>	Description of parameters	Def. value	Def. unit	
SCALar | **ARRay,**	Scalar values only (incl. ramp matching) Scalar measured values and arrays	ARRay	–	
<Statistics>	**Description of parameters**	**Def. value**	**Def. unit**	**FW vers.**
1 to 1000 | **OFF**	Number of bursts per statistics cycle Statistics off (equivalent to 1)	100	–	V1.15

Description of command

This command restricts the type of measured values to accelerate the measurement and determines the number of bursts within a statistics cycle.

CONFigure:POWer[:NORMal][:GMSK]:CONTrol:REPetition — Test cycles
CONFigure:POWer[:NORMal]:EPSK:CONTrol:REPetition
<Repetition>,<StopCond>,<Stepmode>

<Repetition>	Description of parameters	Def. value	Def. unit	
CONTinuous | **SINGleshot |** **1 to 10000**	Continuous measurement (until `STOP` or `ABORT`) Single shot measurement (until `Status = RDY`) Multiple measurement (*counting*, until `Status = STEP | RDY`)	SING	–	
<StopCondition>	**Description of parameters**	**Def. value**	**Def. unit**	
SONerror | **NONE**	Stop measurement in case of error *(stop on error)* Continue measurement even in case of error	NONE	–	
<Stepmode>	**Description of parameters**	**Def. value**	**Def. unit**	**FW vers.**
STEP | **NONE**	Interrupt measurement after each statistics cycle Continue measurement according to its rep. mode	NONE	–	V1.15

Description of command

This command determines the number of statistics cycles, the stop condition and the stepping mode for the measurement.

Note: In the case of READ commands (`READ:...`), the <Repetition> parameter has no effect; the measurement is always stopped after a single shot

DISPlay:POWer[:NORMal][:GMSK]:CONTrol:GRID *<Enable>*
DISPlay:POWer[:NORMal]:EPSK:CONTrol:GRID *<Enable>* Grid

<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	Switch on grid lines Switch off grid lines	ON	–	V1.15

Description of command

This command switches the grid lines in the test diagrams on or off.

CONFigure:POWer[:NORMal]:EPSK:CONTrol:RPMode *<Mode>* Ref. Power Mode

<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
CURRent | **AVERage |** **DCOMpens**	Ref. Power calculated from current burst Ref. Power calculated from average curve Data compensated/corrected reference power	AVER	–	V2.15

Description of command

This command determines how the reference power (0-dB line in the *P/t Norm. 8PSK* test diagram) for 8PSK-modulated signals is calculated.

NOTE

With firmware version V3.80 the default setting has been changed from CURR to AVER in order to comply with the current conformance test specification 51.010.

CONFigure:POWer[:NORMal][:GMSK]:CONTrol:DEFault <Enable>
CONFigure:POWer[:NORMal]:EPSK:CONTrol:DEFault <Enable> Default Settings

<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	The parameters are set to their default values Some or all parameters are not set to default	ON	–	V2.00

Description of command

If used as a setting command with the parameter *ON* this command sets all parameters of the subsystem to their default values (the setting *OFF* causes an error message).

If used as a query the command returns whether all parameters are set to their default values *(ON)* or not *(OFF)*.

Subsystem POWer[:NORMal]...:LIMit:LINE

The subsystem *POWer[:NORMal]...:LIMit:LINE* defines the limit lines and thus the tolerance values for the normal burst power measurement. The subsystem corresponds to the tab *Limit Lines* in the popup menu *Power Configuration.*

CONFigure:POWer[:NORMal][:GMSK]:LIMit:LINE:UPPer<nr>[:STATic]:ENABle ***<Enable>***
CONFigure:POWer[:NORMal]:EPSK:LIMit:LINE:UPPer<nr>[:STATic]:ENABle ***<Enable>***
CONFigure:POWer[:NORMal][:GMSK]:LIMit:LINE:UPPer<nr>[:STATic]
CONFigure:POWer[:NORMal]:EPSK:LIMit:LINE:UPPer<nr>[:STATic] Upper Limit Line

Parameters for query: ***<StartTime>, <EndTime>, <StartRelLevel>, <EndRelLevel>, <StartAbsLevel>, <EndAbsLevel>, <StartVisibility>, <EndVisibility>***

for setting: ***<StartTime>, <EndTime>, <StartRelLevel>, <EndRelLevel>, <StartAbsLevel>, <EndAbsLevel>, <Visibility>***

Parameters	Value range	Description of parameters	Def. value
<Enable>	ON | OFF	Defined section on/off	See below
<StartTime>,	–10 bit to +156 ¾ bit | OFF	Start point of time	
<EndTime>,	–10 bit to +156 ¾ bit | OFF,	End point of time	
<StartRelLevel>,	–100 dB to 20 dB | OFF,	Start point of level (relative)	
<EndRelLevel>,	–100 dB to 20 dB | OFF,	End point of level (relative)	
<StartAbsLevel>,	–90 dBm to 50 dBm | OFF,	Start point of level (absolute)	
<EndAbsLevel>,	–90 dBm to 50.0 dBm | OFF,	End point of level (absolute)	
<Visibility>	ON | OFF	Range of limit lines on/off	
<StartVisib.>			
<EndVisib>			

Description of command	FW vers.
These commands activate and define upper limit lines for normal bursts. The limit lines are defined section by section; the suffix <nr> numbers the various ranges of the limit lines.	V1.15

For GMSK modulation (keyword `[:GMSK]`), 8 areas are defined in the default setting, another 8 areas can be activated if required. The default settings are given in the table below:

	for Enable		forTable					
Suffix	Enable	Start Time	Stop Time	Start rel.Level	Stop rel.Level	Start abs.Level	Stop abs.Level	Visibility
1	ON	–10.0 bit	–7 ¼ bit	–59.0[1] dB	–59.02 dB	–36.0[2] dBm	–36.0[2] dBm	ON
2	ON	–7 ¼ bit	–4 ½ bit	–30.0 dB	–30.0 dB	–17.0[3] dBm	–17.0[3] dBm	ON
3	ON	–4 ½ bit	–2 ¼ bit	–6.0 dB	–6.0 dB	OFF	OFF	ON
4	ON	–2 ¼ bit	+½ bit	+4.0 dB	+4.0 dB	OFF	OFF	ON
5	ON	½ bit	150 ¼ bit	+1.0 dB	+1.0 dB	OFF	OFF	ON
6	ON	150 ¼ bit	152 ½ bit	–6.0 dB	–6.0 dB	OFF	OFF	ON
7	ON	152 ½ bit	155 ¼ bit	–30.0 dB	–30.0 dB	–17.0[3] dBm	–17.0[3] dBm	ON
8	ON	155 ¼ bit	156 ¾ bit	–59.0[1] dB	–59.0[1] dB	–36.0[2] dBm	–36.0[2] dBm	ON
9	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
...								
16	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF

The setting *Visibility = Off* implies that the corresponding range, including the limit check, is switched off. *Enable = Off* switches off the entire limit check.

1 GSM400/850/900. The value for GSM1800 and GSM1900 is –48.0 dB.
2 GSM400/850/900. The value for GSM1800 and GSM1900 is –48.0 dBm.
3 GSM400/850/900. The value for GSM1800 and GSM1900 is –20.0 dBm.

The default settings for 8MSK modulation (EDGE channels, keyword `:EPSK`) are given in the table below:

	for Enable		forTable					
		Start	Stop	Start	Stop	Start	Stop	
Suffix	Enable	Time	Time	rel.Level	rel.Level	abs.Level	abs.Level	Visibility
1	ON	–10.0 symb	–7 ¼ symb	–59.0[1] dB	–59.0[1] dB	–36.0[2] dBm	–36.0[2] dBm	ON
2	ON	–7 ¼ symb	–4 ½ symb	–30.0 dB	–30.0 dB	–17.0[3] dBm	–17.0[3] dBm	ON
3	ON	–4 ½ symb	–2 ¼ symb	–6.0 dB	–6.0 dB	OFF	OFF	ON
4	ON	–2 ¼ symb	+½ symb	+4.0 dB	+4.0 dB	OFF	OFF	ON
5	ON	½ symb	1 ½ symb	+2.4 dB	+2.4 dB	OFF	OFF	ON
6	ON	1 ½ symb	146 ½ symb	+4.0 dB	+4.0 dB	OFF	OFF	ON
7	ON	146 ½ symb	147 ½ symb	+2.4 dB	+2.4 dB	OFF	OFF	ON
8	ON	147 ½ symb	150 ¼ symb	+4.0 dB	+4.0 dB	OFF	OFF	ON
9	ON	150 ¼ symb	152 ½ symb	–6.0 dB	–6.0 dB	OFF	OFF	ON
10	ON	152 ½ symb	155 ¼ symb	–30.0 dB	–30.0 dB	–17.0[3] dBm	–17.0[3] dBm	ON
11	ON	155 ¼ symb	156 ¾ symb	–59.0[1] dB	–59.0[1] dB	–36.0[2] dBm	–36.0[2] dBm	ON
12	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
...								
16	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF

CONFigure:POWer[:NORMal][:GMSK]:LIMit:LINE:LOWer<nr>[:STATic]:ENABle ***<Enable>***
CONFigure:POWer[:NORMal]:EPSK:LIMit:LINE:LOWer<nr>[:STATic]:ENABle ***<Enable>***

CONFigure:POWer[:NORMal][:GMSK]:LIMit:LINE:LOWer<nr>[:STATic]
CONFigure:POWer[:NORMal]:EPSK:LIMit:LINE:LOWer<nr>[:STATic] Lower Limit Line

Parameters for query: ***<StartTime>, <EndTime>, <StartRelLevel>, <EndRelLevel>, <StartAbsLevel>, <EndAbsLevel>, <StartVisibility>, <EndVisibility>***

for setting: ***<StartTime>, <EndTime>, <StartRelLevel>, <EndRelLevel>, <StartAbsLevel>, <EndAbsLevel>, <Visibility>***

Parameters	Value range	Description of parameters	Def. value
<Enable>	ON | OFF	Definition section on/off	See below
<StartTime>,	–10 bit to +156 ¾ bit | OFF	Start point of time	
<EndTime>,	–10 bit to +156 ¾ bit | OFF,	End point of time	
<StartRelLevel>,	–100 dB to 20 dB | OFF,	Start point of level (relative)	
<EndRelLevel>,	–100 dB to 20 dB | OFF,	End point of level (relative)	
<StartAbsLevel>,	–90 dBm to 50 dBm | OFF,	Start point of level (absolute)	
<EndAbsLevel>,	–90 dBm to 50 dBm | OFF,	End point of level (absolute)	
<Visibility>	ON | OFF	Range of limit lines on/off	
<StartVisib.>			
<EndVisib>			

Description of command	FW vers.
These commands activate and define lower limit lines for normal bursts. The limit lines are defined section by section; the suffix <nr> numbers the different ranges of limit lines.	V1.15

Only 1 area is defined in the default setting, another 15 areas can be activated if required. The default settings for GMSK modulation (keyword `[:GMSK]`) are shown in the table below:

	for Enable		for Table					
	Start	Stop	Start	Stop	Start	Stop		
Suffix	Enable	Time	Time	rel.Level	rel.Level	abs.Level	abs.Level	Visibility
1	ON	–10.0 bit	½ bit	OFF	OFF	OFF	OFF	OFF
2	ON	½ bit	147 ½ bit	–1.0 dB	–1.0 dB	OFF	OFF	ON
3	ON	147 ½ bit	156 ¾ bit	OFF	OFF	OFF	OFF	ON
4	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
...								
16	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF

The default settings for 8MSK modulation (EDGE channels, keyword `:EPSK`) are given in the table below:

	for Enable		for Table					
	Start	Stop	Start	Stop	Start	Stop		
Suffix	Enable	Time	Time	rel.Level	rel.Level	abs.Level	abs.Level	Visibility
1	ON	–10.0 symb	½ symb	OFF	OFF	OFF	OFF	OFF
2	ON	½ symb	1 symb	–2.0 dB	–2.0 dB	OFF	OFF	ON
3	ON	1 symb	1 ½ symb	0.0 dB	0.0 dB	OFF	OFF	ON
4	ON	1 ½ symb	146 ½ symb	–15.0 dB	–15.0 dB	OFF	OFF	ON
5	ON	146 ½ symb	147 symb	0.0 dB	0.0 dB	OFF	OFF	ON
6	ON	147 symb	147 ½ symb	–2.0 dB	–2.0 dB	OFF	OFF	ON
7	ON	147 ½ symb	156 ¾ symb	OFF	OFF	OFF	OFF	OFF
8	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
...								
16	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF

CONFigure:POWer[:NORMal][:GMSK]:LIMit:LINE:UPPer<AreaNr>:DYNamic<RangeNr>:ENABle
CONFigure:POWer[:NORMal]:EPSK:LIMit:LINE:UPPer<AreaNr>:DYNamic<RangeNr>:ENABle
<Enable>

CONFigure:POWer[:NORMal][:GMSK]:LIMit:LINE:UPPer<AreaNr>:DYNamic<RangeNr>
CONFigure:POWer[:NORMal]:EPSK:LIMit:LINE:UPPer<AreaNr>:DYNamic<RangeNr> ***<fromTPCL>, <toTPCL>, <Correction>, <Enable>*** Dynamic Correction

<fromPCL>	Description of parameters	Def. value	Def. unit	
0 to 31 | MAX | OFF	First PCL for which area <AreaNr> is changed	See table below	PCL	
<toPCL>	Description of parameters	Def. value	Def. unit	
0 to 31 | MAX | OFF	Last PCL for which area <AreaNr> is changed.	See table below	PCL	
<Correction>	Description of parameters	Def. value	Def. unit	
-10 dB to +10 dB | OFF	Correction value (relative) for the limit line in area <AreaNr> applied for all PCLs between <fromPCL> and <toPCL> (including)	See table below	dB	
<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | OFF	Enable or disable dynamic correction in the current limit line area and PCL range	See table below	–	V1.15

Description of command

These command activates and defines dynamic correction of the upper limit line of area <AreaNr> (<AreaNr> = 1 to 16) depending on the PCL range <RangeNr> (<RangeNr> = 1 to 10 for each area). *MAX* denotes the maximum output power (smallest PCL) of the mobile phone under test.

In the areas no. 3 and 6, the following ranges are defined:

Range	**from TPCL**	**to TPCL**	**Correction**	**Enable**
1	16	16	+2.0 dB	ON
2	17	17	+4.0 dB	ON
3	18	19	+5.0 dB	ON
4	OFF	OFF	0.0 dB	OFF
5	OFF	OFF	0.0 dB	OFF
6	OFF	OFF	0.0 dB	OFF
7	OFF	OFF	0.0 dB	OFF
8	OFF	OFF	0.0 dB	OFF
9	OFF	OFF	0.0 dB	OFF
10	OFF	OFF	0.0 dB	OFF

In the remaining areas, the dynamic limit line correction is disabled in all ranges.

CONFigure:POWer[:NORMal][:GMSK]:LIMit:LINE:UPPer<AreaNr>:ALL:DYNamic:ENABle
CONFigure:POWer[:NORMal]:EPSK:LIMit:LINE:UPPer<AreaNr>:ALL:DYNamic:ENABle
<Enable> Dynamic Correction on/off

<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | OFF	Switch dynamic correction on or off	ON	–	V2.00

Description of command

This command switches the dynamic correction of the upper limit area <nr> for all ten PCL ranges on or off.

CONFigure:POWer[:NORMal][:GMSK]:LIMit:LINE:UPPer:ALL:DYNamic:ENABle *<Enable>*
CONFigure:POWer[:NORMal]:EPSK:LIMit:LINE:UPPer:ALL:DYNamic:ENABle *<Enable>*
Dynamic Correction on/off

<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | OFF	Switch dyn. correction for the whole template on or off	ON	–	V2.00

Description of command

This command switches the dynamic correction of the upper limit line in all areas and for all PCL ranges on or off. The query returns 160 Boolean values corresponding to the limit check in PCL ranges 1 to 10 (inner loop) in each of the areas 1 to 16 (outer loop).

CONFigure:POWer[:NORMal][:GMSK]:LIMit:LINE:LOWer<AreaNr>:DYNamic<RangeNr>
CONFigure:POWer[:NORMal]:EPSK:LIMit:LINE:LOWer<AreaNr>:DYNamic<RangeNr>
<fromTPCL>, <toTPCL>, <Correction>, <Enable> Dynamic Correction

<fromPCL>	Description of parameters	Def. value	Def. unit	
0 to 31 | MAX | OFF	First PCL for which area <AreaNr> is changed	OFF	PCL	
<toPCL>	Description of parameters	Def. value	Def. unit	
0 to 31 | MAX | OFF	Last PCL for which area <AreaNr> is changed.	OFF	PCL	
<Correction>	Description of parameters	Def. value	Def. unit	
-10 dB to +10 dB | OFF	Correction value (relative) for the limit line in area <AreaNr> applied for all PCLs between <fromPCL> and <toPCL> (including)	OFF	dB	
<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | OFF	Enable or disable dynamic correction in the current limit line area and PCL range	OFF	–	V2.00

Description of command

These command activates and defines dynamic correction of the lower limit line of area <AreaNr> depending on the PCL range <RangeNr>. *MAX* denotes the maximum output power (smallest PCL) of the mobile phone under test.

By default, the dynamic limit line correction is disabled in all ranges and areas.

CONFigure:POWer[:NORMal][:GMSK]:LIMit:LINE:LOWer<AreaNr>:ALL:DYNamic:ENABle
CONFigure:POWer[:NORMal]:EPSK:LIMit:LINE:LOWer<AreaNr>:ALL:DYNamic:ENABle
<Enable> Dynamic Correction on/off

<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | OFF	Switch dynamic correction on or off	OFF	–	V2.00

Description of command

This command switches the dynamic correction of the lower limit area <nr> for all ten PCL ranges on or off. The query returns 160 Boolean values corresponding to the limit check in PCL ranges 1 to 10 (inner loop) in each of the areas 1 to 16 (outer loop).

CONFigure:POWer[:NORMal][:GMSK]:LIMit:LINE:LOWer:ALL:DYNamic:ENABle *<Enable>*
CONFigure:POWer[:NORMal]:EPSK:LIMit:LINE:LOWer:ALL:DYNamic:ENABle *<Enable>*
Dynamic Correction on/off

<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | OFF	Switch dyn. correction for the whole template on or off	OFF	–	V2.00

Description of command

This command switches the dynamic correction of the lower limit line in all areas and for all PCL ranges on or off.

CONFigure:POWer[:NORMal][:GMSK]:LIMit:LINE:DEFault *<Enable>* Default Settings
CONFigure:POWer[:NORMal]:EPSK:LIMit:LINE:DEFault *<Enable>*

<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	All parameters are set to their default values Some or all parameters differ from the default values	ON	–	V1.15

Description of command

If used as a setting command with the parameter *ON* this command sets all parameters of the subsystem to their default values (the setting *OFF* causes an error message). If used as a query the command returns whether all parameters are set to their default values *(ON)* or not *(OFF)*.

Subsystem POWer[:NORMal]...:LIMIt:ABPower

The subsystem *POWer[:NORMal]...:LIMit:ABPower* defines the limit values for the average normal burst power. The subsystem corresponds to the tab *Limits* in the popup menu *Power Configuration.*

CONFigure:POWer[:NORMal][:GMSK]:LIMit:ABPower<nr> Average Burst Power
<StartPCL>, <StopPCL>, <LowerLimit>, <UpperLimit>
CONFigure:POWer[:NORMal][:GMSK]:LIMit:ABPower<nr>:ENABle *<Enable>*

Parameter	Value range	Description of parameters	Def. value
<Enable>	**ON | OFF**	Definition section on/off	see below
<StartPCL>,	**0 to 31 | MAX**	Start value for PCL	see
<StopPCL>,	**0 to 31 | MAX**	End value for PCL	below
<LowerLimit>,	**–10.0 dB to 0.0 dB**	Lower level limit	
<UpperLimit>	**0.0 dB to +10.0 dB**	Upper level limit	

Description of command	FW vers.
These commands determine the tolerances for ranges of power control levels (PCLs). <nr> is the number of the group ($<nr> \in \{1,...,10\}$) The setting *MAX* is synonymous with the highest PCL of the mobile, depending on its power class.	V1.15

4 level ranges are defined in the default setting, another 6 ranges can be activated if required. The default settings for GSM 900/1800/1900 are according to the following table. The default settings for GSM850, GSM GT800, and GSM400 are identical to GSM900:

	For Enable	for table			
Suffix	Enable	StartPCL	StopPCL	LowerLimit	UpperLimit
1	ON	MAX	MAX	–2.0 dB	+2.0 dB
2	ON	0	2/8/8	–2.0/–3/–3 dB	+2.0/3.0/3.0 dB
3	ON	3/9/9	15/13/13	–3.0/–4/–4 dB	+3.0/4.0/4.0 dB
4	ON	16/14/14	31/28/29	–5.0 dB	+5.0 dB
5	OFF/ON/ON	OFF/29/30	OFF/29/31	OFF/–2.0/–2.0 dB	OFF/5.0/2.0 dB
6	OFF/ON/OFF	OFF/30/OFF	OFF/31/OFF	OFF/–3.0 dB/OFF	OFF/2.0 dB/OFF
10	OFF	OFF	OFF	OFF	OFF

Subsystem SUBarrays:POWer

The subsystem *SUBarrays:POWer* defines the measurement range and the type of output values.

CONFigure:SUBarrays:POWer[:NORMal][:GMSK] Definition of Subarrays
CONFigure:SUBarrays:POWer[:NORMal]:EPSK
<Mode>,<Start>,<Samples>{,<Start>,<Samples>}

<Mode>	Description of parameters	Def. value	Def. unit	
ALL | **ARIThmetical |** **MINimum |** **MAXimum |** **IVAL,**	Return all measurement values Return arithm. mean value in every range Return minimum value in every range Return maximum value in every range Return single interpolated value at <Start>	ALL	–	
<Start>	Description of parameters	Def. value	Def. unit	
–10 bit to 156 ¾ bit,	Start time in current range	–10	bit	
<Samples>	Description of parameters	Def. value	Def. unit	FW vers.
1 to 668	Number of samples in current range	668	–	V2.00

Description of command

This command configures the `READ:SUBarrays:POWer...`, `FETCh:SUBarrays:POWer...`, and `SAMPle:SUBarrays:POWer` commands. It restricts the measurement to up to 32 subranges where either all measurement results (the number of which is given by the second numerical parameter) or a single statistical value is returned. The subranges are defined by the start time and the number of test points which are located on a fixed, equidistant grid with a step width of ¼ bit. If <Start> does not coincide with a test point then the range will start at the next test point that is larger than <Start>.

For <Mode> = IVAL, the <Samples> parameter is ignored and the CMU returns a single measurement value corresponding to the abscissa value <Start>. If <Start> is located between two test points with valid results then the result is calculated from the results at these two adjacent test points by linear interpolation.

The subranges may overlap but must be within the total range of the *POWer* measurement. Test points outside this range are not measured (result *NAN)* and do not enter into the ARIThmetical, MINimum and MAXimum values.

By default, only one range corresponding to the total measurement range is used and all measurement values are returned.

Measured Values

The commands of the following subsystems determine and return the results of the normal burst power measurement. They correspond to the graphical menu *Power* with its various display elements.

Subsystem POWer[:NORMal]...

The subsystem *POWer[:NORMal]...* contains the commands for measurement and output of the normal burst power and its comparison with tolerance values. The subsystem corresponds to the graphical measurement menu *Power.*

READ[:SCALar]:POWer[:NORMal][:GMSK]? **READ[:SCALar]:POWer[:NORMal]:EPSK?**	Scalar results: Start single shot measurement and return results
FETCh[:SCALar]:POWer[:NORMal][:GMSK]? **FETCh[:SCALar]:POWer[:NORMal]:EPSK?**	Read out measurement results (unsynchronized)
SAMPle[:SCALar]:POWer[:NORMal][:GMSK]? **SAMPle[:SCALar]:POWer[:NORMal]:EPSK?**	Read out measurement results (synchronized)

Returned values	Value range	Def. value	Def. unit	FW vers.
AvgBurstPwCurr,	–137 dBm to +53 dBm	NAN	dBm	V1.15
PeakBurstPwCurr,	–137 dBm to +53 dBm	NAN	dBm	
PowerControlLevel,	0 to 32 (dep. on network, see chap. 4)	NAN	PCL	
TimingAdvError,	-100.0 bit to+100.0 bit	NAN	bit	
BurstsOutOfTol,	0.0 % to 100.0 %	NAN	%	
BurstMatching	INV | MATC | NMAT | OUT | NTR | NRAM | OFLW | UFLW | NTSC | OFF	INV	–	
AvgBurstPwAvg	–137 dBm to +53 dBm	NAN	dBm	

Description of command

These commands are always queries.

- `READ` starts a single shot measurement and returns the results.
- `FETCh` outputs the results without taking care of the measurement state.
- `SAMPle` waits until the results are valid for the first time (depending on the chosen statistic count) and then outputs the results.

For more details refer to the description of measurement control in chapter 5 of the CMU200 operating manual.

The results are:

Average burst power (current burst)
Peak burst power (current burst)
Power control level
Timing advance error
Burst out of tolerance
Burst template matching
Average burst power of average trace

The following messages may be output for the value *BurstMatching*:

INV	*invalid*
MATC	*matching*
NMAT	*not matching*
OUT	*out of range*
NTR	*no trigger*
NRAM	*not ramping (burst not found)*
OFLW	*overflow*
UFLW	*underflow*
NTSC	*no training sequence code*
OFF	*off*

CALCulate:POWer[:NORMal][:GMSK]:LIMit:MATChing?
CALCulate:POWer[:NORMal]:EPSK:LIMit:MATChing? Limit Matching

Returned values	Value range	Def. value	Def. unit	FW vers.
AvgBurstPwCurr,	NMAU | NMAL | INV | OK	INV	–	V1.15
PeakBurstPwCurr,	NMAU | NMAL | INV | OK	INV	–	
TimingAdvError,	OK (no limit check)	INV	–	
BurstMatching	INV | MATC | NMAT | OUT | NTR | NRAM | OFLW | UFLW | NTSC | OFF	INV	—	
AvgBurstPwAvg	NMAU | NMAL | INV | OK	INV		

Description of command

This command is always a query. It indicates whether and in which way the tolerances for the scalar measured values (see command above) have been exceeded. The following messages may be output for the values *AvgBurstPowerCurr, PeakBurstPowerCurr* and *AvgBurstPowerAvg*:

OK	Tolerance value matched	*OK.*
NMAU	Underflow of tolerance value	*not matching, underflow*
NMAL	Tolerance value exceeded	*not matching, overflow*
INV	Measured value invalid	*invalid*

The following messages may be output for the value *BurstMatching*:

INV	*invalid*
MATC	*matching*
NMAT	*not matching*
OUT	*out of range*
NTR	*no trigger*
NRAM	*not ramping (burst not found)*
OFLW	*overflow*
UFLW	*underflow*
NTSC	*no training sequence code*
OFF	*off*

READ:ARRay:POWer[:NORMal][:GMSK][:CURRent]?
READ:ARRay:POWer[:NORMal]:EPSK[:CURRent]? Burst Power
READ:ARRay:POWer[:NORMal][:GMSK]:AVERage?
READ:ARRay:POWer[:NORMal]:EPSK:AVERage?
READ:ARRay:POWer[:NORMal][:GMSK]:MAXimum?
READ:ARRay:POWer[:NORMal]:EPSK:MAXimum?
READ:ARRay:POWer[:NORMal][:GMSK]:MINimum?
READ:ARRay:POWer[:NORMal]:EPSK:MINimum?
Start single shot measurement and return results ⇒ *RUN*
FETCh:ARRay:POWer[:NORMal][:GMSK][:CURRent]?
FETCh:ARRay:POWer[:NORMal]:EPSK[:CURRent]?
FETCh:ARRay:POWer[:NORMal][:GMSK]:AVERage?
FETCh:ARRay:POWer[:NORMal]:EPSK:AVERage?
FETCh:ARRay:POWer[:NORMal][:GMSK]:MAXimum?
FETCh:ARRay:POWer[:NORMal]:EPSK:MAXimum?
FETCh:ARRay:POWer[:NORMal][:GMSK]:MINimum?
FETCh:ARRay:POWer[:NORMal]:EPSK:MINimum?
Read meas. results (unsynchronized) ⇒ *RUN*
SAMPle:ARRay:POWer[:NORMal][:GMSK][:CURRent]?
SAMPle:ARRay:POWer[:NORMal]:EPSK[:CURRent]? SAMPle:ARRay:POWer[:NORMal][:GMSK]:AVERage?
SAMPle:ARRay:POWer[:NORMal]:EPSK:AVERage?
SAMPle:ARRay:POWer[:NORMal][:GMSK]:MAXimum?
SAMPle:ARRay:POWer[:NORMal]:EPSK:MAXimum?
SAMPle:ARRay:POWer[:NORMal][:GMSK]:MINimum?
SAMPle:ARRay:POWer[:NORMal]:EPSK:MINimum?
Read results (synchronized) ⇒ *RUN*

Returned values	Description of parameters	Def. value	Def. unit	FW vers.
–100.0 dB to + 20.0 dB	BurstPower[1], 1st value for burst power	NAN	dB	V1.15
...	...	...	...	
–100.0 dB to + 20.0 dB	BurstPower[x], xth value for burst power	NAN	dB	

Description of command

These commands are always queries. They output the different power values of the bursts in a fixed ¼-bit pattern. The number of measured values is 668, corresponding to a time range of –10 bit to 156 ¾ bit.

READ:SUBarrays:POWer[:NORMal][:GMSK][:CURRent]? **READ:SUBarrays:POWer[:NORMal]:EPSK[:CURRent]?** **READ:SUBarrays:POWer[:NORMal][:GMSK]:AVERage?** **READ:SUBarrays:POWer[:NORMal]:EPSK:AVERage?** **READ:SUBarrays:POWer[:NORMal][:GMSK]:MAXimum?** **READ:SUBarrays:POWer[:NORMal]:EPSK:MAXimum?** **READ:SUBarrays:POWer[:NORMal][:GMSK]:MINimum?** **READ:SUBarrays:POWer[:NORMal]:EPSK:MINimum?**				Subarray Results
	Start single shot measurement and return results			⇒ *RUN*
FETCh:SUBarrays:POWer[:NORMal][:GMSK][:CURRent]? **FETCh:SUBarrays:POWer[:NORMal]:EPSK[:CURRent]?** **FETCh:SUBarrays:POWer[:NORMal][:GMSK]:AVERage?** **FETCh:SUBarrays:POWer[:NORMal]:EPSK:AVERage?** **FETCh:SUBarrays:POWer[:NORMal][:GMSK]:MAXimum?** **FETCh:SUBarrays:POWer[:NORMal]:EPSK:MAXimum?** **FETCh:SUBarrays:POWer[:NORMal][:GMSK]:MINimum?** **FETCh:SUBarrays:POWer[:NORMal]:EPSK:MINimum?**				
	Read meas. results (unsynchronized)			⇒ *RUN*
SAMPle:SUBarrays:POWer[:NORMal][:GMSK][:CURRent]? **SAMPle:SUBarrays:POWer[:NORMal]:EPSK[:CURRent]?** **SAMPle:SUBarrays:POWer[:NORMal][:GMSK]:AVERage?** **SAMPle:SUBarrays:POWer[:NORMal]:EPSK:AVERage?** **SAMPle:SUBarrays:POWer[:NORMal][:GMSK]:MAXimum?** **SAMPle:SUBarrays:POWer[:NORMal]:EPSK:MAXimum?** **SAMPle:SUBarrays:POWer[:NORMal][:GMSK]:MINimum?** **SAMPle:SUBarrays:POWer[:NORMal]:EPSK:MINimum?**				
	Read results (synchronized)			⇒ *RUN*
Ret. values per subrange	Description of parameters	Def. value	Def. unit	FW vers.
–100.0 dB to + 20.0 dB **...** **–100.0 dB to + 20.0 dB**	BurstPower[1], 1st value for burst power ... BurstPower[x], xth value for burst power	NAN ... NAN	dB ... dB	V2.00
Description of command				

These commands are always queries. They output the burst power versus time in a fixed ¼- bit pattern and in the subranges defined by means of the `CONFigure:SUBarrays:POWer` command. In the default setting of the configuration command the `READ:SUBarrays...`, `FETCh:SUBarrays...`, and `SAMPle:SUBarrays...` command group is equivalent to the `READ:ARRay...`, `FETCh:ARRay...`, and `SAMPle:ARRay...` command group described above.

The `CONFigure:SUBarrays:POWer` command defines a maximum of 32 subranges. If one of the statistical modes (`ARIThmetical`, `MINimum`, `MAXimum`) is set, only one value is returned per subrange.

The calculation of *current, average, minimum,* and *maximum* results is explained in chapter 3 (cf. *display mode*).

CALCulate:ARRay:POWer[:NORMal][:GMSK]:LIMit:MATChing[:CURRent]?
CALCulate:ARRay:POWer[:NORMal]:EPSK:LIMit:MATChing[:CURRent]?
CALCulate:ARRay:POWer[:NORMal][:GMSK]:LIMit:MATChing:AVERage?
CALCulate:ARRay:POWer[:NORMal]:EPSK:LIMit:MATChing:AVERage?
CALCulate:ARRay:POWer[:NORMal][:GMSK]:LIMit:MATChing:MAXimum?
CALCulate:ARRay:POWer[:NORMal]:EPSK:LIMit:MATChing:MAXimum?
CALCulate:ARRay:POWer[:NORMal][:GMSK]:LIMit:MATChing:MINimum?
CALCulate:ARRay:POWer[:NORMal]:EPSK:LIMit:MATChing:MINimum?

Burst Matching

Returned values	Value range	Def. value	Def. unit	FW vers.
Matching	MATC | NMAT | INV | NTSC | OUT	INV	–	V1.15

Description of command

This command is always a query. It indicates whether and in which way tolerances for the burst power (see command above) have been exceeded.

The following messages may be output for the value *Matching*:

MATC	*matching*
NMAT	*not matching*
INV	*invalid*
NTSC	*no training sequence code*
OUT	*out of tolerance*

CALCulate:ARRay:POWer[:NORMal][:GMSK]:AREA:LIMit:MATChing[:CURRent]?
CALCulate:ARRay:POWer[:NORMal]:EPSK:AREA:LIMit:MATChing[:CURRent]?
CALCulate:ARRay:POWer[:NORMal][:GMSK]:AREA:LIMit:MATChing:AVERage?
CALCulate:ARRay:POWer[:NORMal]:EPSK:AREA:LIMit:MATChing:AVERage?
CALCulate:ARRay:POWer[:NORMal][:GMSK]:AREA:LIMit:MATChing:MAXimum?
CALCulate:ARRay:POWer[:NORMal]:EPSK:AREA:LIMit:MATChing:MAXimum?
CALCulate:ARRay:POWer[:NORMal][:GMSK]:AREA:LIMit:MATChing:MINimum?
CALCulate:ARRay:POWer[:NORMal]:EPSK:AREA:LIMit:MATChing:MINimum?

Range Violation

Returned value	Description of parameters	Def. value	Def. unit	FW vers.
32 bit value,	Indicator for upper limit matching in area 1 to 16 (16 least significant bits),	NAN	–	1.20
32 bit value	Indicator for lower limit matching in area 1 to 16 (16 least significant bits)	NAN	–	

Description of command

This command is always a query. If a bit is set in the two returned values the corresponding section of the limit lines is exceeded.

POWer:ABURst

The subsystem *POWer:ABURst* measures the MS output carrier power versus time for access bursts. The subsystem corresponds to the measurement menu *Power,* application *P/t Access...,* and the associated popup menu *Power Configuration.* It contains all commands for measurement control and for the output of measurement results. The limit lines, however, are taken from the `POWer[:NBURst]` subsystem and adapted to the shortened access burst:

- The central part (area no. 5 of the upper limit line and area no. 3 of the lower limit line) is 60 bits shorter.
- The position of areas around the falling edge is adapted to the shortened central part: Areas no. 6 to 8 of the upper limit line and area no. 3 of the lower limit line are shifted by –60 bit.

Note that access burst measurements are always made on a single burst, so no `:CONTrol` subsystem and no display modes `[:CURRent], :AVERage, MINimum, :MAXimum` are needed.

Note:

To perform any kind of measurement and obtain a meaningful result, an appropriate test setup is required (see application examples in chapter 2 of this manual). Consequently, for the measurements reported in the following sections, the *Call Established (CEST)* signalling state must be reached before any of the commands retrieving test results *(READ...?, FETCh...?, SAMPle...?,* or *CALCulate...LIMit?)* can be used. Test configurations, however, can be defined any time.

Control of Measurement – Subsystem POWer:ABURst

The subsystem *POWer:ABURst* controls the access burst power measurement.

INITiate:POWer:ABURst[:GMSK]	Start new measurement	⇒	*RUN*
ABORt:POWer:ABURst[:GMSK]	Abort measurement and switch off	⇒	*OFF*
STOP:POWer:ABURst[:GMSK]	Stop measurement after current stat. cycle	⇒	*STOP*
CONTinue:POWer:ABURst[:GMSK]	Next meas. step (only *stepping mode*)	⇒	*RUN*
Description of command			FW vers.
These commands have no query form. They start or stop the measurement, setting it to the status indicated in the top right column.			V3.0

CONFigure:POWer:ABURst[:GMSK]:EREPorting <*Mode*>				Event Reporting
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
SRQ | **SOPC |** **SRSQ |** **OFF**	Service request Single operation complete SRQ and SOPC No reporting	OFF	–	V3.0
Description of command				
This command defines the events generated when the measurement is terminated or stopped *(event reporting,* see chapter 5 of CMU manual).				

FETCh:POWer:ABURst[:GMSK]:STATus?				Measurement Status
Returned values	Description of parameters	Def. value	Def. unit	FW vers.
OFF | **RUN |** **STOP |** **ERR |** **STEP |** **RDY,** **1 to 10000 |** **NONE**	Measurement in the OFF state (*RST or ABORt) Running (after INITiate, CONTinue or READ) Stopped (STOP) OFF (could not be started) Stepping mode (<stepmode>=STEP) Stopped according to repetition mode and stop condition Counter for current statistics cycle No counting mode set	OFF NONE	– –	V3.0
Description of command				
This command is always a query. It returns the status of the measurement (see chapters 3 and 5 of CMU manual).				

Test Configuration

The commands of the following subsystems configure the signal power measurement. They correspond to the sections in the *Power Configuration* popup menu that are related to the access burst power measurement.

Subsystem POWer:ABURst...:TIME

The subsystem *POWer:ABURst...:TIME* contains the command for shifting the time axis (and thus the tolerance mask). The subsystem corresponds to the *Timing Bit Offset* hotkey in the graphical measurement menu *Power.*

CONFigure:POWer:ABURst[:GMSK]:TOFFset *<Offset>*				Bit Offset
<Offset>	Description of parameters	Def. value	Def. unit	FW vers.
–4.00 to +4.00	Number of bits	0	bit	V3.0
Description of command				
This command defines an offset time in ¼ bit units by which the burst is shifted relative to the time axis and the tolerance template.				

Subsystem SUBarrays:POWer

The subsystem *SUBarrays:POWer* defines the measurement range and the type of output values.

CONFigure:SUBarrays:POWer:ABURst[:GMSK] <Mode>,<Start>,<Samples>{,<Start>,<Samples>} — Definition of Subarrays

<Mode>	Description of parameters	Def. value	Def. unit	
ALL | **ARIThmetical |** **MINimum |** **MAXimum |** **IVAL,**	Return all measurement values Return arithm. mean value in every range Return minimum value in every range Return maximum value in every range Return single interpolated value at <Start>	ALL	–	
<Start>	Description of parameters	Def. value	Def. unit	
–10 bit to 96 ¾ bit,	Start time in current range	–10	bit	
<Samples>	Description of parameters	Def. value	Def. unit	FW vers.
1 to 428	Number of samples in current range	428	–	V3.0

Description of command

This command configures the `READ:SUBarrays:POWer...`, `FETCh:SUBarrays:POWer...`, and `SAMPle:SUBarrays:POWer` commands. It restricts the measurement to up to 32 subranges where either all measurement results (the number of which is given by the second numerical parameter) or a single statistical value is returned. The subranges are defined by the start time and the number of test points which are located on a fixed, equidistant grid with a step width of ¼ bit. If <Start> does not coincide with a test point then the range will start at the next test point that is larger than <Start>.

For <Mode> = IVAL, the <Samples> parameter is ignored and the CMU returns a single measurement value corresponding to the abscissa value <Start>. If <Start> is located beween two test points with valid results then the result is calculated from the results at these two adjacent test points by linear interpolation.

The subranges may overlap but must be within the total range of the *POWer* measurement. Test points outside this range are not measured (result *NAN)* and do not enter into the ARIThmetical, MINimum and MAXimum values.

By default, only one range corresponding to the total measurement range is used and all measurement values are returned.

Measured Values

The commands of the following subsystems determine and return the results of the access burst power measurement. They correspond to the graphical menu *Power* with its various display elements.

Subsystem POWer:ABURst...

The subsystem *POWer:ABURst...* contains the commands for measurement and output of the access burst power and its comparison with tolerance values. The subsystem corresponds to the graphical measurement menu *Power.*

READ[:SCALar]:POWer:ABURst[:GMSK]?	Scalar results Start single shot measurement and return results
FETCh[:SCALar]:POWer:ABURst[:GMSK]?	Read out measurement results (unsynchronized)
SAMPle[:SCALar]:POWer:ABURst[:GMSK]?	Read out measurement results (synchronized)

Returned values	Value range	Def. value	Def. unit	FW vers.
Avg. Burst Pw. (Curr),	See data sheet	NAN	dBm	V3.0
Time of Arrival,	–100.0 bit to +100.0 bit	NAN	bit	
TSC detected,	OFF | GSM0 to GSM7 | DUMMy	NAN	–	
BurstMatching	INV | MATC | NMAT | OUT | NTR | NRAM | OFLW | UFLW | NTSC | OFF	INV	–	

Description of command

These commands are always queries.

- `READ` starts a single shot measurement and returns the results.
- `FETCh` outputs the results without taking care of the measurement state.
- `SAMPle` waits until the results are valid for the first time (depending on the chosen statistic count) and then outputs the results.

For more details refer to the description of measurement control in chapter 5 of the CMU200 operating manual.

The following messages may be output for the value *BurstMatching*:

INV	*invalid*
MATC	*matching*
NMAT	*not matching*
OUT	*out of range*
NTR	*no trigger*
NRAM	*not ramping (burst not found)*
OFLW	*overflow*
UFLW	*underflow*
NTSC	*no training sequence code*
OFF	*off*

CALCulate:POWer:ABURst[:GMSK]:LIMit:MATChing? Limit Matching

Returned values	Value range	Def. value	Def. unit	FW vers.
Avg. Burst Pw. (Curr),	NMAU | NMAL | INV | OK	INV	–	V3.0
BurstMatching	INV | MATC | NMAT | OUT | NTRG | NRAM | OFLW | UFLW | NTSC | ATSC | OFF	INV	–	

Description of command

This command is always a query. It indicates whether and in which way the tolerances for the scalar measured values (see command above) have been exceeded.

The following messages may be output for the value *AvgBurstPowerCurr*:

OK	Tolerance value matched	*OK.*
NMAU	Underflow of tolerance value	*not matching, underflow*
NMAL	Tolerance value exceeded	*not matching, overflow*
INV	Measured value invalid	*invalid*

The following messages may be output for the value *BurstMatching*:

INV	*invalid*
MATC	*matching*
NMAT	*not matching*
OUT	*out of range*
NTRG	*no trigger*
NRAM	*not ramping (burst not found)*
OFLW	*overflow*
UFLW	*underflow*
NTSC	*no training sequence code*
ATSC	adjacent timeslot active
OFF	*off*

Burst Power

READ:ARRay:POWer:ABURst[:GMSK]? Start single shot measurement and return results
FETCh:ARRay:POWer:ABURst[:GMSK]? Read measurement results (unsynchronized)
SAMPle:ARRay:POWer:ABURst[:GMSK]? Read results (synchronized)

Returned values	Description of parameters	Def. value	Def. unit	FW vers.
–100.0 dB to + 20.0 dB	BurstPower[1], 1st value for burst power	NAN	dB	V3.0
...	...	...	...	
–100.0 dB to + 20.0 dB	BurstPower[x], xth value for burst power	NAN	dB	

Description of command

These commands are always queries. They output the different power values of the bursts in a fixed ¼-bit pattern. The number of measured values is 428, corresponding to a time range of –10 bit to 96 ¾ bit.

Subarray Results

READ:SUBarrays:POWer:ABURst[:GMSK]? Start single shot meas. and return results ⇒ *RUN*
FETCh:SUBarrays:POWer:ABURst[:GMSK]? Read meas. results (unsynchronized) ⇒ *RUN*
SAMPle:SUBarrays:POWer:ABURst[:GMSK]? Read results (synchronized) ⇒ *RUN*

Ret. values per subrange	Description of parameters	Def. value	Def. unit	FW vers.
–100.0 dB to + 20.0 dB	BurstPower[1], 1st value for burst power	NAN	dB	V3.0
...	...	...	...	
–100.0 dB to + 20.0 dB	BurstPower[x], xth value for burst power	NAN	dB	

Description of command

These commands are always queries. They output the burst power versus time in a fixed ¼- bit pattern and in the subranges defined by means of the `CONFigure:SUBarrays:POWer` command. In the default setting of the configuration command the `READ:SUBarrays...`, `FETCh:SUBarrays...`, and `SAMPle:SUBarrays...` command group is equivalent to the `READ:ARRay...`, `FETCh:ARRay...`, and `SAMPle:ARRay...` command group described above.

The `CONFigure:SUBarrays:POWer` command defines a maximum of 32 subranges. If one of the statistical modes (`ARIThmetical`, `MINimum`, `MAXimum`) is set, only one value is returned per subrange.

The calculation of *current, average, minimum,* and *maximum* results is explained in chapter 3 (cf. *display mode*).

CALCulate:ARRay:POWer:ABURst[:GMSK]:LIMit:MATChing? **Limit Matching, Array**

Returned values	Value range	Def. value	Def. unit	FW vers.
Matching	INV | MATC | NMAT | OUT | NTR | NRAM | OFLW | UFLW | NTSC | OFF	INV	–	V3.0

Description of command

This command is always a query. It indicates whether and in which way the tolerances for the burst power (see command above) have been exceeded. The following messages may be output for the value *Matching*:

INV	*invalid*
MATC	*matching*
NMAT	*not matching*
OUT	*out of range*
NTR	*no trigger*
NRAM	*not ramping (burst not found)*
OFLW	*overflow*
UFLW	*underflow*
NTSC	*no training sequence code*
OFF	*off*

CALCulate:ARRay:POWer:ABURst[:GMSK]:AREA:LIMit:MATChing? **Limit Matching, Area**

Returned value	Description of parameters	Def. value	Def. unit	FW vers.
32 bit value,	Indicator for upper limit matching in area 1 to 16 (16 least significant bits),	NAN	–	V3.0
32 bit value	Indicator for lower limit matching in area 1 to 16 (16 least significant bits)	NAN	–	

Description of command

This command is always a query. If a bit is set in the two returned values the corresponding section of the limit lines is exceeded.

POWer:PCL

The subsystem *POWer:PCL* controls the power vs PCL measurement. It corresponds to the measurement menu *Power* with the application *P/PCL*:

INITiate:POWer:PCL	Start new measurement	⇒ *RUN*
ABORt:POWer:PCL	Abort running measurement and switch off	⇒ *OFF*
STOP:POWer:PCL	Stop measurement after current stat. cycle	⇒ *STOP*
CONTinue:POWer:PCL	Next measurement step (only *stepping mode*)	⇒ *RUN*
Description of command		FW vers.
These commands have no query form. They start or stop the measurement, setting it to the status indicated in the top right column.		V2.00

CONFigure:POWer:PCL:EREPorting <*Mode*>				Event Reporting
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
SRQ |	Service request	OFF	–	V2.00
SOPC |	Single operation complete			
SRSQ |	SRQ and SOPC			
OFF	No reporting			
Description of command				
This command defines the events generated when the measurement is terminated or stopped *(event reporting,* see chapter 5 of CMU manual).				

FETCh[:SCALar]:POWer:PCL:STATus?				Measurement Status
Return	Description of parameters	Def. value	Def. unit	FW vers.
OFF |	Measurement in the *OFF* state (`*RST` or `ABORt`)	OFF	–	V2.00
RUN |	Running (after `INITiate, CONTinue` or `READ`)			
STOP |	Stopped (`STOP`)			
ERR |	*OFF* (could not be started)			
STEP |	Stepping mode *(<stepmode>=STEP)*			
RDY,	Stopped according to repetition mode and stop condition			
1 to 10000 |	Counter for current statistics cycle			
NONE	No counting mode set	NONE	–	
Description of command				
This command is always a query. It returns the status of the measurement (see chapters 3 and 5 of CMU manual).				

Subsystem POWer:PCL:CONTrol

CONFigure:POWer:PCL:CONTrol:REPetition <*Repetition*>,<*StopCondition*>,<*Stepmode*> Test Cycles				
<Repetition>	Description of parameters	Def. value	Def. unit	
CONTinuous |	Continuous measurement (*continuous*, until `STOP` or `ABORT`)	SING	–	
SINGleshot |	Single measurement (*single shot*, `until Status = RDY`)			
1 to 10000	Multiple measurement (*counting*, until `Status = STEP | RDY`)			
<StopCond>	Description of parameters	Def. value	Def. unit	
SONerror | **NONE**	Stop measurement in case of error (*stop on error*) Continue measurement even in case of error	NONE	–	
<Stepmode>	Description of parameters	Def. value	Def. unit	FW vers.
STEP | **NONE**	Interrupt measurement after each statistics cycle Continue measurement according to its rep. mode	NONE	–	V2.00
Description of command				
This command determines the number of statistics cycles and the stepping mode for the measurement. **Note:** In the case of READ commands (`READ:`...), the <Repetition> parameter has no effect; the measurement is always stopped after a single shot.				

Subsystem POWer:PCL:CHANnel

The subsystem *POWer:PCL:CHANnel* defines three or seven channels for the *P/PCL* measurement. The subsystem corresponds to the *Channel Count* hotkey and the MS Signal softkey in the measurement menu *P/PCL.*

CONFigure:POWer:PCL:CCOunt <Channels> Channel Count				
<Channels>	Description of parameters	Def. value	Def. unit	FW vers.
C3 | C7	3 or 7 different channels measured	C3	–	V2.15
Description of command				
This command defines whether three or seven different channels are measured in the P/PCL measurement.				

CONFigure:POWer:PCL:CHANnel <Channel1>, ..., <Channeln> Channel				
Channel<nr>	Value range	Def. value: Cannel 1,2,3	Def. unit	FW vers.
GSM400	259 to 293, 306 to 340	259,276,293	–	V2.00[4]
GSM GT800	350 to 425	350,388,425		
GSM850	128 to 251	128,190,251		
GSM900	0 to 124; 955 to 1023	1,62,124		
GSM1800	512 to 885	512,698,885		
GSM1900	512 to 810	512,661,810		

[4] In firmware versions <2.15, only three channels could be measured.

Description of command
This command defines the GSM channel numbers for the P/PCL measurement. The total number n of channels measured is either 3 or 7, depending on the `CONFigure:POWer:PCL:CCOunt` setting. If 7 channels are measured, the following default values apply: GSM400 259, 265, 270, 276, 282, 287, 293 GSM GT800 350, 363, 375, 388, 400, 413, 425 GSM850 128, 149, 169, 190, 210, 230, 251 GSM900 1, 22, 42, 63, 83, 104, 124 GSM1800 512, 574, 636, 669, 761, 823, 885 GSM1900 512, 562, 611, 661, 711, 760, 810

Subsystem POWer:PCL

The subsystem *POWer:PCL* contains the commands for measurement and output of the power versus PCL application for three or seven selected channels. The subsystem corresponds to the measurement menu *P/PCL.*

Scalar Results

READ[:SCALar]:POWer:PCL? Start single shot measurement and return results
FETCh[:SCALar]:POWer:PCL? Read out measurement results (unsynchronized)
SAMPle[:SCALar]:POWer:PCL? Read out measurement results (synchronized)

Return	Value range	Def. value	Def. unit	FW vers.
PCL1, P1Ch1, P1Ch2, P1Ch3,	**GSM400/GT800/850/900:**			V2.00
	PCL: 0 to 31	NAN	–	
	Power: 5.0 dBm to +39.0 dBm	NAN	dBm	
... ,	**GSM1800:**			
	PCL:0 to 31	NAN		
PCLn, PnCh1, PnCh2,PnCh3	Power: 0.0 dBm to +36.0 dBm	NAN	dBm	
	GSM1900:			
	PCL:0 to 31	NAN		
	Power: 0.0 dBm to +33.0 dBm	NAN	dBm	

Description of command

These commands are always queries. They start a measurement and return all measurement results. The returned list contains all possible PCLs of the mobile phone together with the measured MS output powers in the three selected channels. The output values are:

- PCL1 to PCLn *PCLs of the mobile*
- PxChy *Average burst power for PCL = x and channel = y*

The PCL range depends on the GSM phase and the power class of the mobile. For a list of possible PCLs and nominal maximum output power of the mobiles refer to Chapter 4.

				Scalar Results
READ[:SCALar]:POWer:PCL:PCLPower<PCL>?		Start single shot measurement and return results		
FETCh[:SCALar]:POWer:PCL:PCLPower<PCL>?		Read out measurement results (unsynchronized)		
SAMPle[:SCALar]:POWer:PCL:PCLPower<PCL>?		Read out measurement results (synchronized)		
Returned Value	Value range	Def. value	Def. unit	FW vers.
PCh1, ... , P1Chn	See previous command	NAN	dBm	V2.15

Description of command

These commands are always queries. They start a measurement and return the mobile output power at one particular PCL specified with the numeric index <PCL> and for the channels specified via `CONFigure:POWer:PCL:CHANnel`. The total number n of channels measured is either 3 or 7, depending on the `CONFigure:POWer:PCL:CCOunt` setting. See also command description for `READ[:SCALar]:POWer:PCL[:CURRent]?`

CALCulate:POWer:PCL[:CURRent]:LIMit:MATChing?				Results of Limit Check
Returned values	Description of parameters	Def. value	Def. unit	FW vers.
Matching	OK | NMAU | NMAL | INV	INV	–	V2.00

Description of command

This command is always a query. It indicates whether and in which way the tolerances for the burst power (see preceding command) are exceeded. The tolerance values are set via `CONF:POW:LIM:ABP<nr>`.

The following messages may be output for the measured value *Matching*:

OK	Tolerance value matched	*OK.*
NMAU	Underflow of tolerance value	*not matching, underflow*
NMAL	Tolerance value exceeded	*not matching, overflow*
INV	Measured value invalid	*invalid*

The complete output list reports the limit matching for all measured PCLs and the three or seven channels defined via `CONFigure:POWer:PCL:CHANnel`, starting with the channels for the first PCL, e.g. (for three channels):

1, OK, OK, OK, 2, OK, OK, OK, 3, OK, OK, OK, ...

POWer:MPR

The subsystem *POWer:MPR* combines the *POWer* and *MODulation* systems, i.e. it measures the signal power vs. time and the scalar modulation parameters simultaneously. The subsystem contains all commands for measurement control and for the output of measurement results; configurations such as limit lines must be defined separately in the *POWer* and *MODulation* systems.

The *POWER:MPR* has no equivalent in manual control where the power and modulation measurement results are displayed separately.

Control of measurement – Subsystem POWer:MPR

The subsystem *POWer:MPR* controls the combined power and modulation measurement.

INITiate:POWer[:NORMal][:GMSK]:MPR	Start new measurement	⇒ *RUN*
ABORt:POWer[:NORMal][:GMSK]:MPR	Abort running measurement and switch off	⇒ *OFF*
STOP:POWer[:NORMal][:GMSK]:MPR	Stop measurement after current stat. cycle	⇒ *STOP*
CONTinue:POWer[:NORMal][:GMSK]:MPR	Next meas. step (only *stepping mode*)	⇒ *RUN*
Description of command		FW vers.
These commands have no query form. They start and stop the combined power and modulation measurement, setting it to the status indicated in the top right column.		V2.00

CONFigure:POWer[:NORMal][:GMSK]:MPR:EREPorting <*Mode*>				Event Reporting
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
SRQ | **SOPC |** **SRSQ |** **OFF**	Service request Single operation complete SRQ and SOPC No reporting	OFF	–	V2.00
Description of command				
This command defines the events generated when the measurement is terminated or stopped *(event reporting,* see chapter 5 of CMU manual).				

FETCh:POWer[:NORMal][:GMSK]:MPR:STATus?				Measurement Status
Return	Description of parameters	Def. value	Def. unit	FW vers.
OFF | **RUN |** **STOP |** **ERR |** **STEP |** **RDY,**	Measurement in the *OFF* state (`*RST` or `ABORt`) Running (after `INITiate`, `CONTinue` or `READ`) Stopped (`STOP`) *OFF* (could not be started) Stepping mode *(<stepmode>=STEP)* Stopped according to repetition mode and stop condition	OFF	–	V2.00
1 to 10000 | **NONE,**	Counter for current statistics cycle No counting mode set	NONE	–	
1 to 1000 | **NONE**	Counter for current evaluation period within a cycle Statistic count set to off	NONE	–	
Description of command				
This command is always a query. It returns the status of the measurement (see chapters 3 and 5 of CMU manual).				

Subsystem POWer:MPR:CONTrol

The subsystem *POWer:MPR:CONTrol* defines the repetition mode, statistic count, and stop condition of the measurement.

CONFigure:POWer[:NORMal][:GMSK]:MPR:CONTrol <*Mode*>, <*Statistics*>				Scope of Measurement
<Mode>	Desciption of parameters	Def. value	Def. unit	
SCALar | **ARRay**	Scalar values only (incl. ramp matching) Scalar measured values and arrays	ARRay	–	
<Statistics>	Description of parameters	Def. value	Def. unit	FW vers.
1 to 1000 | **NONE**	Number of bursts per statistics cycle Statistics off (equivalent to 1)	100	–	V2.00
Description of command				
This command specifies the type of measured values and defines the number of bursts forming a statistics cycle.				

CONFigure:POWer[:NORMal][:GMSK]:MPR:CONTrol:REPetition <*Repetition*>,<*StopCond*>,<*Stepmode*>				Test Cycles
<Repetition>	Description of parameters	Def. value	Def. unit	
CONTinuous | **SINGleshot |** **1 to 10000**	Continuous measurement (until `STOP` or `ABORT`) Single shot measurement (until `Status = RDY`) Multiple measurement (*counting*, until `Status = STEP | RDY`)	SING	–	
<StopCond>	Description of parameters	Def. value	Def. unit	
SONerror | **NONE**	Stop measurement in case of error *(stop on error)* Continue measurement even in case of error	NONE	–	
<Stepmode>	Description of parameters	Def. value	Def. unit	FW vers.
STEP | **NONE**	Interrupt measurement after each statistics cycle Continue measurement according to its rep. mode	NONE	–	V2.00
Description of command				
This command determines the number of statistics cycles, the stop condition and the stepping mode for the measurement. **Note:** In the case of READ commands (`READ:...`), the <Repetition> parameter has no effect; the measurement is always stopped after a single shot.				

Test Configuration

The commands of the following subsystems configure the combined power and modulation measurement. Note that configurations such as limit lines must be defined separately in the *POWer* and *MODulation* systems.

Subsystem SUBarrays:POWer:MPR

The subsystem *SUBarrays:POWer:MPR* defines the measurement range and the type of output values.

CONFigure:SUBarrays:POWer[:NORMal][:GMSK]:MPR <Mode>,<Start>,<Samples>{,<Start>,<Samples>} — Definition of Subarrays

<Mode>	Description of parameters	Def. value	Def. unit	
ALL | **ARIThmetical |** **MINimum |** **MAXimum |** **IVAL,**	Return all measurement values Return arithm. mean value in every range Return minimum value in every range Return maximum value in every range Return single interpolated value at <Start>	ALL	–	
<Start>	Description of parameters	Def. value	Def. unit	
–10 bit to 156 ¾ bit,	Start time in current range	–10	bit	
<Samples>	Description of parameters	Def. value	Def. unit	FW vers.
1 to 668	Number of samples in current range	668	–	V2.00

Description of command

This command configures the `READ:SUBarrays...`, `FETCh:SUBarrays...,`, and `SAMPle:SUBarrays:POWer:MPR` commands. It restricts the measurement to up to 32 subranges where either all measurement results (the number of which is given by the second numerical parameter) or a single statistical value is returned. The subranges are defined by the start time and the number of test points which are located on a fixed, equidistant grid with a step width of ¼ bit. If <Start> does not coincide with a test point then the range will start at the next test point that is larger than <Start>.

For <Mode> = IVAL, the <Samples> parameter is ignored and the CMU returns a single measurement value corresponding to the abscissa value <Start>. If <Start> is located beween two test points with valid results then the result is calculated from the results at these two adjacent test points by linear interpolation.

The subranges may overlap but must be within the total range of the *Power* measurement. Test points outside this range are not measured (result *NAN)* and do not enter into the ARIThmetical, MINimum and MAXimum values.

By default, only one range corresponding to the total measurement range is used and all measurement values are returned.

Measured Values – Subsystem POWer:MPR

The subsystem *POWer:MPR* determines and outputs the results of the combined power and modulation measurement.

				Scalar Results
READ[:SCALar]:POWer[:NORMal][:GMSK]:MPR?	Start single shot measurement and return results			
FETCh[:SCALar]:POWer[:NORMal][:GMSK]:MPR?	Read out meas. results (unsynchronized)			
SAMPle[:SCALar]:POWer[:NORMal][:GMSK]:MPR?	Read out measurement results (synchronized)			
Returned values	Value range	Def. value	Def. unit	FW vers.
AvgBurstPwCurr,	–137 dBm to +53 dBm	NAN	dBm	V2.00
PeakBurstPwCurr,	–137 dBm to +53 dBm	NAN	dBm	
PowerControlLevel,	0 to 32 (dep. on network, power class...)	NAN	PCL	
TimingAdvError,	–100.0 bit to +100.0 bit	NAN	bit	
BurstsOutOfTol,	0.0% too 100.0%	NAN	%	
BurstMatching,	INV | MATC | NMAT | OUT | NTR | NRAM | OFLW | UFLW | NTSC | OFF	INV	–	
PhErrPeakCurrent,	–100.0 ° to +100.0 °	NAN	deg	
PhErrPeakAverage,	–100.0 ° to +100.0 °	NAN	deg	
PhErrPeakMaxMin,	–100.0 ° to +100.0 °	NAN	deg	
PhErrRMSCurrent,	–100.0 ° to +100.0 °	NAN	deg	
PhErrRMSAverage,	–100.0 ° to +100.0 °	NAN	deg	
PhErrRMSMaxMin,	–100.0 ° to +100.0 °	NAN	deg	
FreqErrCurrent,	–1000.0 Hz to + 1000.0 Hz	NAN	Hz	
FreqErrAverage,	–1000.0 Hz to + 1000.0 Hz	NAN	Hz	
FreqErrMaxMin,	–1000.0 Hz to + 1000.0 Hz	NAN	Hz	
AvgBurstPwAvg	–137 dBm to +53 dBm	INV	dBm	
Description of command				
These commands are always queries. They start a combined power vs. time and modulation measurement and output all scalar measurement results. For detailed information refer to the description of the analogous commands in the POWer and MODulation systems.				

READ:ARRay:POWer[:NORMal][:GMSK]:MPR[:CURRent]?		Traces
READ:ARRay:POWer[:NORMal][:GMSK]:MPR:AVERage?		
READ:ARRay:POWer[:NORMal][:GMSK]:MPR:MAXimum?		
READ:ARRay:POWer[:NORMal][:GMSK]:MPR:MINimum?		
	Start measurement and wait for end	⇒ *RUN*
FETCh:ARRay:POWer[:NORMal][:GMSK]:MPR[:CURRent]?		
FETCh:ARRay:POWer[:NORMal][:GMSK]:MPR:AVERage?		
FETCh:ARRay:POWer[:NORMal][:GMSK]:MPR:MAXimum?		
FETCh:ARRay:POWer[:NORMal][:GMSK]:MPR:MINimum?		
	Read meas. results (unsynchronized)	⇒ *RUN*
SAMPle:ARRay:POWer[:NORMal][:GMSK]:MPR[:CURRent]?		
SAMPle:ARRay:POWer[:NORMal][:GMSK]:MPR:AVERage?		
SAMPle:ARRay:POWer[:NORMal][:GMSK]:MPR:MAXimum?		
SAMPle:ARRay:POWer[:NORMal][:GMSK]:MPR:MINimum?		
	Read results (synchronized)	⇒ *RUN*

Returned values	Description of parameters	Def. value	Def. unit	FW vers.
–100.0 dB to + 20.0 dB	BurstPower[1], 1st value for burst power	NAN	dB	V2.00
...	...	...	...	
–100.0 dB to + 20.0 dB	BurstPower[x], xth value for burst power	NAN	dB	

Description of command

These commands are always queries. They output the burst power versus time in a fixed ¼- bit pattern. The number of measured values is 668, corresponding to a time range of –10 bit to 156 ¾ bit.

The calculation of *current, average, minimum* and *maximum* results is explained in chapter 3 (cf. *display mode*).

READ:SUBarrays:POWer[:NORMal][:GMSK]:MPR[:CURRent]?

Subarray Results

READ:SUBarrays:POWer[:NORMal][:GMSK]:MPR:AVERage?
READ:SUBarrays:POWer[:NORMal][:GMSK]:MPR:MAXimum?
READ:SUBarrays:POWer[:NORMal][:GMSK]:MPR:MINimum?

Start measurement and wait for end ⇒ *RUN*

FETCh:SUBarrays:POWer[:NORMal][:GMSK]:MPR[:CURRent]?
FETCh:SUBarrays:POWer[:NORMal][:GMSK]:MPR:AVERage?
FETCh:SUBarrays:POWer[:NORMal][:GMSK]:MPR:MAXimum?
FETCh:SUBarrays:POWer[:NORMal][:GMSK]:MPR:MINimum?

Read meas. results (unsynchronized) ⇒ *RUN*

SAMPle:SUBarrays:POWer[:NORMal][:GMSK]:MPR[:CURRent]?
SAMPle:SUBarrays:POWer[:NORMal][:GMSK]:MPR:AVERage?
SAMPle:SUBarrays:POWer[:NORMal][:GMSK]:MPR:MAXimum?
SAMPle:SUBarrays:POWer[:NORMal][:GMSK]:MPR:MINimum?

Read results (synchronized) ⇒ *RUN*

Ret. values per subrange	Description of parameters	Def. value	Def. unit	FW vers.
–100.0 dB to + 20.0 dB	BurstPower[1], 1st value for burst power	NAN	dB	V2.00
...	...	...	...	
–100.0 dB to + 20.0 dB	BurstPower[x], xth value for burst power	NAN	dB	

Description of command

These commands are always queries. They output the burst power versus time in a fixed ¼- bit pattern and in the subranges defined by means of the `CONFigure:SUBarrays:POWer[:NORMal][:GMSK]:MPR` command. In the default setting of the configuration command the `READ:SUBarrays...`, `FETCh:SUBarrays...`, and `SAMPle:SUBarrays...` command group is equivalent to the `READ:ARRay...`, `FETCh:ARRay...`, and `SAMPle:ARRay...` command group described above.

The `CONFigure:SUBarrays:POWer[:NORMal][:GMSK]:MPR` command defines a maximum of 32 subranges. If one of the statistical modes `(ARIThmetical, MINimum, MAXimum)` is set, only one value is returned per subrange.

The calculation of *current, average, minimum,* and *maximum* results is explained in chapter 3 (cf. *display mode*).

CALCulate:POWer[:NORMal][:GMSK]:MPR:LIMit:MATChing?				Limit Matching
Returned values	Value range	Def. value	Def. unit	FW vers.
AvgBurstPwCurr,	NMAU | NMAL | INV | OK	INV	–	V2.00
PeakBurstPwCurr,	NMAU | NMAL | INV | OK	INV	–	
BurstMatching,	INV | MATC | NMAT | OUT | NTR | NRAM | OFLW | UFLW | NTSC | OFF	INV	–	
PhErrPeakCurrent,		INV	–	–
PhErrPeakAverage,	For all measured values:	INV	–	
PhErrPeakMaxMin,		INV	–	
PhErrRMSCurrent,		INV	–	
PhErrRMSAverage,	NMAU | NMAL | INV | OK	INV	–	
PhErrRMSMaxMin,		INV	–	
FreqErrCurrent,		INV	–	
FreqErrAverage,		INV	–	
FreqErrMaxMin,		INV	–	
AvgBurstPwAvg		INV	–	

Description of command

This command is always a query. It indicates whether and in which way the tolerances for the scalar results (see command above) in the *power vs time* and the *modulation* measurement have been exceeded.

The following messages may be output for the values A*vgBurstPower (current or average)* and *PeakBurstPower* and for all results of the modulation measurement:

NMAU	Tolerance value underflow	*not matching, underflow*
NMAL	Tolerance value exceeded	*not matching, overflow*
INV	Measurement invalid	*invalid*
OK	Tolerance value matched	

The following messages may be output for the value *BurstMatching*:

INV	*invalid*
MATC	*matching*
NMAT	*not matching*
OUT	*out of range*
NTR	*no trigger*
NRAM	*not ramping (burst not found)*
OFLW	*overflow*
UFLW	*underflow*
NTSC	*no training sequence code*
OFF	*off*

Receiver Quality

The subsystem *RXQuality* comprises the commands for all receiver quality measurements. The subsystem corresponds to the main menu *Receiver Quality* and the associated popup menu *Receiver Quality Configuration.*

Important Note: Receiver Quality Measurements with MCS-5 to MCS-9

Receiver Quality measurements on circuit-switched channels using the modulation and coding schemes MCS-5 to MCS-9 (see `CONFigure:NETWork[:CSWitched]:SMODe:TRAFfic` command) can not be performed in parallel to TX Tests (`POWer...`, `MODulation...`, `SPECtrum`). The Receiver Quality measurement must be in the READY or OFF state before a TX Test can be started. Conversely, all TX Tests must be in the READY or OFF state before a Receiver Quality measurement using MCS-5 to MCS-9 can be started.

General Settings – Subsystem RXQuality...

The subsystem *RXQuality...* provides common settings for all *Receiver Quality* measurement applications.

CONFigure:RXQuality[:CSWitched]:BITStream <*Mode*>
CONFigure:RXQuality:PDATa:BITStream <*Mode*> — Bit Stream BER

<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
PR9 | **PR11 |** **PR15 |** **PR16**	2^9-1 PSR bit pattern 2^{11}-1 PSR bit pattern 2^{15}-1 PSR bit pattern 2^{16}-1 PSR bit pattern	PR9	–	V3.10

Description of command	Sig. State
This command defines the pseudo random bit sequence that the CMU transmits to the MS during *Receiver Quality* measurements.	all

CONFigure:RXQuality:CONTrol:AGCTime <AGCTime> — AGC Holdoff Time

<AGCTime>	Description of parameters	Def. value	Def. Unit	FW vers.
0 s to 100 s	Automatic gain control	0.5	s	V3.60

Description of command
This command defines hold off times during which the mobile can adapt itself to the new RF level at the beginning of the *Receiver Quality* measurement. A short holdoff time accelerates the measurement.

CONFigure:RXQuality:CONTrol:DEFault <*Enable*> — Default Settings

<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	The parameters are set to default values Some or all parameters differ from the default value	ON	–	V2.00

Description of command
As a *setting command* with the setting *ON* this command sets all parameters of the subsystem to default values (the setting *OFF* causes an error message). As a query, this command reads out whether all parameters are set to default values *(ON)* or not *(OFF)*.

Confidence BER – Subsystem RXQuality:CONTrol:CONFidence...

The subsystem *RXQuality:CONTrol:CONFidence...* configures the single shot or continuous confidence BER measurement. The settings are provided in the *Confidence Settings* section of the *Control* tab of the *Receiver Configuration* menu.

CONFigure:RXQuality:CONTrol:CONFidence:FAIL <*Level*>				Confidence Fail
<Level>	Description of parameters	Def. value	Def. unit	FW vers.
C500 | C900 | C980 | C998	95 %, 99 %, 99.8 % or 99.98 % confidence level	C980	–	V3.40
Description of command				
This command defines the confidence level for early fail decisions.				

CONFigure:RXQuality:CONTrol:CONFidence:PASS <*Level*>				Confidence Pass
<Level>	Description of parameters	Def. value	Def. unit	FW vers.
C500 | C900 | C980 | C998	95 %, 99 %, 99.8 % or 99.98 % confidence level	C980	–	V3.40
Description of command				
This command defines the confidence level for early pass decisions.				

CONFigure:RXQuality:CONTrol:CONFidence:RWINdow <*Factor*>				Result Window
<Factor>	Description of parameters	Def. value	Def. unit	FW vers.
OFF | **P10 | P20 | P30**	Dual-limit test switched off, single-limit test Dual-limit test with a range of 10, %, 20 %, or 30 %	OFF	–	V3.40
Description of command				
This command selects the BER range factor for statistical dual-limit BER tests.				

CONFigure:RXQuality:CONTrol:CONFidence:MTTime <*Time*>				Min. Test Time
<Time>	Description of parameters	Def. value	Def. unit	FW vers.
0.0 s to 100 000.0 s	Minimum Test Time	0.0	s	V3.40
Description of command				
This command defines the minimum test time before a check of the early pass and early fail limits can stop the measurement.				

RF Level Search – Subsystem RXQuality:CONTrol:SEARch...

The subsystem *RXQuality:CONTrol:SEARch...* configures the search range for the *RF Level Search* measurement. The settings are provided in the *Search Settings* section of the *Control* tab of the *Receiver Configuration* menu.

CONFigure:RXQuality:CONTrol:SEARch:MCYCles <*Cycles*>				Max. Cycle
<Level>	Description of parameters	Def. value	Def. unit	FW vers.
0 to 100	Maximum number of search cycles	20	–	V3.60
Description of command				
This command defines the maximum number of single measurements in a RF level search iteration.				

CONFigure:RXQuality:CONTrol:SEARch:ULIMit <*Cycles*>				Upper Level Limit
<Level>	Description of parameters	Def. value	Def. unit	FW vers.
0.0 dBm to –200.0 dBm	Upper level limit	–80.0	dBm	V3.60
Description of command				
This command defines the maximum allowed RF level during the search procedure.				

CONFigure:RXQuality:CONTrol:SEARch:LLIMit <*Cycles*>				Lower Level Limit
<Level>	Description of parameters	Def. value	Def. unit	FW vers.
0.0 dBm to –200.0 dBm	Upper level limit	–110.0	dBm	V3.60
Description of command				
This command defines the minimum allowed RF level during the search procedure.				

Receiver Quality – Single Shot

The subsystem *RXQuality:BER* contains the commands for receiver quality measurements in the single shot repetition mode. The subsystem corresponds to the main menu *Receiver Quality,* application *BER*, and the corresponding sections of the associated popup menu *Receiver Quality Configuration.*

Control of Measurement – Subsystem RXQuality:BER

The subsystem *RXQuality:BER* controls the single shot receiver quality measurements.

CONFigure:RXQuality:BER:TSETup <*TestSetup*>				Test Setup
<TestSetup>	Description of parameters	Def. value	Def. unit	FW vers.
T1 | **T2 |** **...** **T10**	Single Shot Test Setup 1 ... Single Shot Test Setup 10	T1	–	V2.00
Description of command				
This command selects one out of 10 test setups, i.e. one data set parametrizing a particular single shot receiver quality measurement. When a new test setup is selected, the running measurement is aborted (measurement state *OFF)* and all measured values are set to *INV* (invalid). The new measurement must be re-started with `INITiate:RXQuality:BER`.				

INITiate:RXQuality:BER	Start new measurement	⇒ *RUN*
ABORt:RXQuality:BER	Abort running measurement and switch off	⇒ *OFF*
STOP:RXQuality:BER	Stop measurement	⇒ *STOP*
CONTinue:RXQuality:BER	Next measurement step (only *stepping mode*)	⇒ *RUN*
Description of command		FW vers.
These commands have no query form. They start or stop the current single shot measurement, setting it to the status indicated in the top right column.		V2.00

CONFigure:RXQuality:BER:EREPorting <*Mode*>	Event Reporting			
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
SRQ | **SOPC |** **SRSQ |** **OFF**	Service request Single operation complete SRQ and SRSQ No reporting	OFF	–	V2.00
Description of command				
This command defines the events generated when the measurement is terminated or stopped *(event reporting,* see chapter 5).				

FETCh:RXQuality:BER:STATus?	Measurement Status			
Return	Description of parameters	Def. value	Def. unit	FW vers.
OFF | **RUN |** **STOP |** **ERR |** **STEP |** **RDY,**	Measurement in the *OFF* state (`*RST` or `ABORt`) Running (after `INITiate, CONTinue` or `READ`) Stopped (`STOP`) *OFF* (could not be started) Stepping mode *(<stepmode>=STEP)* Stopped according to repetition mode and stop condition	OFF	–	V2.00
1 to 200000 | **NONE**	Counter for current evaluation period (frame) Statistic count set to off (only 1 frame)	NONE	–	
Description of command				
This command is always a query. It returns the status of the measurement (see chapter 5).				

Subsystem RXQuality:BER:CONTrol

The subsystem *RXQuality:BER:CONTrol* sets the control parameters for the single shot receiver quality measurements. The subsystem corresponds to the tab *Control* in the popup menu *Receiver Quality Configuration.*

Meas. Mode, Frames, Circuit Switched BER

CONFigure:RXQuality:BER<nr>:CONTrol[:CSWitched] *<Mode>, <FramesToSend>*

<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
RFER | **BER |** **BBB |** **BDBL |** **AIBF,**	Residual bit error rate, frame erasure rate Bit error rate Burst by burst BER/Data Block Error Rate AMR Inband FER (with option R&S CMU-K45)	BER	–	V2.00 V3.60
<FramesToSend>	Description of parameters	Def. value	Def. unit	
1 to 200000 | **NONE**	No. of frames to be sent No average (only 1 frame considered)	See below	–	

Description of command

This command defines the measured value and the number of frames to be sent in a circuit switched single shot measurement, constituting a statistics cycle. The suffix <nr> refers to the selected test setup (<nr> = 1 to 10). For definition of the measured value (BER, RFER etc.) see Chapter 4.

The following default settings are valid for the command parameters:

<nr>	1	2	3	4	5	6	7	8	9	10
Mode	BER	BER	BER	BER	BER	BER	BER	BER	BER	BER
Frames	100	100	500	500	100	500	500	100	100	100

Meas. Mode, Frames, Packet Data BER

CONFigure:RXQuality:BER<nr>:CONTrol:PDATa *<Mode>, <FramesToSend>*

<Mode> for PDATa	Description of parameters	Def. value	Def. unit	FW vers.
BDBL | **UBON ,**	BER/Data Block Error Rate USF BLER only	BDBL	–	V3.80
<FramesToSend>	Description of parameters	Def. value	Def. unit	
1 to 200000 | **NONE**	No. of frames to be sent No average (only 1 frame considered)	See below	–	

Description of command

This command defines the measured value and the number of frames to be sent in a single shot packet data measurement, constituting a statistics cycle. The suffix <nr> refers to the selected test setup (<nr> = 1 to 10). For definition of the measured value (BER, RFER etc.) see Chapter 4.

The following default settings are valid for the command parameters:

<nr>	1	2	3	4	5	6	7	8	9	10
Mode	BDBL	BDBL	BDBL	BDBL	BDBL	BDBL	BDBL	BDBL	BDBL	BDBL
Frames	100	100	500	500	100	500	500	100	100	100

CONFigure:RXQuality:BER<nr>:CONTrol:REPetition <*StopCondition*>,<Stepmode> — Test Cycles

<StopCondition>	Description of parameters	Def. value	Def. unit	FW vers.
ALIMits |	Measurement aborted when all limits are exceeded	See below	–	V2.00
FLIMit |	Aborted when first limit value is exceeded			
CLEVel |	Statistical BER test switched on			
NONE |	Not aborted, measurement over all frames			
RFLS	RF Level Search			V3.60

<Stepmode>	Description of parameters	Def. value	Def. unit	FW vers.
STEP |	Interrupt measurement after each statistics cycle	NONE	–	V2.00
NONE	Continue measurement according to its rep. mode			

Description of command

This command determines the stop condition and the stepping mode for the measurement. The repetition mode of the measurement (single shot) is identified by the `BER` keyword in the command header. In *RF Level Search* mode, the measurement is repeated at varying signal level until the target bit error rate is found.

Depending on the test setup, the following default settings are valid:

<nr>	1	2	3	4	5	6	7	8	9	10
StopCond	FLIM	FLIM	FLIM	FLIM	FLIM	FLIM	FLIM	FLIM	FLIM	FLIM

CONFigure:RXQuality:BER<nr>:CONTrol[:CSWitched][:TCH]:LEVel:UTIMeslot <*Level*> — TCH Level BER, Used Timeslot

<Level>	Description of parameters	Def. value	Def. unit	FW vers.
–137 dBm to –27 dBm	RF1 level in used timeslot	See below	dBm	V2.00
–137 dBm to –10 dBm	RF2 level in used timeslot		dBm	
–90 dBm to +13 dBm	RF3 OUT level in used timeslot		dBm	

Description of command

This command defines the absolute level of the traffic channel (*TCH*) in the used timeslot for the single shot application <nr>. This level applies to the receiver quality measurement only.

The default setting depends on the test setup (all level values in dBm, corresponding to RF2):

<nr>	1	2	3	4	5	6	7	8	9	10
Level	–102.0	–104.0	–102.0	–104.0	–100.0	–100.0	–100.0	–102.0	–102.0	–102.0

CONFigure:RXQuality:BER<nr>:CONTrol[:CSWitched][:TCH]:LEVel:UNTimeslot *<Level>*

TCH Level BER, Unused Timeslot

<Level>	Description of parameters	Def. value	Def. unit	FW vers.
–127 dB to +127 dB	Level in unused timeslot	See below	dB	V2.00

Description of command

This command defines the relative level of the traffic channel (*TCH*) in the unused timeslot for the single shot application <nr>. This level applies to the receiver quality measurement only. The level range quoted above is restricted by the condition that the absolute level (calculated from the used timeslot level and the relative level in the unused timeslots) must not exceed the level ranges of the RF connectors.

Example: With output connector RF2 and a default used timeslot level of –102 dBm, the unused timeslot level can be set in the range –35 dB to +92 dB, corresponding to an absolute level of –137 dBm to –10 dBm.

The default setting depends on the test setup (all level values in dB):

<nr>	1	2	3	4	5	6	7	8	9	10
Level	–18.0	–16.0	–18.0	–16.0	–20.0	–20.0	–20.0	–18.0	–18.0	–18.0

Reference Level, Multislot

CONFigure:RXQuality:BER<nr>:CONTrol[:CSWitched][:TCH]:MSLot:RLEVel *<Level>*
CONFigure:RXQuality:BER<nr>:CONTrol:PDATa:[:TCH]:MSLot:RLEVel *<Level>*

<Level>	Description of parameters	Def. value	Def. unit	FW vers.
–137 dBm to –27 dBm	Reference level for RF1	See below	dBm	V3.05
–137 dBm to –10 dBm	Reference level for RF2	See below	dBm	
–90 dBm to +13 dBm	Reference level for RF3 OUT	–90	dBm	

Description of command

This command defines the reference value for the individual downlink (BS) TCH signal levels used for the multislot BER test on circuit switched channels. See command `CONFigure:RXQuality:BER<nr>:CONTrol[:CSWitched][:TCH]:MSLot:LEVel:INDividual` on p. 6.180 and the corresponding packet data command.

The default setting depends on the test setup (all level values in dB):

<nr>	1	2	3	4	5	6	7	8	9	10
Level	–102.0	–104.0	–102.0	–104.0	–100.0	–100.0	–100.0	–102.0	–102.0	–102.0

Slot Configuration: Individual (Multislot)

CONFigure:RXQuality:BER<nr>:CONTrol[:CSWitched][:TCH]:MSLot:LEVel:INDividual
CONFigure:RXQuality:BER<nr>:CONTrol:PDATa[:TCH]:MSLot:LEVel:INDividual
<Level_0>, ..., <Level_7>

<Level_n>	Description of parameters	Def. value	Def. unit	FW vers.
–127 dB to +127 dB	Power of CMU in timeslot no. n	0	dB	V3.05

Description of command

This command defines the levels in all 8 timeslots of the downlink (BS) TCH signal relative to the *Reference Level* set via `CONFigure:RXQuality:BER<nr>:CONTrol[:CSWitched][:TCH]:MSLot:RLEVel` (see p. 6.179) and the corresponding packet data command. The levels are valid for BER tests if the MS is set to multislot operation.

The level range quoted above is restricted by the condition that the absolute level (calculated from the reference level and the relative individual levels) must not exceed the level ranges of the RF connectors.

Example: With output connector RF2 and a default used timeslot level of –102 dBm, the individual levels can be set in the range –35 dB to +92 dB, corresponding to absolute levels of –137 dBm to –10 dBm.

The PDATa command refers to packet-switched data traffic channels and requires option CMU-K42.

Slot Configuration: Individual (Single-Slot, Circuit Switched)

CONFigure:RXQuality:BER<nr>:CONTrol[:CSWitched][:TCH]:LEVel[:SLOT]:ZERO *<Level>*
CONFigure:RXQuality:BER<nr>:CONTrol[:CSWitched][:TCH]:LEVel[:SLOT]:ONE *<Level>*
CONFigure:RXQuality:BER<nr>:CONTrol[:CSWitched][:TCH]:LEVel[:SLOT]:TWO *<Level>*
CONFigure:RXQuality:BER<nr>:CONTrol[:CSWitched][:TCH]:LEVel[:SLOT]:THRee *<Level>*
CONFigure:RXQuality:BER<nr>:CONTrol[:CSWitched][:TCH]:LEVel[:SLOT]:FOUR *<Level>*
CONFigure:RXQuality:BER<nr>:CONTrol[:CSWitched][:TCH]:LEVel[:SLOT]:FIVE *<Level>*
CONFigure:RXQuality:BER<nr>:CONTrol[:CSWitched][:TCH]:LEVel[:SLOT]:SIX *<Level>*
CONFigure:RXQuality:BER<nr>:CONTrol[:CSWitched][:TCH]:LEVel[:SLOT]:SEVen *<Level>*

<Level>	Description of parameters	Def. value	Def. unit	FW vers.
–127 dB to +127 dB	Power of CMU in timeslot no. n	0	dB	V3.05

Description of command

These commands define the levels of the downlink (BS) TCH signal relative to the *Reference Level* set via `CONFigure:RXQuality:BER<nr>:CONTrol[:CSWitched][:TCH]:MSLot:RLEVel` (see p. 6.179). The levels are valid for BER tests if the MS is set to multislot operation.

The level range quoted above is restricted by the condition that the absolute level (calculated from the reference level and the relative individual levels) must not exceed the level ranges of the RF connectors.

Example With output connector RF2 and a default used timeslot level of –102 dBm, the individual levels can be set in the range –35 dB to +92 dB, corresponding to absolute levels of –137 dBm to –10 dBm.

Slot Configuration: Individual (Single-Slot, Packet Data)				
CONFigure:RXQuality:BER<nr>:CONTrol:PDATa[:TCH]:MSLot:LEVel[:SLOT]:ZERO *<Level>* **CONFigure:RXQuality:BER<nr>:CONTrol:PDATa[:TCH]:MSLot:LEVel[:SLOT]:ONE *<Level>*** **CONFigure:RXQuality:BER<nr>:CONTrol:PDATa[:TCH]:MSLot:LEVel[:SLOT]:TWO *<Level>*** **CONFigure:RXQuality:BER<nr>:CONTrol:PDATa[:TCH]:MSLot:LEVel[:SLOT]:THRee *<Level>*** **CONFigure:RXQuality:BER<nr>:CONTrol:PDATa[:TCH]:MSLot:LEVel[:SLOT]:FOUR *<Level>*** **CONFigure:RXQuality:BER<nr>:CONTrol:PDATa[:TCH]:MSLot:LEVel[:SLOT]:FIVE *<Level>*** **CONFigure:RXQuality:BER<nr>:CONTrol:PDATa[:TCH]:MSLot:LEVel[:SLOT]:SIX *<Level>*** **CONFigure:RXQuality:BER<nr>:CONTrol:PDATa[:TCH]:MSLot:LEVel[:SLOT]:SEVen *<Level>***				
<Level>	Description of parameters	Def. value	Def. unit	FW vers.
–127 dB to +127 dB	Power of CMU in timeslot no. n	0	dB	V3.40
Description of command				
These commands define the levels of the downlink (BS) TCH signal relative to the *Reference Level* set via `CONFigure:RXQuality:BER<nr>:CONTrol:PDATa:[:TCH]:MSLot:RLEVel` (see p. 6.179). The levels are valid for BER tests if the MS is set to multislot operation. The level range quoted above is restricted by the condition that the absolute level (calculated from the reference level and the relative individual levels) must not exceed the level ranges of the RF connectors. **Example** With output connector RF2 and a default used timeslot level of –102 dBm, the individual levels can be set in the range –35 dB to +92 dB, corresponding to absolute levels of –137 dBm to –10 dBm.				

CONFigure:RXQuality:BER<nr>:CONTrol:DEFault <Enable>	Default Settings			
<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	All parameters are set to their default values Some or all parameters differ from the default values	ON	–	V2.00
Description of command				
As a *setting command* with the setting *ON* this command sets all parameters of the subsystem to default values (the setting *OFF* causes an error message). As a query, this command reads out whether all parameters are set to default values *(ON)* or not *(OFF)*.				

Subsystem RXQuality:BER:LIMit

The subsystem *RXQuality:BER:LIMit* defines tolerance values for the single shot receiver quality measurements. The subsystem corresponds to the tab *Limits* in the popup menu *Receiver Quality Configuration.*

CONFigure:RXQuality:BER<nr>:LIMit:CLII *<ClassIIBER>*	Class II Bits			
<ClassIIBER>	Description of parameters	Def. value	Def. unit	FW vers.
0 % to 100 %	Upper limit of error rate for class II bits	0.2	%	V2.00
Description of command				
This command defines an upper limit for the bit error rate of class II (unprotected bits, see Chapter 4) in test setup <nr>. Irrespective of the test setup, the default setting is 0.2 %.				

CONFigure:RXQuality:BER<nr>:LIMit:CLIB <*ClassIbBER*>				Class Ib Bits
<ClassIbBER>	Description of parameters	Def. value	Def. unit	FW vers.
0 % to 100 %	Upper limit of error rate for class Ib bits	0.4	%	V2.00
Description of command				
This command defines an upper limit for the bit error rate of class Ib (partly protected bits, see Chapter 4) in the test setup <nr>. Irrespective of the test setup, the default setting is 0.4 %.				

CONFigure:RXQuality:BER<nr>:LIMit:FERRors <Frame Errors>				Frame Errors
<FERRors>	Description of parameters	Def. value	Def. unit	FW vers.
0 % to 100 %	Upper limit for erased frame errors	0.1	%	V2.00
Description of command				
This command defines an upper limit for frame errors in the test setup <nr>. Irrespective of the test setup, the default setting is 0.1 %.				

CONFigure:RXQuality:BER<nr>:LIMit:DBLer <Data_BLER>				Data Block Error Rate
<Data_BLER>	Description of parameters	Def. value	Def. unit	FW vers.
0 % to 100 %	Upper limit for data block error rate	10.0	%	V3.05
Description of command				
This command defines an upper limit for the data BLER in the test setup <nr>. Irrespective of the test setup, the default setting is 10.0 %.				

CONFigure:RXQuality:BER<nr>:LIMit:USFBler <USF_BLER>				USF Block Error Rate
<USF_BLER>	Description of parameters	Def. value	Def. unit	FW vers.
0 % to 100 %	Upper limit for USF block error rate	1.0	%	V3.05
Description of command				
This command defines an upper limit for the USF BLER in the test setup <nr>. Irrespective of the test setup, the default setting is 10.0 %.				

CONFigure:RXQuality:BER<nr>:LIMit:DEFault <Enable>				Default Settings
<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	All parameters are set to their default values Some or all parameters differ from the default values	ON	–	V2.00
Description of command				
As a *setting command* with the setting *ON* this command sets all parameters of the subsystem to default values (the setting *OFF* causes an error message). As a query, this command reads out whether all parameters are set to default values *(ON)* or not *(OFF)*.				

Measured Values – Subsystem RXQuality:BER

The subsystem *RXQuality:BER* measures and outputs the bit error rate and compares it with the tolerance values. The subsystem corresponds to the measurement menus *Receiver Quality* for the single shot type of measurement and measured values *(RFER, BER, BurstByBurst, DBLER, AMR Inband FER).*

Scalar Results

READ[:SCALar]:RXQuality:BER?	Start single shot measurement and return results			
FETCh[:SCALar]:RXQuality:BER?	Read out meas. results (unsynchronized)			
SAMPle[:SCALar]:RXQuality:BER?	Read out measurement results (synchronized)			
Returned values for RFER	Value range	Def. value	Def. unit	
ProgressTime,	0.0% to 100.0%	NAN	%	V2.00
ClassIIBits,	0.000% to 100.000%	NAN	%	
ClassIbBits,	0.000% to 100.000%	NAN	%	
FER,	0.000% to 100.000%	NAN	%	
CRCErrors,	0 to 200000	NAN	–	
Status,	INV | PASS | FAIL | TLOW | IMP	INV	–	
Statistical Result*),	RUNN | EFAI | EPAS | FAIL | PASS | THIG | TLOW	NAN	–	V3.40
RF Search Level	–200.0 dB to 0.0 dB | LLR | MCR	NAN	dBm	V3.60
Returned values for BER	Value range	Def. value	Def. unit	
ProgressTime,	0.0% to 100.0%	NAN	%	V2.00
ClassIIBits,	0.000% to 100.000%	NAN	%	
ClassIbBits,	0.000% to 100.000%	NAN	%	
CRCErrors,	0 to 200000	NAN	–	
Status	INV | PASS | FAIL | TLOW | IMP	INV	–	
Statistical Result*),	RUNN | EFAI | EPAS | FAIL | PASS | THIG | TLOW	NAN	–	V3.40
RF Search Level	–200.0 dB to 0.0 dB | LLR | MCR	NAN	dBm	V3.60
Returned values for BBB	Value range	Def. value	Def. unit	
ProgressTime,	0.0% to 100.0%	NAN	%	V2.00
BER,	0.000% to 100.000%	NAN	%	
CRCErrors,	0 to 200000	NAN	–	
Status	INV | PASS | FAIL | TLOW | IMP	INV	–	
Statistical Result*),	RUNN | EFAI | EPAS | FAIL | PASS | THIG | TLOW	NAN	–	V3.40
RF Search Level	–200.0 dB to 0.0 dB | LLR | MCR	NAN	dBm	V3.60
Returned values for BDBL	Value range	Def. value	Def. unit	FW vers.
ProgressTime,	0.0% to 100.0%	NAN	%	V2.00
BER,	0.000% to 100.000%	NAN	%	
USFBLER	0.000% to 100.000%	NAN	%	
DBLER	0.000% to 100.000%	NAN	%	
CRCErrors,	0 to 200000	NAN	–	
Status	INV | PASS | FAIL | TLOW | IMP	INV	–	
Statistical Result*),	RUNN | EFAI | EPAS | FAIL | PASS | THIG | TLOW	NAN	–	V3.40
False USF Detection)**	0.000% to 100.000%	INV	%	V3.60
RF Search Level*)**	–200.0 dB to 0.0 dB | LLR | MCR	NAN	dBm	
Returned values for AIBF	Value range	Def. value	Def. unit	
ProgressTime,	0.0% to 100.0%	NAN	%	V3.60
FER,	0.000% to 100.000%	NAN	–	
Status	INV | PASS | FAIL | TLOW | IMP	INV	–	
Statistical Result*),	RUNN | EFAI | EPAS | FAIL | PASS | THIG | TLOW	NAN	–	
RF Search Level	(always NAN in the current firmware version)	NAN	dBm	

Returned values for UBON	Value range	Def. value	Def. unit	FW vers.
ProgressTime,	0.0% to 100.0%	NAN	%	V3.80
USFBLER	0.000% to 100.000%	NAN	%	
CRCErrors,	0 to 200000	NAN	–	
Status	INV | PASS | FAIL | TLOW | IMP	INV	–	
Statistical Result*),	RUNN | EFAI | EPAS | FAIL | PASS | THIG | TLOW	NAN	–	
False USF Detection	0.000% to 100.000%	INV	%	
RF Search Level*)**	–200.0 dB to 0.0 dB | LLR | MCR	NAN	dBm	

Description of command

These commands are always queries. They start a bit-error-rate test in the single shot repetition mode and output the measurement results (see also detailed explanation of measured values in Chapter 4 and table in section *BER Tests of PDTCHs*). The results depend on the measurement mode set via the `CONFigure:RXQuality:BER<nr>:CONTrol...` commands (RFER, BER, BBB, DBLer, AIBF, UBON). They are

ProgressTime	Relative progress of the measurement
ClassIIBits	(Residual) bit error rate for class II bits
ClassIbBits	(Residual) bit error rate for class Ib bits
FER	Frame erasure rate
BER	Bit error rate (no distinction between bit classes)
DBLER	Data block error rate
USFBLER	USF block error rate, available for packet-switched channels only (CMU-K42)
CRCErrors	Cyclic redundancy check (CRC) errors
Status	Measurement status

The following messages can be output for the measurement status:

INV	Measurement invalid	*invalid*
PASS	All tolerances matched	*passed*
FAIL	Not all tolerances matched	*failed*
IMP	Measurement impossible, therefore invalid	*impossible*

*) The statistical result is available only if statistical BER testing is activated via *`CONFigure:RXQuality:BER<nr>:CONTrol:REPetition`* (see p. 6.178, otherwise, NAN is returned). The following messages can be output for the measurement status:

RUNN	Confidence test running	*running*
EFAI	Test stopped, failed early	*early fail*
EPAS	Test stopped, passed early	*early pass*
THIG	Test stopped, result too thigh (dual-limit test)	*too high*
TLOW	Test stopped, result too low (dual-limit test)	*too low*
INV	Measurement invalid	*invalid*
PASS	All tolerances matched	*passed*
FAIL	Not all tolerances matched	*failed*
IMP	Measurement impossible, therefore invalid	*impossible*

**) For circuit switched main service, the returned value is always NAN.

***) The following messages can be output if a RF level search is active (see *`CONFigure:RXQuality:BER<nr>:CONTrol:REPetition`* on 6.178, otherwise, NAN is returned):

Numeric value	RF Search level	*invalid*
LLR	Stopped because level limit reached	*level limit reached*
MCR	Stopped because max. no. of cycles reached	*max. cycles reached*

Note: *The measurement mode UBON is available for packet data main service only. BDBL is available for packet data and circuit switched main service. The remaining measurement modes are available for circuit switched main service only.*

CALCulate:RXQuality:BER:LIMit:MATChing?				Limit Matching
Returned values for RFER	Value range	Def. value	Def. unit	FW vers.
Total,	PASS | FAIL | INV | TLOW | IMP	INV	–	V3.40
ClassIIBits,	NMAU | INV | OK	INV	–	
ClassIbBits,	NMAU | INV | OK	INV	–	
FER,	NMAU | INV | OK	INV	–	
CRCerrors	NMAU | INV | OK	INV	–	
Returned values for BER	Value range	Def. value	Def. unit	
Total,	PASS | FAIL | INV | TLOW | IMP	INV	–	
ClassIIBits,	NMAU | INV | OK	INV	–	
ClassIbBits,	NMAU | INV | OK	INV	–	
CRCerrors	NMAU | INV | OK	INV	–	
Returned values for BBB	Value range	Def. value	Def. unit	
Total,	PASS | FAIL | INV | TLOW | IMP	INV	–	
BER,	NMAU | INV | OK	INV	–	
CRCerrors	NMAU | INV | OK	INV	–	
Returned values for BDBL	Value range	Def. value	Def. unit	FW vers.
Total,	PASS | FAIL | INV | TLOW | IMP	INV	–	V3.40
BER,	NMAU | INV | OK	INV	–	
USFBLER	NMAU | INV | OK	INV	–	
DBLER	NMAU | INV | OK	INV	–	
CRCerrors	NMAU | INV | OK	INV	–	
False USF Detection*)	NMAU | INV | OK	INV	–	V3.60
Returned values for AIBF	Value range	Def. value	Def. unit	FW vers.
Total,	PASS | FAIL | INV | TLOW | IMP	INV	–	V3.60
FER	NMAU | INV | OK	INV	–	
Returned values for UBON	Value range	Def. value	Def. unit	FW vers.
Total,	PASS | FAIL | INV | TLOW | IMP	INV	–	V3.80
USFBLER	NMAU | INV | OK	INV	–	
CRCerrors	NMAU | INV | OK	INV	–	
False USF Detection	NMAU | INV | OK	INV	–	

Description of command

This command is always a query. It indicates whether and in which way the tolerances for the bit error rate test (see command above) have been exceeded. See also detailed explanation of measured values in Chapter 4 and table in section *BER Tests of PDTCHs*.

The following messages can be output for the measured quantities:

PASS	all tolerances matched	*passed*
FAIL	Not all tolerances matched	*failed*
INV	Invalid measurement	*invalid*
IMP	Measurement impossible, therefore invalid	*impossible*
NMAU	Tolerance exceeded	*not matching, underflow*
INV	Invalid measurement	*invalid*
OK.	all tolerances matched	

*) For circuit switched main service, the returned value is always NAN.

Receiver Quality – Continuous

The subsystem *RXQuality:BAVerage* contains the commands for receiver quality measurement with continuous repetition. The subsystem corresponds to the main menu *Receiver Quality,* application *BER Average* and the corresponding parts of the associated popup menu *Receiver Quality Configuration.*

Control of Measurement – Subsystem RXQuality:BAVerage

The subsystem *RXQuality:BAVerage* controls the *Continuous* measurement.

INITiate:RXQuality:BAVerage **ABORt:RXQuality:BAVerage** **STOP:RXQuality:BAVerage** **CONTinue:RXQuality:BAVerage**	Start new measurement Abort running measurement and switch off Stop measurement Next measurement step (only *stepping mode*)	⇒ *RUN* ⇒ *OFF* ⇒ *STOP* ⇒ *RUN*
Description of command		FW vers.
These commands have no query form. They start or stop the Continuous measurement, setting it to the status indicated in the top right column.		V2.00

CONFigure:RXQuality:BAVerage:EREPorting <*Mode*>				Event Reporting
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
SRQ | **SOPC |** **SRSQ |** **OFF**	Service request Single operation complete SRQ and SRSQ No reporting	OFF	–	V2.00
Description of command				
This command defines the events generated when the measurement is terminated or stopped *(event reporting,* see chapter 5).				

FETCh:RXQuality:BAVerage:STATus?				Measurement Status
Return	Description of parameters	Def. value	Def. unit	FW vers.
OFF | **RUN |** **STOP |** **ERR |** **STEP |** **RDY,**	Measurement in the *OFF* state (`*RST` or `ABORt`) Running (after `INITiate, CONTinue` or `READ`) Stopped (`STOP`) *OFF* (could not be started) Stepping mode *(<stepmode>=STEP)* Stopped according to repetition mode and stop condition	OFF	–	V2.00
1 to 500 | **NONE**	Counter for current evaluation period (frame) No averaging	NONE	–	
Description of command				
This command is always a query. It returns the status of the measurement (see chapter 5).				

Subsystem RXQuality:BAVerage:CONTrol

The subsystem *RXQuality:BAVerage:CONTrol* sets the parameters for the continuous receiver quality measurement. The subsystem corresponds to the tab *Control* in the popup menu *Receiver Quality Configuration.*

Meas. Mode, Circuit Switched Average

CONFigure:RXQuality:BAVerage:CONTrol[:CSWitched] <*Mode*>, <*FramesToAverage*>
CONFigure:RXQuality:BAVerage:CONTrol:PDATa <*Mode*>, <*FramesToAverage*>

<Mode>	Description of parameters	Def. value	Def. unit	
RFER | **BER |** **BBB |** **BDBL |** **AIBF,**	Residual bit error rate, frame erasure rate Bit error rate Burst by burst BER/Data Block Error Rate AMR Inband FER (with option R&S CMU-K45)	BER	–	V2.00 V3.60
<FramesToAverage>	Description of parameters	Def. value	Def. unit	
1 to 500 | **OFF**	No. of frames to average No average (only 1 frame considered)	100	–	

Description of command

This command defines the measured value and the number of frames to be averaged in the continuous circuit switched measurement, constituting a statistics cycle. For definition of the measured value (BER, RBER etc.) see Chapter 4.

Meas. Mode, Frames, Packet Data Average

CONFigure:RXQuality:BAVerage:CONTrol:PDATa <*Mode*>, <*FramesToAverage*>

<Mode> for PDATa	Description of parameters	Def. value	Def. unit	FW vers.
BDBL | **UBON ,**	BER/Data Block Error Rate USF BLER only	BDBL	–	V3.80
<FramesToAverage>	Description of parameters	Def. value	Def. unit	
1 to 500 | **NONE**	No. of frames to average No average (only 1 frame considered)	100	–	

Description of command

This command defines the measured value and the number of frames to be averaged in a continuous packet data measurement, constituting a statistics cycle. For definition of the measured value (BER, RFER etc.) see Chapter 4.

CONFigure:RXQuality:BAVerage:CONTrol:REPetition <*StopCondition*> ,<Stepmode> Stop Condition

<StopCondition>	Description of parameters	Def. value	Def. Unit	
ALIMits | **FLIMit |** **NONE**	Measurement aborted when all limits are exceeded Aborted when first limit value is exceeded Not aborted, measurement over all frames	FLIM	–	
<Stepmode>	Description of parameters	Def. value	Def. Unit	FW vers.
STEP | **NONE**	Interrupt measurement after each statistics cycle Continue measurement according to its rep. mode	NONE	–	V2.00

Description of command

This command determines the stop condition and the stepping mode for the measurement.

CONFigure:RXQuality:BAVerage:CONTrol[:TCH]:LEVel:UTIMeslot *<Level>*

TCH BER Level, Used Timeslot

<Level>	Description of parameters	Def. value	Def. unit	FW vers.
–137 dBm to –27 dBm	RF1 level in used timeslot	–102.0	dBm	V2.00
–137 dBm to –10 dBm	RF2 level in used timeslot	–102.0	dBm	
–90 dBm to +13 dBm	RF3 OUT level in used timeslot	–90.0	dBm	

Description of command

This command defines the absolute level of the traffic channel (*TCH*) in the used timeslot for the continuous application. This level applies to the *Receiver Quality* measurement only

CONFigure:RXQuality:BAVerage:CONTrol[:TCH]:LEVel:UNTimeslot *<Level>*

TCH BER Level, Unused Timeslot

<Level>	Description of parameters	Def. value	Def. unit	FW vers.
–127 dB to +127 dB	Level in unused timeslot	–18.0	dB	V2.00

Description of command

This command defines the relative level of the traffic channel (*TCH*) in the unused timeslot for the continuous application. This level applies to the receiver quality measurement only. The value range mentioned above is valid provided that the sum of the absolute level of the used timeslot and the relative value for the unused timeslot does not exceed the value ranges for the absolute level of the used timeslot (for RF1, RF2 and RF3 OUT).

Reference Level, Multislot

CONFigure:RXQuality:BAVerage:CONTrol[:CSWitched][:TCH]:MSLot:RLEVel *<Level>*
CONFigure:RXQuality:BAVerage:CONTrol:PDATa[:TCH]:MSLot:RLEVel *<Level>*

<Level>	Description of parameters	Def. value	Def. unit	FW vers.
–137 dBm to –27 dBm	RF1 reference level	–102.0	dBm	V3.05
–137 dBm to –10 dBm	RF2 reference level	–102.0	dBm	
–90 dBm to +13 dBm	RF3 OUT reference level	–90.0	dBm	

Description of command

These commands define the reference value for the individual downlink (BS) TCH signal levels used for the multislot BAVerage test on circuit switched and packet data channels. See command *CONFigure:RXQuality:BAVerage:CONTrol[:CSWitched][:TCH]:MSLot:LEVel:INDividual* on p. 6.189 and the corresponding packet data command.

Slot Configuration: Individual (Multislot)

CONFigure:RXQuality:BAVerage:CONTrol[:CSWitched][:TCH]:MSLot:LEVel:INDividual
CONFigure:RXQuality:BAVerage:CONTrol:PDATa[:TCH]:MSLot:LEVel:INDividual
<Level_0>, ..., <Level_7>

<Level_n>	Description of parameters	Def. value	Def. unit	FW vers.
–127 dB to +127 dB	Power of CMU in timeslot no. n	0	dB	V3.05

Description of command

This command defines the levels in all 8 timeslots of the downlink (BS) TCH signal relative to the *Reference Level* set via *CONFigure:RXQuality:BAVerage:CONTrol[:CSWitched][:TCH]:MSLot:RLEVel* (see p. 6.188) and the corresponding packet data command. The levels are valid for BER tests if the MS is set to multislot operation.

The level range quoted above is restricted by the condition that the absolute level (calculated from the reference level and the relative individual levels) must not exceed the level ranges of the RF connectors.

Example: With output connector RF2 and a default used timeslot level of –102 dBm, the individual levels can be set in the range –35 dB to +92 dB, corresponding to absolute levels of –137 dBm to –10 dBm.

The `PDATa` command refers to packet-switched data traffic channels and requires option CMU-K42.

CONFigure:RXQuality:BAVerage:CONTrol:DEFault <Enable> Default Settings

<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	The parameters are set to default values Some or all parameters differ from the default value	ON	–	V2.00

Description of command

As a *setting command* with the setting *ON* this command sets all parameters of the subsystem to default values (the setting *OFF* causes an error message).

As a query, this command reads out whether all parameters are set to default values *(ON)* or not *(OFF)*.

Subsystem RXQuality:BAVerage:LIMit

The subsystem *RXQuality:BAVerage:LIMit* defines tolerance values for the continuous receiver quality measurement. The subsystem corresponds to the tab *Limits* in the popup menu *Receiver Quality Configuration.*

CONFigure:RXQuality:BAVerage:LIMit:CLII *<ClassIIBER>* Class II Bits

<ClassIIBER>	Description of parameters	Def. value	Def. unit	FW vers.
0 % to 100 %	Upper limit of error rate for class II bits	0.2	%	V2.00

Description of command

This command defines an upper limit for the bit error rate of class II (unprotected bits, see Chapter 4) for continuous application.

CONFigure:RXQuality:BAverageLIMit:CLIB *<ClassIbBER>* Class Ib Bits

<ClassIbBER>	Description of parameters	Def. value	Def. unit	FW vers.
0 % to 100 %	Upper limit of error rate for class Ib bits	0.4	%	V2.00

Description of command

This command defines an upper limit for the bit error rate of class Ib (partly protected bits, see Chapter 4) for the continuous application.

CONFigure:RXQuality:BAVerage:LIMit:FERRors <Frame Errors>				Frame Errors
<FERRors>	Description of parameters	Def. value	Def. unit	FW vers.
0 % to 100 %	Upper limit for erased frame errors	0.1	%	V2.00
Description of command				
This command defines an upper limit for the relative portion of invalid and therefore erased frames (*frame erasure rate*, see Chapter 4) in the measurement of the residual bit error rate (*RBER*, see command `CONFigure:RXQuality:BAVerage:CONTrol`) and for the continuous application.				

CONFigure:RXQuality:BAVerage:LIMit:DBLer <Data_BLER>				Data Block Error Rate
<Data_BLER>	Description of parameters	Def. value	Def. unit	FW vers.
0 % to 100 %	Upper limit for data block error rate	10.0	%	V3.05
Description of command				
This command defines an upper limit for the data BLER.				

CONFigure:RXQuality:BAVerage:LIMit:USFBler <USF_BLER>				USF Block Error Rate
<USF_BLER>	Description of parameters	Def. value	Def. unit	FW vers.
0 % to 100 %	Upper limit for USF block error rate	10.0	%	V3.05
Description of command				
This command defines an upper limit for the USF BLER.				

CONFigure:RXQuality:BAVerage:LIMit:DEFault <Enable>				Default Settings
<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	The parameters are set to default values Some or all parameters differ from the default value	ON	–	V2.00
Description of command				
As a *setting command* with the setting *ON* this command sets all parameters of the subsystem to default values (the setting *OFF* causes an error message). As a query, this command reads out whether all parameters are set to default values *(ON)* or not *(OFF)*.				

Measured Values – Subsystem RXQuality:BAVerage

The subsystem *RXQuality:BAVerage* contains the commands for measurement and output of the bit error rate and its comparison with the tolerance values. The subsystem corresponds to the measurement menus *Receiver Quality* for the continuous measurement.

				Scalar Results
FETCh[:SCALar]:RXQuality:BAVerage?				Read out results (unsynchronized)
SAMPle[:SCALar]:RXQuality:BAVerage?				Read out results (synchronized)
Returned values for RFER	Value range	Def. value	Def. unit	FW vers.
ProgressTime,	0.0 to 100.0 %	NAN	%	V2.00
ClassIIBits,	0.000 to 100.000 %	NAN	%	
ClassIbBits,	0.000 to 100.000 %	NAN	%	
FER,	0.000 to 100.000 %	NAN	%	
CRCErrors,	0 to 500	NAN	–	
Status	INV | PASS | FAIL | TLOW | IMP	INV	–	
Returned values for BER	Value range	Def. value	Def. unit	
ProgressTime,	0.0 to 100.0 %	NAN	%	
ClassIIBits,	0.000 to 100.000 %	NAN	%	
ClassIbBits,	0.000 to 100.000 %	NAN	%	
CRCErrors,	0 to 500	NAN	–	
Status	INV | PASS | FAIL | TLOW | IMP	INV	–	
Returned values for BBB	Value range	Def. value	Def. unit	
ProgressTime,	0.0% to 100.0%	NAN	%	
ClassIIBits,	0.000% to 100.000%	NAN	%	
CRCErrors,	0 to 500	NAN	–	
Status	INV | PASS | FAIL | TLOW | IMP	INV	–	

Returned values for BDBL	Value range	Def. value	Def. unit	FW vers.
ProgressTime,	0.0% to 100.0%	NAN	–%	V2.00
BER,	0.000% to 100.000%	NAN	%	
USFBLER	0.000% to 100.000%	NAN	%	
DBLER	0.000% to 100.000%	NAN	%	
CRCErrors,	0 to 500	NAN	–	
Status	INV | PASS | FAIL | TLOW | IMP	INV	–	
False USF Detection[*)]	0.000% to 100.000%	INV		V3.60
Returned values for AIBF	Value range	Def. value	Def. unit	
ProgressTime,	0.0% to 100.0%	NAN	%	V3.60
FER,	0.000% to 100.000%	NAN	–	
Status	INV | PASS | FAIL | TLOW | IMP	INV	–	
Returned values for UBON	Value range	Def. value	Def. unit	
ProgressTime,	0.0% to 100.0%	NAN	–%	V3.80
USFBLER	0.000% to 100.000%	NAN	%	
CRCErrors,	0 to 500	NAN	–	
Status	INV | PASS | FAIL | TLOW | IMP	INV	–	
False USF Detection	0.000% to 100.000%	INV		

Description of command

These commands are always queries. They start a bit error rate test in the continuous repetition mode and output the measurement results (see also detailed explanation of measured values in Chapter 4). The results depend on the measurement mode set via the `CONFigure:RXQuality:BAVerage<nr> :CONTrol` command (RFER, BER etc.). They are:

ProgressTime	Relative progress of the measurement
ClassIIBits	(Residual) bit error rate for class II bits
ClassIbBits	(Residual) bit error rate for class Ib bits
BER	Bit error rate (no distinction between bit classes)
FER	Frame erasure rate
DBLER	Data Block Error Rate
USFBLER	USF block error rate, available for packet-switched channels only (CMU-K42)
CRCErrors	Cyclic redundancy check (CRC) errors
Status	Measurement status

The following messages can be output for the measurement status:

INV	Measurement invalid	*invalid*
PASS	All tolerances matched	*passed*
FAIL	Not all tolerances matched	*failed*
IMP	Measurement impossible, therefore invalid	*impossible*

*) For circuit switched main service, the returned value is always NAN.

Note: *The measurement mode UBON is available for packet data main service only. BDBL is available for packet data and circuit switched main service. The remaining measurement modes are available for circuit switched main service only.*

CALCulate:RXQuality:BAVerage:LIMit:MATChing?				Limit Matching
Returned values for RFER	Value range	Def. value	Def. unit	
Total,	PASS | FAIL | INV | TLOW | IMP	INV	–	
ClassIIBits,	NMAU | INV | OK	INV	–	
ClassIbBits,	NMAU | INV | OK	INV	–	
FER,	NMAU | INV | OK	INV	–	
CRCerrors	NMAU | INV | OK	INV	–	
Returned values for BER	Value range	Def. value	Def. unit	
Total,	PASS | FAIL | INV | TLOW | IMP	INV	–	
ClassIIBits,	NMAU | INV | OK	INV	–	
ClassIbBits,	NMAU | INV | OK	INV	–	
CRCerrors	NMAU | INV | OK	INV	–	
Returned values for BBB	Value range	Def. value	Def. unit	
Total,	PASS | FAIL | INV | TLOW | IMP	INV	–	
BER,	NMAU | INV | OK	INV	–	
CRCerrors	NMAU | INV | OK	INV	–	
Returned values for BDBL	Value range	Def. value	Def. unit	FW vers.
Total,	PASS | FAIL | INV | TLOW | IMP	INV	–	V2.00
BER,	NMAU | INV | OK	INV	–	
USFBLER	NMAU | INV | OK	INV	–	
DBLER	NMAU | INV | OK	INV	–	
CRCerrors	NMAU | INV | OK	INV	–	
False USF Detection*)	NMAU | INV | OK	INV	–	V3.60
Returned values for AIBF	Value range	Def. value	Def. unit	
Total,	PASS | FAIL | INV | TLOW | IMP	INV	–	V3.60
FER	NMAU | INV | OK	INV	–	
Returned values for UBON	Value range	Def. value	Def. unit	FW vers.
Total,	PASS | FAIL | INV | TLOW | IMP	INV	–	V3.80
USFBLER	NMAU | INV | OK	INV	–	
CRCerrors	NMAU | INV | OK	INV	–	
False USF Detection	NMAU | INV | OK	INV	–	

Description of command

This command is always a query. It indicates whether and in which way the tolerances for the bit error rate test (see command above) have been exceeded.

The following messages can be output for the measured quantities:

PASS	all tolerances matched	*passed*
FAIL	Not all tolerances matched	*failed*
INV	Invalid measurement	*invalid*
IMP	Measurement impossible, therefore invalid	*impossible*
NMAU	Tolerance exceeded	*not matching, underflow*
INV	Invalid measurement	*invalid*
OK	all tolerances matched	

*) For circuit switched main service, the returned value is always INV.

Receiver Quality – Block Error Ratio

The subsystem *RXQuality:BLER* contains the commands for the Block Error Ratio (BLER) measurement. The subsystem corresponds to the main menu *Receiver Quality,* application *BLER* and the corresponding parts of the associated popup menu *Receiver Quality Configuration.*

Control of Measurement – Subsystem RXQuality:BLER

The subsystem *RXQuality:BLER* controls the BLER measurement.

INITiate:RXQuality:BLER	Start new measurement	⇒ *RUN*
ABORt:RXQuality:BLER	Abort running measurement and switch off	⇒ *OFF*
STOP:RXQuality:BLER	Stop measurement	⇒ *STOP*
CONTinue:RXQuality:BLER	Next measurement step (only *stepping mode*)	⇒ *RUN*
Description of command		FW vers.
These commands have no query form. They start or stop the BLER measurement, setting it to the status indicated in the top right column.		V3.10

CONFigure:RXQuality:BLER:EREPorting <*Mode*>				Event Reporting
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
SRQ |	Service request	OFF	–	V3.10
SOPC |	Single operation complete			
SRSQ |	SRQ and SRSQ			
OFF	No reporting			
Description of command				
This command defines the events generated when the measurement is terminated or stopped *(event reporting,* see chapter 5).				

FETCh:RXQuality:BLER:STATus?				Measurement Status
Return	Description of parameters	Def. value	Def. unit	FW vers.
OFF |	Measurement in the *OFF* state (`*RST` or `ABORt`)	OFF	–	V3.10
RUN |	Running (after `INITiate, CONTinue` or `READ`)			
STOP |	Stopped (`STOP`)			
ERR |	*OFF* (could not be started)			
STEP |	Stepping mode *(<stepmode>=STEP)*			
RDY,	Stopped according to repetition mode and stop cond.			
1 to 2000 |	Counter for current evaluation period (RLC blocks)			
NONE	Statistic count set to OFF (only one block)	NONE	–	
Description of command				
This command is always a query. It returns the status of the measurement (see chapter 5).				

Subsystem RXQuality:BLER:CONTrol

The subsystem *RXQuality:BLER:CONTrol* defines parameters controlling the scope of the BLER measurement. The subsystem corresponds to the *Control* tab in the popup menu *Receiver Quality Configuration.*

CONFigure:RXQuality:BLER:CONTrol:REPetition *<Repetition>*, *<StopCond>*, *<Stepmode>*				Statistics
<Repetition>	Description of parameters	Def. value	Def. unit	
CONTinuous | **SINGleshot |** **1 to 10000**	Continuous measurement (until `STOP` or `ABORT`) Single shot measurement (until `Status = RDY`) Multiple measurement (*counting*, until `Status = STEP | RDY`)	SING	–	
<StopCond>	Description of parameters	Def. value	Def. unit	
NONE	Continue measurement even in case of error	NONE	–	
<Stepmode>	Description of parameters	Def. value	Def. unit	FW vers.
STEP | **NONE**	Interrupt measurement after each statistics cycle Continue measurement according to its rep. mode	NONE	–	V2.00
Description of command				
This command determines the number of statistics cycles, the stop condition and the stepping mode for the measurement. The second parameter is reserved for the limit check and has no effect at present. **Note:** In the case of READ commands (`READ:...`), the *<Repetition>* parameter has no effect; the measurement is always stopped after a single shot				

CONFigure:RXQuality:BLER:CONTrol:RLBCount *<Blocks>*				RLC Block Count
<Blocks>	Description of parameters	Def. value	Def. unit	FW vers.
100 to 10 000 000	Number of RLC blocks	2000	(blocks)	V3.10
Description of command				
This command sets the number of RLC blocks to be sent and evaluated in a single shot BLER measurement.				

CONFigure:RXQuality:BLER:CONTrol:PDATa[:TCH]:MSLot:RLEVel *<Level>*				Reference Level, Multislot
<Level>	Description of parameters	Def. value	Def. unit	FW vers.
–137 dBm to –27 dBm **–137 dBm to –10 dBm** **–90 dBm to +13 dBm**	RF1 reference level RF2 reference level RF3 OUT reference level	–85 –85 –85	dBm dBm dBm	V3.10
Description of command				
This command defines the reference value for the individual downlink (BS) TCH signal levels used for the multislot BLER test on packet data channels. See command `CONFigure:RXQuality:BLER:CONTrol:PDATa[:TCH]:MSLot:LEVel:INDividual`.				

				Slot Configuration: Individual (Multislot)
CONFigure:RXQuality:BLER:CONTrol:PDATa[:TCH]:MSLot:LEVel:INDividual ***<Level_0>, ..., <Level_7>***				
<Level_n>	Description of parameters	Def. value	Def. unit	FW vers.
–127 dB to +127 dB	Power of CMU in timeslot no. n	0	dB	V3.10

Description of command

This command defines the levels in all 8 timeslots of the downlink (BS) TCH signal relative to the *Reference Level* set via `CONFigure:RXQuality:BLER:CONTrol:PDATa[:TCH]:MSLot:RLEVel` and the corresponding packet data command. The levels are valid for BLER tests if the MS is set to multislot operation.

The level range quoted above is restricted by the condition that the absolute level (calculated from the reference level and the relative individual levels) must not exceed the level ranges of the RF connectors.

Example: With output connector RF2 and a default used timeslot level of –85 dBm, the individual levels can be set in the range –52 dB to +75 dB, corresponding to absolute levels of –137 dBm to –10 dBm.

CONFigure:RXQuality:BLER:CONTrol:DLDCycle *<Blocks>*				DL Resources in Use
<Blocks>	Description of parameters	Def. value	Def. unit	FW vers.
RB1 | RB2 | … RB12	n/12 of the DL RLC blocks where n= 1 … 12	RB12	–	V3.50

Description of command

This command selects the percentage of DL RLC blocks assigned to the MS under test and used for the BLER calculation.

CONFigure:RXQuality:BLER:CONTrol:DEFault <Enable>				Default Settings
<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	The parameters are set to default values Some or all parameters differ from the default value	ON	–	V3.10

Description of command

As a *setting command* with the setting *ON* this command sets all parameters of the subsystem to default values (the setting *OFF* causes an error message).

As a query, this command reads out whether all parameters are set to default values *(ON)* or not *(OFF)*.

Measured Values – Subsystem RXQuality:BLER

The subsystem *RXQuality:BLER* contains the commands for measurement and output of the Block Error Ratio. The subsystem corresponds to the measurement menu *Receiver Quality* for the BLER measurement.

				Scalar Results
READ[:SCALar]:RXQuality:BLER?				Start single shot measurement and return results
FETCh[:SCALar]:RXQuality:BLER?				Read out results (unsynchronized)
SAMPle[:SCALar]:RXQuality:BLER?				Read out results (synchronized)
Returned values	Value range	Def. value	Def. unit	FW vers.
Progress Time	0.000 % to 100.000 %	NAN	%	V3.10
BLER Overall	0.000 % to 100.000 %	NAN	%	
Overall No. of RLC Blocks,	1 to 2000	NAN	–	
BLER Slot 0,	0.000 % to 100.000 %	NAN	%	
RLC Blocks Slot 0,	0 to $2^{32} – 1$	NAN	–	
...				
BLER Slot 7,	0.000 to 100.000 %	NAN	%	
RLC Blocks Slot 7,	0 to $2^{32} – 1$	NAN	–	
RLC Data Rate Overall	0 kbit/s to 80 kbit/s times the no. of slots	NAN	kbit/s	
RLC Data Rate Slot 0	0 kbit/s to 80 kbit/s	NAN	kbit/s	V3.40
…				
RLC Data Rate Slot 7	0 kbit/s to 80 kbit/s	NAN	kbit/s	
Long Term Throughput	0 kbit/s to 80 kbit/s times the no. of slots	NAN	kbit/s	V3.50
Long Term Throughput/Slot	0 kbit/s to 80 kbit/s	NAN	kbit/s	V3.50

Description of command

These commands are always queries. They start a Block Error Ratio test in the continuous repetition mode and output the measurement results (see also detailed explanation of measured values in Chapter 4). *Progress Time* is the relative progress of the BLER measurement. In a single shot measurement the *RLC Data Rate* is only available if the number of transferred blocks (command `CONFigure:RXQuality:BLER:CONTrol:RLBCount`) is set to a value that is reached in less than 6 seconds (3 update periods).

Symbolic Status Event Register Evaluation

The following commands are used to retrieve the events reported in function groups *GSM400/850/900/1800/1900-MS Signalling*; see section *Symbolic Status Event Register Evaluation* in Chapter 5 of the CMU operating manual.

STATus:OPERation:SYMBolic:ENABle <Event>{,<Event>}				Symbolic status evaluation
Parameter list	Parameter description	Def. Value[5]	Default Unit	FW vers.
<Event>{,<Event>} | **NONE**	List of symbols for events to be reported No event reported	NONE	–	V3.05
Command description				
This command enables event reporting for one or several events in the current *GSMxxx-MS Signalling* function group, i.e. it sets the corresponding bits in the `STATus:OPERation:CMU:SUM<nr>:CMU<nr_event>:ENABle` register (`<nr> = 1 | 2, <nr_event>` denotes the current function group) and in all sum registers up to the status byte. The events and the corresponding symbols for the function group are listed in Chapter 5 (see section *Status Registers).* The symbols may be entered in arbitrary order.				

STATus:OPERation:SYMBolic[:EVENt]?				Symbolic status evaluation
Response	Parameter description	Def. Value[6]	Default Unit	FW vers.
NONE | **<Event>{,<Event>}**	No event in the *RF* function group List of reported events	NONE	–	V3.05
Command description				
This command is always a query. It lists the events reported in the current *GSMxxx-MS Signalling* function group and deletes these events in the `STATus:OPERation:CMU:SUM<nr>:CMU<nr_event>:EVENt` register as well as in all sum registers.				

[5] The default values quoted in this command are achieved after a `STATus:PRESet` command. `*RST` does not overwrite the entries in the status registers; see section *Reset Values of the Status Reporting Systems* in chapter 5.

[6] The default values quoted in this command are achieved after a `*CLS` command. `*RST` does not overwrite the entries in the status registers; see section *Reset Values of the Status Reporting Systems* in chapter 5.

Connection Control (Signalling only)

In the *Signalling* mode, the CMU is able to generate BCCH and TCH signals and to set up a connection to the mobile. A broad range of signalling parameters can be configured and measurements may be performed with a connection established.

The remote-control commands presented in this section control the signalling (connection setup and release, services, signalling parameters), determine the inputs and outputs as well as the reference frequency. They correspond to the settings in the popup menu of the softkey *Connect. Control* located to the right of the headline of each main menu.

Important note: Current vs. default values

Some parameters of the CMU can assume two independent values: The ***default*** *value is used to set up a connection; it can be modified in the signalling states* Signal Off, Signal On *and* Registered. *The* ***current*** *value is valid during the connection (signalling state* Call Established). *Whenever the CMU enters the* Call Established *state the default value overwrites the current value. The current value can still be changed during the connection, however, modifying this current value does not alter the default value. An example for such a double parameter in GSM-MS is the BS signal level in the used and unused timeslots.*

Default values are set with a `CONFigure ...` *command, current values are set with the corresponding* `PROCedure ...` *command.*

Subsystem LEVel (Input Level)

The subsystem *LEVel* controls the level in the RF input signal path. It corresponds to the table section *Analyzer Level* in the *MS Signal* tab of the *Connection Control* menu.

[SENSe:]LEVel:MODE *<Mode>* — Input Level – Mode

<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
MANual | **PCLevel |** **AUTomatic**	Manual setting of max. input level According to power control level of the mobile Automatic setting corresponding to average power of signal applied	PCLevel	–	V1.15

Description of command

This command defines the mode for setting the maximum input level.

[SENSe:]LEVel:MAXimum *<Level>* — Max. Level

<Level>	Description of parameters	Def. value	Def. unit	FW vers.
–40 dBm to +53 dBm **–54 dBm to +39 dBm** **–77 dBm to 0 dBm**	Maximum input level for RF1 Maximum input level for RF2 Maximum input level for RF 4 IN	+30.0 +30.0 0.0	dBm dBm dBm	V1.15

Description of command

This command defines the maximum input level. The value range depends on the RF input used and the external attenuation set (see `[SENSe:]CORRection:LOSS:INPut<nr>[:MAGNitude]` command). If option R&S CMU-U99 *(RF 1 with RF 2 Level Range)* is fitted, RF 1 takes on the level range of RF2.

[SENSe:]LEVel:ATTenuation <*Mode*>				Attenuation
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
NORMal | **LNOise |** **LDIStortion**	Mixer level in normal range Low noise (mixer level 10 dB higher than in normal setting) Low distortion (mixer level 10 dB lower than in normal setting)	LNOise	–	V1.15
Description of command				
This command tunes the RF analyzer for normal setting, low noise level (full dynamic range), or low distortion (high intermodulation spacing).				

[SENSe:]LEVel:DEFault <*Enable*>				Default Settings
<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	All parameters are set to their default values All or some parameters differ from the default values	ON	–	V2.00
Description of command				
If used as a setting command with the parameter *ON* this command sets all parameters of the subsystem to their default values (the setting *OFF* causes an error message). If used as a query the command returns whether all parameters are set to their default values *(ON)* or not *(OFF)*.				

Subsystem TRIGger (Trigger Mode)

The subsystem *TRIGger* defines the trigger mode. It corresponds to the *Trigger* tab in the *Connection Control* menu.

TRIGger[:SEQuence]:SOURce <*Source*>				Trigger Source
<Source>	Description of parameters	Def. value	Def. unit	FW vers.
SIGNalling | **FRUN |** **RFPower |** **IFPower**	The measurement is triggered by the signalling unit The measurement is triggered by the TDMA timing (free-run mode) of the analyzed signal Wideband RF power trigger Narrow-band IF power trigger	SIGN	–	V1.15
Description of command				
This command defines the source for the trigger event. The settings *RFPower* and *IFPower* require burst signals. The setting *FRUN* requires burst signals with incorporated training sequence.				

TRIGger[:SEQuence]:THReshold:RFPower <*Threshold*>				Level – RF Power
<Threshold>	Parameter description	Def. value	Default unit	FW vers.
LOW | **MEDium |** **HIGH**	Low trigger threshold *(RF Max. Level* – 26 dB) Medium trigger threshold *(RF Max. Level* – 16 dB) High trigger threshold *(RF Max. Level* – 6 dB)	MEDium	–	V3.10
Command description				
This command sets the RF input signal level at which the measurement is triggered relative to the maximum RF input level; see `[SENSe:]LEVel:MAXimum`. The setting has effect for trigger source `RFPower` only (see `TRIG:SEQ:SOUR`).				

TRIGger[:SEQuence]:THReshold:IFPower <*Threshold*>				Level – IF Power
<Threshold>	Parameter description	Def. value	Default unit	FW vers.
–47 dB to 0 dB	IF power threshold	–26	dB	V3.10

Command description

This command sets the IF signal level at which the measurement is triggered. The IF power threshold is defined relative to the maximum RF input level; see `[SENSe:]LEVel:MAXimum`. The setting has effect for trigger source `IFPower` only (see `TRIG:SEQ:SOUR`).

TRIGger[:SEQuence]:SLOPe <*Slope*>				Slope
<Slope>	Parameter description	Def. value	Default unit	FW vers.
POSitive | **NEGative**	Rising edge Falling edge	POS	–	V3.10

Command description

This command qualifies whether the trigger event occurs on the *Rising Edge* or on the *Falling Edge* of the trigger signal. The setting has no influence on *Free Run* measurements (see `TRIG:SEQ:SOUR`).

TRIGger:OUTPut:PIN<nr>:SIGNal <*Signal*>				Output Trigger Signal
<Signal>	Parameter description	Def. value	Default unit	FW vers.
NONE | **FCL |** **HOPP** **CAMS** **CAOS** **M026 | M052 | M104**	No trigger signal at pin <nr> Frame clock Hopping trigger Ctrl. Acks (Main Slot) Ctrl. Acks (Other Slots) 26 / 52 / 104 Multiframe	FCL (for <nr> = 2, 3), HOPP (for <nr> = 4), NONE (for <nr> = 5)	–	V3.10 V3.60 V3.80

Command description

This command assigns one of the output trigger signals (or no signal) to pins 2 to 5 (<nr> = 2 to 5) of the AUX 3 connector. The settings are only valid for *Signalling* trigger source (command `TRIGger[:SEQuence]:SOURce SIGNalling`).

TRIGger:OUTPut:PIN<nr>:DELay:ENABle <*Enable*>				Output Trigger Signal
<Enable>	Parameter description	Def. value	Default unit	FW vers.
ON | OFF	Enable/disable delay at pin <nr>	OFF (for <nr> = 2, 4, 5) ON (for <nr> = 3)	–	V3.10

Command description

This command qualifies whether the frame trigger signal at pins 2 to 5 (<nr> = 2 to 5) of the AUX 3 connector is delayed by the specified delay time (see command `TRIGger:OUTPut:DELay:VALue` below). The settings are only valid if a trigger signal is actually applied to the pins (command `TRIGger:OUTPut:PIN:SIGNal`).

TRIGger:OUTPut:DELay:VALue <*Slots*>				Delay
<Slots>	Parameter description	Def. value	Default unit	FW vers.
0 to 7	Delay time for frame trigger signal	2	(slots)	V3.10

Command description

This command sets a delay time (integer number of slots) for the trigger signal. 0 slots is equivalent to the *OFF* setting in the `TRIGger:OUTPut:PIN:DELay:ENABle` command.

TRIGger[:SEQuence]:DEFault <*Enable*>				Trigger Default Settings
<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	All parameters are set to their default values All or some parameters differ from the default values	ON	–	V2.00
Description of command				
If used as a setting command with the parameter *ON* this command sets all parameters of the subsystem to their default values (the setting *OFF* causes an error message). If used as a query the command returns whether all parameters are set to their default values *(ON)* or not *(OFF)*.				

Subsystem SIGNalling (Connection Setup and Cleardown)

The subsystem *SIGNalling* controls the connection setup and cleardown from the CMU to the mobile and determines the signalling parameters. Together with the subsystem *WPOWer* it corresponds to the different *Signalling* tabs (for different signalling states, see command `PROCedure:SIGNalling[:CSWitched]:ACTion`) in the popup menu *Connect. Control*.

PROCedure:SIGNalling[:CSWitched]:ACTion <*Action*>				Signalling Control
<Action>	Description of parameters	Def. value	Def. unit	FW vers.
SOFF | **SON |** **MTC |** **SMS |** **CRELease |** **HANDover**	Switch off BCCH signal *(signal off)* Switch on BCCH signal *(signal on)* Mobile terminating call Short message service Call release Dual-band GSM or GSM to WCDMA FDD inter cell handover (to target network defined via `CONFigure:HANDover:TARGet`)	–	–	V1.15
Description of command				Sig. State
This command has no query form. It changes between the different signalling states of the CMU. The current state can be queried via `SIGN:STAT?`				See below

Important Note: ***Signalling States and Local to Remote Switchover***

The default signalling state of the CMU in remote control is SOFF (see Fig. 6-1 below). This state is automatically reached on switchover from manual to remote control; an existing connection to the MS under test is dropped.

To suspend this default behavior of the CMU, the base system command `SYSTem:GTRM:COMP` has been introduced. `SYSTem:GTRM:COMP OFF` prevents the instrument from changing the signalling state local to remote switchover. In particular, an existing connection is maintained. The default behavior of the CMU is restored each time the instrument is rebooted. For more information see the documentation of the base system commands in the CMU manual.

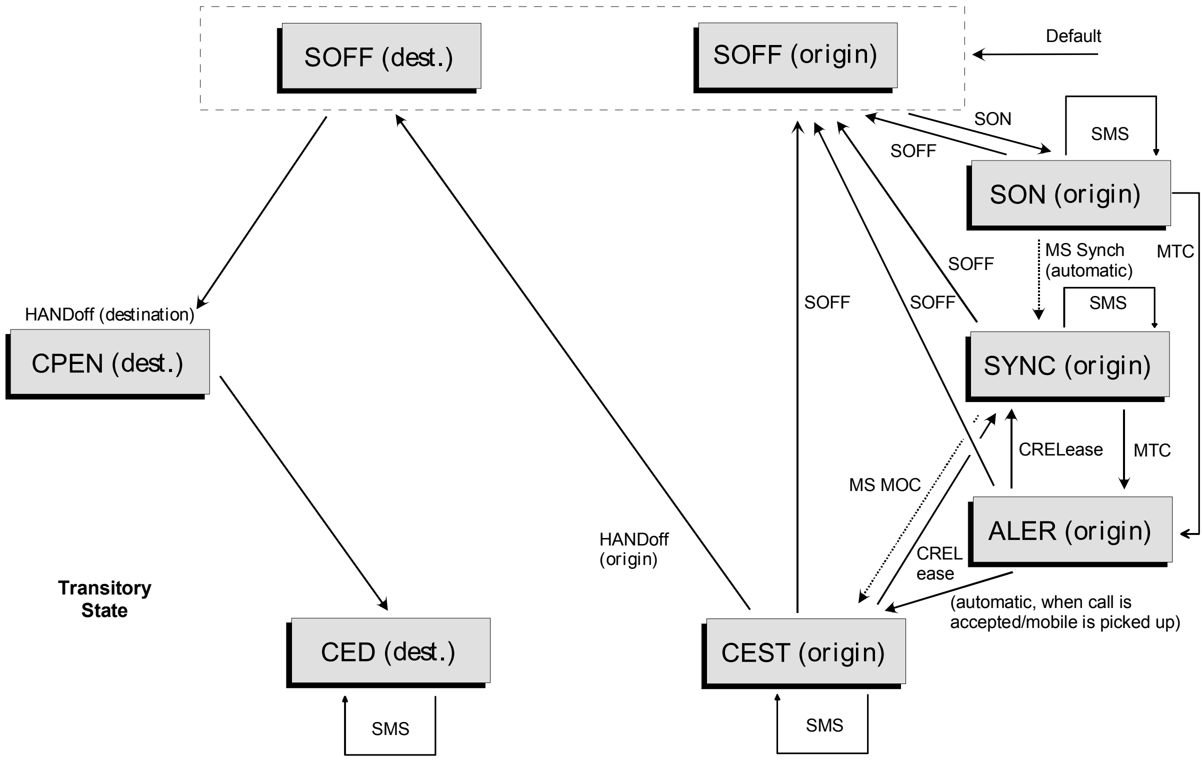


Fig. 6-1 Signalling states of the CMU and transitions including handover

Signalling states:

SOFF	signal off	CEST	call established
SON	signal on	CPEN	call pending
SYNC	synchronized	CED	call established dual band
ALER	alerting		

Actions:	*initiated from the CMU:*	*initiated from the mobile phone:*	
	See description of command	MS Synch	Synchronization of mobile phone
		MS MOC	Mobile originated call

Further transitions between the signalling states (not shown in Fig. 6-1) may occur, e.g. in case of errors (see chapter 4 of this manual).

[SENSe:]SIGNalling[:CSWitched]:STATe?				Signalling State
Return	Description of parameters	Def. value	Def. unit	FW vers.
SOFF | **SON |** **SYNC |** **ALER |** **CEST |** **CPEN |** **CED**	Signal for synchronization switched off *(signal off)* Signal for synchronization switched on *(signal on)* Synchronization of CMU and mobile phone and location update established *(synchronized)* Mobile is ringing *(Alerting)* Call to mobile set up *(call established)* Call pending Call established dual band (or GSM to WCDMA inter cell) handover	SOFF	–	V1.15
Description of command				Sig. State
This command is always a query. It returns the current signalling state.				all

PROCedure:SIGNalling[:CSWitched]:DAI <*Interface*> — DAI Acoustic Dev.

<Interface>	Description of parameters	Def. value	Def. unit	FW vers.
NORMal |	Default setting active during call setup	NORM	–	V3.0
DECoder |	Test of speech decoder / DTX functions (downlink)			
ENCoder |	Test of speech encoder / DTX functions (uplink)			
ADEVice	Test of acoustic devices and A/D & D/A			

Description of command	Sig. State
This command determines the routing of the speech data and which device is being tested.	CEST

[SENSe:]SIGNalling[:CSWitched]:SMS? — Short Message Service Text

Return	Description of parameters	Def. value	Def. unit	FW vers.
"<String>"	Short message received	""	–	V2.0

Description of command	Sig. State
This command is always a query. It reads the short message received.	all

CONFigure:SIGNalling[:CSWitched]:SMS <*Text*> — Short Message Service Text

<Text>	Description of parameters	Def. value	Def. unit	FW vers.
"<String>"	Short message to be sent	"Rohde & Schwarz Short Message Service Text"	–	V2.0

Description of command	Sig. State
This command defines a short message in the form of any alphanumeric string with a maximum of 160 characters.	all

PROCedure:SIGNalling[:CSWitched][:TCH]:CHANnel <*Number*> — Traffic Channel

<Number>	Description of parameters	Def. value	Def. unit	FW vers.
259 to 293 | 306 to 340	Number of traffic channel, GSM400	275	–	V1.15
350 to 425	Number of traffic channel, GSM GT800	392	–	
128 to 251	Number of traffic channel, GSM850	192	–	
0 to 124 | 955 to 1023	Number of traffic channel, GSM900	62	–	
512 to 885	Number of traffic channel, GSM1800	740	–	
512 to 810	Number of traffic channel, GSM1900	610		

Description of command	Sig. State
This command changes the traffic channel number (and thus the frequency) for signals of the CMU while a connection is established.	CEST

PROCedure:SIGNalling[:TCH]:TADVance <*Bit* > — Timing Advance

<Bit>	Description of parameters	Def. value	Def. unit	FW vers.
0 bit to 63 bit	Timing advance for GSM GT800/850/900/1800/1900	0	bit	V3.05
0 bit to 219 bit	Timing advance for GSM400	0	bit	

Description of command	Sig. State
This command changes the mobile's timing while a connection is established. NOTE *This setting is valid for both circuit switched and packet data connections.*	CEST, TEST

				Combined Channel/TS/PCL Change
PROCedure:SIGNalling[:CSWitched][:TCH][:SSLot]:CHCCombined <ChannelNumber>, <Timeslot>, <PCL>				
<ChannelNumber>	Description of parameters	Def. value	Def. unit	
259 to 293 | 306 to 340	Number of traffic channel, GSM400	275	–	
350 to 425	Number of traffic channel, GSM GT800	392	–	
128 to 251	Number of traffic channel, GSM850	192	–	
0 to 124 | 955 to 1023	Number of traffic channel, GSM900	62	–	
512 to 885	Number of traffic channel, GSM1800	740	–	
512 to 810	Number of traffic channel, GSM1900	610		
<Timeslot>>	Description of parameters	Def. value	Def. unit	
2 to 6 |	Number of timeslot with BATC setting	3	–	
0 to 7	Number of timeslot with BOTC setting			
<PCL>	Description of parameters	Def. value	Def. unit	FW vers.
	Power of mobile phone in PCL units,			
5 to 19	GSM400/GT800/850/900	15	PCL	–
0 to 31	GSM1800	10	PCL	–
0 to 31	GSM1900	10	PCL	V1.15
Description of command				Sig. State
This command controls the combined channel change, the number of the traffic channel for signals of the CMU, the timeslot for this channel and the mobile power level being changed at the same time. Thus, the command combines the three commands `PROCedure:SIGNalling[:CSWitched][:TCH]:CHANnel <Number>`, `PROCedure:SIGNalling[:CSWitched][:TCH][:SSLot]:TIMeslot <Timeslot>`, and `PROCedure:SIGNalling[:CSWitched]:MS:PCL <PCL>` (see below). All GSM timeslots are available if the control channel mode is set to BOTC (see command *CONFigure:BSSignal:CCH[:TX]:MODE* on p. 6.212). The GSM PCL levels are listed in chapter 4 (see list of tables or index).				CEST

PROCedure:SIGNalling[:CSWitched][:TCH][:SSLot]:FHOPping:SEQuence *<Sequence>*				Hopping
<Sequence>	Description of parameters	Def. value	Def. unit	FW vers.
A | B | C | D |	Select hopping sequence	OFF	–	V3.05
OFF	Switch off frequency hopping			
Description of command				Sig. State
This command selects one out of the four possible hopping sequences for the traffic channel or switches frequency hopping off. The hopping sequences are defined via *CONFigure:BSSignal[:CSWitched][:TCH][:SSLot]:FHOPping*; see p. 6.214.				CEST

PROCedure:SIGNalling[:CSWitched][:TCH][:SSLot]:TIMeslot *<Timeslot>*				Timeslot
<Timeslot>	Description of parameters	Def. value	Def. unit	FW vers.
2 to 6 |	Number of timeslot with BATC setting	3	–	V1.15
0 to 7	Number of timeslot with BOTC setting			
Description of command				Sig. State
This command changes the traffic channel timeslot while a connection is established. All GSM timeslots are available if the control channel mode is set to BOTC (see command *CONFigure:BSSignal:CCH[:TX]:MODE* on p. 6.212).				CEST

PROCedure:SIGNalling[:CSWitched][:TCH][:SSLot]:MS:PCL *<PCL>*				PCL
<PCL>	Description of parameters	Def. value	Def. unit	FW vers.
	Power of mobile phone in PCL units,			
0 to 19	GSM400/GT800/850/900	15	PCL	–
0 to 31	GSM1800	10	PCL	–
0 to 31	GSM1900	10	PCL	V1.15
Description of command				Sig. State
This command commands the mobile phone to change its power control level while a connection is established. The range depends on the GSM phase of the mobile (see chapter 4).				CEST Q: all

PROCedure:SIGNalling[:CSWitched][:TCH]:MSLot:SCONfig ***<Main_Slot>, <DL_Enable_0>,..., <DL_Enable_7>, <DL_Power_0>, ..., <DL_Power_7> <UL_Enable_0>,..., <UL_Enable_7>, <UL_PCL_0>, ..., <UL_PCL_7>,<Main_TS>***				Slot Configuration: Uplink/Downlink
<Main_Slot>	Description of parameters	Def. value	Def. unit	FW vers.
0 to 7	Main timeslot, used for signalling	3	–	V3.40
<DL_Enable_n>	Description of parameters	Def. value	Def. unit	FW vers.
ON | OFF	Enable or disable timeslot no. n	ON (slots 3 and 4) OFF (other slots)	–	V3.10
<DL_Power_n>	Description of parameters	Def. value	Def. unit	
–127.0 dB to +127.0 dB	Individual BS level in timeslot no. n:	0.0 (all active DL slots)	dB	
<UL_Enable_n>	Description of parameters	Def. value	Def. unit	
ON | OFF	Enable or disable timeslot no. n	ON (slot 3) OFF (other slots)	–	
<UL_PCL_n>	Description of parameters	Def. value	Def. unit	Sig. State
	MS level in timeslot no. n:			
0 to 19	GSM400/GT800/850/900	15 (slot 3)	PCL	CEST
0 to 31	GSM1800/1900	15 (slot 3)	PCL	
Description of command				

This command changes the main timeslot and the levels in all active or inactive timeslots slots of the BS and MS signal (current values) for the *Individual* level mode (see *Slot Configuration Editor* in manual control and command *CONFigure:BSSignal[:CSWitched][:TCH]:MSLot:LMODe* on p. 6.216). This command overwrites the main timeslot defined via *CONFigure:BSSignal[:CSWitched][:TCH]:MSLot:MTIMeslot* (see p. 6.216).

For the DL signal all GSM timeslots are available if the control channel mode is set to BOTC (see command *CONFigure:BSSignal:CCH[:TX]:MODE* on p. 6.212). Their levels are set individually relative to the *Reference Level* set via *PROCedure:BSSignal[:CSWitched][:TCH]:MSLot:RLEVel* (see p. 6.215). The DL level range quoted above is restricted by the condition that the absolute level (calculated from the reference level and the relative individual levels) must not exceed the level ranges of the RF connectors.

Example: With output connector RF2 and a reference level of –85 dBm, the individual DL timeslot levels can be set in the range –52 dB to +75 dB, corresponding to an absolute level of –137 dBm to –10 dBm.

The UL signal settings must be compatible with the capabilities of the MS under test (multislot class, power class).

PROCedure:SIGNalling[:CSWitched][:TCH][:SSLot]:LOOP ***<Loop>*** **PROCedure:SIGNalling[:CSWitched][:TCH]:MSLot:LOOP** ***<Loop>***				Loop
<Loop>	Description of parameters	Def. value	Def. unit	FW vers.
OFF | **A |** **B |** **C |** **G |** **H |** **I**	No test loop set TCH loop including signalling of erased frames Speech TCH loop without signalling of erased frames TCH burst-by-burst loop Multi-slot TCH burst-by-burst loop Multi-slot TCH loop including signalling of erased frames TCH loop without signalling of erased frames for in-band channel error rate	A (single slot) H (multi-slot)	–	V3.10
Description of command				Sig. State
This command sets the loop type for all but `RXQuality` tests. Test loops A, B, and C, and I are single-slot loops, test loops G and H are multislot loops.				CEST, Q: all

Subsystem HANDover

The subsystem *HANDover* sets the target for a forced handover of the mobile phone. The corresponding softkeys are located in the *Handover* tab in the popup menu *Connect. Control*.

STATus:HANDover:TARGet:LIST?				Destination List
Response	Description of parameters	Def. value	Def. unit	FW vers.
"GSM400MSDualBand", **"GSMGT800MSDualBand",** **"GSM850MSDualBand",** **"GSM900MsDualBand",** **"GSM1800MSDualBand",** **"GSM1900MSDualBand"**	Target list (4 entries at maximum): All installed and enabled GSM networks except the current network	– – – – –	– – – – –	V2.00 V3.01 (ext.)
"WCDMA1900UEFDDInterCell"	WCDMA FDD Inter Cell			C3.60
Description of command				Sig. State
This command is always a query and returns a list of all networks that are available for a handover. The list depends on the software configuration and on the current network.				all

CONFigure:HANDover:TARGet <*Target*>				Destination Selection
<Target>	Description of parameters	Def. value	Def. unit	FW vers.
"GSM400MSDualBand" | **"GSMGT800MSDualBand" |** **"GSM850MSDualBand" |** **"GSM900MSDualBand" |** **"GSM1800MSDualBand" |** **"GSM1900MSDualBand"**	Possible target networks All installed and enabled GSM networks except the current network	see below	–	V2.00 V3.01 (ext.)
"WCDMA1900UEFDDInterCell"	WCDMA FDD Inter Cell			C3.60
NONE	No handover			
Description of command				Sig. State
This command selects a handover target. The available targets comprise all installed and enabled GSM networks except the current network. The handover itself is started via the `PROCedure:SIGNalling[:CSWitched]:ACTion HANDover` command. If GSM400, GSM GT800, GSM850, GSM1800, or GSM1900 is the current network and GSM900 is enabled, GSM900 is used as a default target. If GSM900 is the current network and GSM1800 is enabled, GSM1800 is the default target. Otherwise the default target is set to *NONE.*				all

CONFigure:HANDover:ALERting <*Mode*>				Alerting (WCMA to GSM handover)
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
NONE | **WGSM**	No alerting Alerting with GSM setup message	NONE	–	3.50
Description of command				Sig. State
This command qualifies whether or not alerting is initiated at the mobile so that it starts ringing before the GSM connection is established. It is generally used in a GSM prepare session before a handover from WCDMA to GSM. The setting has no effect for GSM measurements.				all

CONFigure:HANDover:CSYNc <*Mode*>		Cell Synchronization (WCMA to GSM handover)		
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
FSYN **NSYN**	Finely synchronized cell case Non synchronized cell case	FSYN	–	3.50
Description of command				Sig. State
This command selects the procedure for physical channel establishment in a WCDMA to GSM handover. It is generally used in a GSM prepare session before the handover from WCDMA to GSM is initiated. The setting has no effect for GSM measurements.				all

Subsystem MCONtrol (Measured Slots)

The subsystem *MCONtrol* defines the measured timeslots in MS multislot mode. It corresponds to the *Meas. Control* section in the *Analyzer* tab of the *Connection Control* menu.

CONFigure:MCONtrol:MSLot:MESLot <*Slot_No*>				Meas. Slot
<Slot_No>	Description of parameters	Def. value	Def. unit	FW vers.
0 to 7	Traffic channel timeslot number	3	–	V3.10
Description of command				Sig. State
This command defines the measured timeslot of the MS signal. ***Note:*** *To ensure that the CMU generally measures an occupied timeslot, the Meas. Slot. is set equal to the main timeslot upon a reset or whenever a connection is set up. In the CEST and TEST states, the main timeslot and Meas. Slot can be changed independently. In a dual-band handover, the slot configuration of the target network is activated so that the Meas. Slot is set equal to the main timeslot of the target network.*				≠CEST, Q: all

MCONTrol:DEFault <*Enable*>				Default Settings
<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	All parameters are set to their default values All or some parameters differ from the default values	ON	–	V3.10
Description of command				
If used as a setting command with the parameter *ON* this command sets all parameters of the subsystem to their default values (the setting *OFF* causes an error message). If used as a query the command returns whether all parameters are set to their default values *(ON)* or not *(OFF)*.				

Subsystem MSSignal (Signal of Mobile Station)

The subsystem *MSSignal* configures the operating mode and the RF traffic channel signal of the MS under test. It corresponds to the tab *MS Signal* in the popup menu *Connect. Control*.

CONFigure:MSSignal:CCH:PMAX[1] *<Level>* PMAX

<Level>	Description of parameters	Def. value	Def. unit	FW vers.
	Maximum MS power in the cell,			
0 to 19	GSM400/GT800/850/900	5	PCL	–
0 to 31	GSM1800/GSM1900	0	PCL	V3.05

Description of command	Sig. State
This command defines the maximum MS transmitter output power allowed in the cell. The value corresponds to the output power at which the mobile station synchronizes to the network. It is valid both for circuit-switched and for packet data mode. An overview of power control levels (PCL) in GSM is given in chapter 4 (see table or index).	≠CEST ≠TEST, Q: all

The output power during a call can be set by means of the following commands:
CONFigure:MSSignal[:CSWitched][:TCH][:SSLot]:MS:PCL (circuit switched, single slot)
CONFigure:MSSignal[:CSWitched][:TCH]:MSLot:SCONfig (circuit switched, multislot)
CONFigure:MSSignal:PDATa[:TCH]:MSLot:SCONfig (packet data, single slot)

CONFigure:MSSignal[:CSWitched]:DTX *<Mode>* DTX

<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
ON |	Transmission with interruption not possible	OFF	–	V3.05
OFF	Transmission with interruption possible			

Description of command	Sig. State
This command permits the mobile to make use of the DTX mode *(discontinuous transmission mode)*. The status assumed by the mobile is to be determined using the command `[SENSe:]RREPorts:DTX?`. Only useful data are transferred in DTX mode; if nothing is spoken, the mobile will transmit nothing in the traffic frames.	≠CEST, Q: all

CONFigure:MSSignal[:TCH]:TADVance *<Bit >* Timing Advance

<Bit>	Description of parameters	Def. value	Def. unit	FW vers.
0 bit to 63 bit	Timing advance for GSM850/GT800/900/1800/1900	0	bit	V3.05
0 bit to 219 bit	Timing advance for GSM400	0	bit	

Description of command	Sig. State
This command sets the default value for the mobile's timing. NOTE *This setting is valid for both circuit switched and packet data connections.*	≠CEST, ≠TEST Q: all

CONFigure:MSSignal[:CSWitched][:TCH][:SSLot]:MS:PCL *<Level>* PCL Level

<Level>	Description of parameters	Def. value	Def. unit	FW vers.
	Power of mobile phone in PCL units,			V3.05
0 to 19	GSM400/GT800/850/900	15	PCL	
0 to 31	GSM1800/1900	10	PCL	

Description of command	Sig. State
This command defines the mobile power level upon registration in the network. An overview of power control levels (PCL) in GSM is given in chapter 4 (see table or index).	≠CEST, Q: all

[1] In firmware versions <V3.05, this command is replaced by `CONFigure:NETWork[:MS]POWer`. This command sets the maximum MS transmitter power and the MS transmitter power during a call to the same value. It is still available for compatibility reasons.

CONFigure:MSSignal[:CSWitched][:TCH]:MSLot:SCONfig ***<Enable_0>,<Enable_1>, ..., <Enable_7>, <PCL_0>, ..., <PCL_7>***				Slot Configuration: Uplink
<Enable_n>	Description of parameters	Def. value	Def. unit	
ON | OFF	Enable or disable timeslot no. n	see below	–	
<PCL_n>	Description of parameters	Def. value	Def. unit	FW vers.
	Power of mobile phone in timeslot no. n:			V3.05
0 to 19	GSM400/GT800/850/900	15	PCL	
0 to 31	GSM1800/1900	10	PCL	
Description of command				Sig. State
This command defines the active timeslots slots of the MS signal and the transmitter output power that the MS will use in all active slots (default values). In the default setting, only slot 3 is enabled. Slot no. 3 is also the main timeslot; see *CONFigure:BSSignal[:CSWitched][:TCH]:MSLot:MTIMeslot* command on p. 6.216.				≠CEST, Q: all

CONFigure:MSSignal[:CSWitched][:TCH][:SSLot]:LOOP *<Loop>* **CONFigure:MSSignal[:CSWitched][:TCH]:MSLot:LOOP *<Loop>***				Loop
<Loop>	Description of parameters	Def. value	Def. unit	FW vers.
OFF | **A |** **B |** **C |** **G |** **H |** **I**	No test loop set TCH loop including signalling of erased frames Speech TCH loop without signalling of erased frames TCH burst-by-burst loop Multi-slot TCH burst-by-burst loop Multi-slot TCH loop including signalling of erased frames TCH loop without signalling of erased frames for in-band channel error rate	A (single slot) H (multi-slot)	–	V3.10
Description of command				Sig. State
This command sets the loop type for all but `RXQuality` tests. Test loops A, B, and C, and I are single-slot loops, test loops G and H are multislot loops.				≠CEST, Q: all

Subsystem BSSignal (Signal of Base Station/CMU)

The subsystem *BSSignal* configures the operating mode and the RF control and traffic channels that the CMU transmits to communicate with the MS under test. It corresponds to the tab *BS Signal* in the popup menu *Connect. Control*.

CONFigure:BSSignal:FM:DEViation <*FrequencyOffset*> **PROCedure:BSSignal:FM:DEViation <*FrequencyOffset*>**				Frequency Offset
<FrequencyOffset>	Description of parameters	Def. value	Def. unit	FW vers.
–100 kHz to +100 kHz	Frequency offset	0.0	Hz	V1.15
Description of command				Sig. State
This command determines a frequency offset for the CMU signals (CCH and TCH). The PROCedure... command is available for firmware versions ≥V3.10. See note on *Current vs. default values* on p. 6.199.				all

PROCedure:BSSignal:FM:DEViation:RANDom:ENABle <*Enable*>				Random Frequency Offset
<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | OFF	Enable or disable random freq. offset	OFF	–	V3.40
Description of command				Sig. State
This command switches the random frequency on or off. The ON setting causes the (static) frequency offset set via `CONFigure:BSSignal:FM:DEViation` to randomly change its sign after each frame. The random frequency offset is automatically switched off each time that the connection is released.				CEST, TEST

CONFigure:BSSignal:CCH[:TX]:MODE <*Mode*>				BCCH – Mode
<CCHChannel>	Description of parameters	Def. value	Def. unit	FW vers.
BATC **BOTC**	BCCH and TCH BCCH or TCH	BATC	–	V3.05
Description of command				Sig. State
This command determines the BS signal configuration in the CEST state. In the BOTC setting the BCCH is switched off as soon as CEST is reached so that all 8 timeslots are available for the traffic channel (see command *CONFigure:BSSignal[:CSWitched][:TCH][:SSLot]:TIMeslot* on p. 6.214).				≠CEST, Q: all

CONFigure:BSSignal:CCH[:TX]:CHANnel <*CCHChannel*>				BCCH – RF Channel
<CCHChannel>	Description of parameters	Def. value	Def. unit	FW vers.
259 to 293 | 306 to 340	Number of control channel, GSM400	270	–	V1.15
350 to 425	Number of control channel, GSM GT800	362	–	
128 to 251	Number of control channel, GSM850	162	–	
0 to 124 | 955 to 1023	Number of control channel, GSM900	32	–	
512 to 885	Number of control channel, GSM1800	735	–	
512 to 810	Number of control channel, GSM1900	600	–	
Description of command				Sig. State
This command determines the control channel for the CMU signals (BCCH).				SON, SOFF

CONFigure:BSSignal:CCH[:TX]:LEVel[:ABSolute] *<Level>* — BCCH Level

<Level>	Description of parameters	Def. value	Def. unit	FW vers.
–137 dBm to –27 dBm	Absol. level of control channel, RF1	–85	dBm	V1.15
–137 dBm to –10 dBm	Absol. level of control channel, RF2	–85	dBm	
–90 dBm to +13 dBm	Absol. level of control channel, RF3 OUT	–85	dBm	

Description of command	Sig. State
This command determines the level of the control channel in absolute units.	all

Note: *In firmware versions <V3.10 the BCCH level can not be changed in the CEST state.*

After a handover the BCCH level of the origin network is maintained (indication "from other network" in the BS Signal tab of the Connection Control menu), however, the query `CONFigure:BSSignal:CCH[:TX]:LEVel[:ABSolute]?` *will return the default value of the target network, which may differ from the actual BCCH level.*

Changing the BCCH level after a handover (i.e. in the CEST state of the target network) is not allowed and will cause an error message –200, "Execution error".

If option R&S CMU-U99 (RF 1 with RF 2 Level Range) *is fitted, RF 1 takes on the level range of RF2.*

CONFigure:BSSignal[:CSWitched][:TCH]:CHANnel *<TCHChannel>* — Traffic Channel

<TCHChannel>	Description of parameters	Def. value	Def. unit	FW vers.
259 to 293 | 306 to 340	Number of traffic channel, GSM400	275	–	V1.15
350 to 425	Number of traffic channel, GSM GT800	392	–	
128 to 251	Number of traffic channel, GSM850	192	–	
0 to 124 | 955 to 1023	Number of traffic channel, GSM900	62	–	
512 to 885	Number of traffic channel, GSM1800	740	–	
512 to 810	Number of traffic channel, GSM1900	610	–	

Description of command	Sig. State
This command determines the number of the traffic channel.	≠CEST, Q: all

CONFigure:BSSignal[:CSWitched][:TCH]:LEVel:UTIMeslot *<Level>*
PROCedure:BSSignal[:CSWitched][:TCH]:LEVel:UTIMeslot *<Level>* — Used Timeslot Level

<Level>	Description of parameters	Def. value	Def. unit	FW vers.
–137 dBm to –27 dBm	RF1 level in used timeslot	–90	dBm	V1.15
–137 dBm to –10 dBm	RF2 level in used timeslot	–90	dBm	
–90 dBm to +13 dBm	RF3 OUT level in used timeslot	–90	dBm	

Description of command	Sig. State
This command determines the absolute level in the used timeslot. The value range depends on the RF output of the CMU used. See note on *Current vs. default values* on p. 6.199. If option R&S CMU-U99 *(RF 1 with RF 2 Level Range)* is fitted, RF 1 takes on the level range of RF2.	all

CONFigure:BSSignal[:CSWitched][:TCH]:LEVel:UNTimeslot *<Level>* **PROCedure:BSSignal[:CSWitched][:TCH]:LEVel:UNTimeslot *<Level>***				Unused Timeslot Level
<Level>	Description of parameters	Def. value	Def. unit	FW vers.
–127 dB to +127 dB	Level in unused timeslot	see below	dB	V1.15
Description of command				Sig. State
This command determines the (relative) level in the unused timeslots. The level range quoted above is restricted by the condition that the absolute level (calculated from the used timeslot level and the relative level in the unused timeslots) must not exceed the level ranges of the RF connectors. **Example:** With output connector RF2 and a default used timeslot level of –90 dBm, the unused timeslot level can be set in the range –47 dB to +80 dB, corresponding to an absolute level of –137 dBm to –10 dBm. See note on *Current vs. default values* on p. 6.199.				all

CONFigure:BSSignal[:CSWitched][:TCH][:SSLot]:TIMeslot *<Timeslot>*				Timeslot
<Timeslot>	Description of parameters	Def. value	Def. unit	FW vers.
2 to 6 | **0 to 7**	Number of timeslot with BATC setting Number of timeslot with BOTC setting	3	–	V1.15
Description of command				Sig. State
This command determines the timeslot for the BS traffic channel. All GSM timeslots are available if the control channel mode is set to BOTC (see command *CONFigure:BSSignal:CCH[:TX]:MODE* on p. 6.212).				≠CEST, Q: all

CONFigure:BSSignal[:CSWitched][:TCH][:SSLot]:FHOPping:A *<Channel>{,<Channel>}* **CONFigure:BSSignal[:CSWitched][:TCH][:SSLot]:FHOPping:B *<Channel>{,<Channel>}*** **CONFigure:BSSignal[:CSWitched][:TCH][:SSLot]:FHOPping:C *<Channel>{,<Channel>}*** **CONFigure:BSSignal[:CSWitched][:TCH][:SSLot]:FHOPping:D *<Channel>{,<Channel>}***				Edit Hopping Sequence
<Channel>	Description of parameters	Def. value	Def. unit	FW vers.
0 to 124, **955 to 1023 |** **OFF**	Sequence of up to 64 GSM channels, depending on the GSM band used (example: GSM900), undefined channel number	see below	–	1.20
Description of command				Sig. State
These commands define hopping sequences that overwrite the four hopping sequences A to D quoted below. The sequence may consist of up to 64 arbitrary GSM channel numbers; however, a query returns each hopping sequence in ascending order. Undefined channels are set to *OFF*. The current hopping sequence can be changed during the connection, see command *PROCedure:SIGNalling[:CSWitched][:TCH][:SSLot]:FHOPping:SEQuence* on p. 6.205. For GSM400, the following four default sequences are available:				≠CEST, Q: all

Sequence A:	260, 262, 265, 267, 269, 272, 274, 278, 280, 282, 285, 287, 290, 292, OFF, ... OFF
Sequence B:	159, 276, 293, OFF,...OFF
Sequence C:	307, 309, 312, 314, 316, 319, 321, 325, 327, 329, 332, 334, 337, 339, OFF, ... OFF
Sequence D:	306, 323, 340, OFF, ... OFF

For GSM GT800, the following four default sequences are available:	
Sequence A:	350, 352, 355, 357, 360, 362, 365, 367, 370, 372, 375, 377, 380, 382, 385, 387, 390, 392, 395, 397, 400, 402, 405, 407, 410, 412, 415, 417, 420, 422, 425, OFF, ... OFF
Sequence B:	350, 352, 355, 357, 360, 362, 365, 367, 370, 372, 400, 402, 405, 407, 410, 412, OFF, ... OFF
Sequence C:	390, 392, 395, 397, 400, 402, 405, 407, 410, 412, 415, 417, 419, 421, 423, 425, OFF, ... OFF
Sequence D:	350, 388, 425, OFF, ... OFF
For GSM850, the following four default sequences are available:	
Sequence A:	130, 134, 138, 143, 145, 149, 153, 157, 163, 167, 171, 176, 181, 185, 189, 193, 198, 202, 205, 209, 211, 215, 217, 219, 221, 227, 231, 234, 238, 242, 246, 250, OFF, ... OFF
Sequence B:	132, 135, 139, 142, 144, 148, 151, 156, 161, 164, 166, 173, 177, 179, 182, 186, OFF,...OFF
Sequence C:	195, 203, 206, 210, 213, 216, 220, 223, 226, 229, 232, 235, 239, 243, 245, 249, OFF, ... OFF
Sequence D:	128, 190, 251, OFF, ... OFF
For GSM900, the following four default sequences are available:	
Sequence A:	5, 9, 16, 23, 28, 30, 34, 39, 44, 48, 51, 54, 59, 64, 69, 73, 75, 79, 82, 86, 89, 92, 96, 98, 101, 106, 109, 113, 117, 121, OFF, ... OFF
Sequence B:	4, 12, 17, 19, 23, 25, 29, 33, 36, 41, 45, 47, 53, 61, 63, OFF,...OFF
Sequence C:	65, 68, 72, 76, 79, 81, 84, 88, 91, 93, 98, 102, 105, 112, 118, OFF, ... OFF
Sequence D:	1, 62, 124, OFF, ... OFF
For GSM1800, the following four default sequences are available:	
Sequence A:	533, 559, 568, 592, 604, 617, 631, 642, 678, 697, 722, 743, 759, 796, 811, 824, OFF, ... OFF
Sequence B:	513, 518, 527, 533, 541, 545, 553, 562, 570, 577, 585, 597, OFF,...OFF
Sequence C:	755, 761, 773, 777, 788, 796, 801, 807, 816, 824, 829, 833, 847 OFF, ... OFF
Sequence D:	512, 698, 885, OFF, ... OFF
For GSM1900, the following four default sequences are available:	
Sequence A:	533, 559, 568, 592, 604, 617, 631, 642, 678, 697, 722, 743, 759, 796, OFF, ... OFF
Sequence B:	513, 518, 527, 533, 541, 545, 553, 562, 570, 577, 585, 597, OFF,...OFF
Sequence C:	755, 761, 773, 777, 788, 796, 801, 807, OFF, ... OFF
Sequence D:	512, 660, 810, OFF, ... OFF

CONFigure:BSSignal[:CSWitched][:TCH]:MSLot:RLEVel <*Level*> Reference Level
PROCedure:BSSignal[:CSWitched][:TCH]:MSLot:RLEVel <*Level*>

<Level>	Description of parameters	Def. value	Def. unit	FW vers.
–137 dBm to –27 dBm	RF1 level in used timeslot	–85	dBm	V3.05
–137 dBm to –10 dBm	RF2 level in used timeslot	–85	dBm	
–90 dBm to +13 dBm	RF3 OUT level in used timeslot	–85	dBm	

Description of command	Sig. State
This command defines the reference value for the individual downlink (BS) signal levels. See command *PROCedure:SIGNalling[:CSWitched][:TCH]:MSLot:BS:SCONfig:INDividual* on p. 6.206. See also note on *Current vs. default values* on p. 6.199. If option R&S CMU-U99 *(RF 1 with RF 2 Level Range)* is fitted, RF 1 takes on the level range of RF2.	all

CONFigure:BSSignal[:CSWitched][:TCH]:MSLot:MTIMeslot *<Slot_No>*				Main Timeslot
<Slot_No>	Description of parameters	Def. value	Def. unit	FW vers.
0 to 7	Main timeslot, used for signalling	3	–	V3.05
Description of command				Sig. State
This command defines the timeslot that the MS and the BS/CMU use for signalling (default value). Changing the main timeslot also overwrites the *Meas. Slot* (command `CONFigure:MCONtrol:MSLot:MESLot`). If used in the CEST state, this command overwrites the main timeslot set via *`PROCedure:SIGNalling[:CSWitched][:TCH]:MSLot:SCONfig`* (see p. 6.206).				all

CONFigure:BSSignal[:CSWitched][:TCH]:MSLot:LMODe *<Mode>*				Level Mode
<Slot_No>	Description of parameters	Def. value	Def. unit	FW vers.
UUN | **IND**	Used timeslot and unused timeslot levels Individual timeslot levels	UUN	–	V3.05
Description of command				Sig. State
This command determines whether the CMU uses the used/unused timeslot level scheme (two different levels) or individual levels in all timeslots.				≠CEST, Q: all

CONFigure:BSSignal[:CSWitched][:TCH]:MSLot:SCONfig:UUNused *<Enable_0>,<Enable_1>, ..., <Enable_7>*				Slot Configuration: Used/Unused
<Enable_n>	Description of parameters	Def. value	Def. unit	FW vers.
ON | OFF	Enable or disable timeslot no. n	see below	–	V3.05
Description of command				Sig. State
This command defines the active timeslots slots of the BS signal (default values) and implicitly defines the levels for the *Used/Unused* level mode (see command *CONFigure:BSSignal[:CSWitched][:TCH]:MSLot:LMODe* on p. 6.216). • The level in all enabled timeslots is given by the *Used Timeslot Level* defined via *CONFigure:BSSignal[:CSWitched][:TCH]:LEVel:UNTimeslot* (see p. 6.214). • The level in all disabled timeslots is given by the *Unused Timeslot Level* def. via *CONFigure:BSSignal[:CSWitched][:TCH]:LEVel:UTIMeslot* (see p. 6.213). In the default setting, timeslots 3 and 4 are enabled. By default, slot no. 3 is also the main timeslot; see command *CONFigure:BSSignal[:CSWitched][:TCH]:MSLot:MTIMeslot* on p. 6.216. **Note:** The <Enable_n> parameters also apply in individual level mode; they overwrite the parameters in the *CONFigure:BSSignal[:CSWitched][:TCH]:MSLot:SCONfig:INDividual command.*				≠CEST, Q: all

CONFigure:BSSignal[:CSWitched][:TCH]:MSLot:SCONfig:INDividual ***<Enable_0>,<Enable_1>, ..., <Enable_7>, <Level_0>, ..., <Level_7>***				Slot Configuration Individual
<Enable_n>	Description of parameters	Def. value	Def. unit	
ON | OFF	Enable or disable downlink timeslot no. n (the MS is instructed to listen to this TS)	see below	–	
<Level_n>	Description of parameters	Def. value	Def. unit	FW vers.
–127 dB to +127 dB	Power of CMU in timeslot no. n (the CMU actually transmits a signal in this TS)	see below	dB	V3.05
Description of command				Sig. State
This command defines the active timeslots slots of the BS signal (default values) and the levels for the *Individual* level mode (see command *CONFigure:BSSignal[:CSWitched][:TCH]:MSLot:LMODe* on p. 6.216). All 8 timeslots can be enabled and their levels can be set individually. They are defined relative to the *Reference Level* set via *CONFigure:BSSignal[:CSWitched][:TCH]:MSLot:RLEVel* (see p. 6.215). The level range quoted above is restricted by the condition that the absolute level (calculated from the reference level and the relative individual levels) must not exceed the level ranges of the RF connectors. **Example:** With output connector RF2 and a reference level of –85 dBm, the individual timeslot levels can be set in the range –52 dB to +75 dB, corresponding to an absolute level of –137 dBm to –10 dBm. In the default setting, slots 3 and 4 are enabled, both levels are 0 dB. By default, slot no. 3 is also the main timeslot; see *CONFigure:BSSignal[:CSWitched][:TCH]:MSLot:MTIMeslot* command on p. 6.216. ***Note 1:*** *The <Enable_n> parameters also apply in used/unused level mode; they overwrite the parameters in the CONFigure:BSSignal[:CSWitched][:TCH]:MSLot:SCONfig:UUNused command.* ***Note 2: Reserved BCCH Slot*** *If the control channel mode is set to BATC (see command CONFigure:BSSignal:CCH[:TX]:MODE* on p. 6.212), *slots 2 to 6 can be configured as traffic channels. The settings for slots 0, 1 and 7 are ignored; a query returns BCCH for slot no. 0.*				≠CEST, Q: all

Subsystem BSSignal:CCH:AUXTx (Aux Tx Signal)

The subsystem *BSSignal:CCH:AUXTx…* configures the additional RF generator signal Aux Tx (with one of the options R&S CMU-B95 or R&S CMU-B96). It corresponds to the Aux TX section in the *BS Signal* tab in the popup menu *Connect. Control*.

CONFigure:BSSignal:CCH:AUXTx:CHTYpe *<Mode>*				Aux TX – Channel Type
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
OFF | **BCCH |** **BPBC**	Aux TX signal switched off Aux TX signal provides the BCCH Aux TX signal provides the BCCH and PBCCH	OFF	–	V3.40
Description of command				Sig. State
This command configures the Aux TX signal off or configures it for a control channel.				SON, SOFF

CONFigure:BSSignal:CCH:AUXTx:CHANnel <*Channel*>		Aux TX – RF Channel		
<Channel>	Description of parameters	Def. value	Def. unit	FW vers.
259 to 293 | 306 to 340	Number of Aux TX channel, GSM400	266	–	V3.40
350 to 425	Number of Aux TX channel, GSM GT800	366		
128 to 251	Number of Aux TX channel, GSM850	166	–	
0 to 124 | 955 to 1023	Number of Aux TX channel, GSM900	36	–	
512 to 885	Number of Aux TX channel, GSM1800	731	–	
512 to 810	Number of Aux TX channel, GSM1900	605	–	
Description of command				Sig. State
This command determines the control channel for the CMU signals (BCCH). **Note:** *The control channel must be different from the traffic channel set via* `CONFigure:BSSignal[:CSWitched][:TCH]:CHANnel` *(see p. 6.213). An attempt to select equal channel numbers for both channels causes a settings conflict.*				SON, SOFF

CONFigure:BSSignal:CCH:AUXTx:LEVel[:ABSolute] <*Level*>		Aux TX – Level		
<Level>	Description of parameters	Def. value	Def. unit	FW vers.
–122 dBm to –72 dBm	Absol. level of Aux TX channel, RF1	–75	dBm	V3.40
–110 dBm to –60 dBm	Aux TX level, RF2	–75	dBm	
–107 dBm to +13 dBm	Aux TX level, RF3 (option R&S CMU-B96 only)	–75	dBm	V3.80
Description of command				Sig. State
This command determines the Aux TX level in absolute units. Output of the Aux TX signal at RF3 OUT is only possible with option R&S CMU-B96. ***Note:*** *After a handover the Aux TX level of the origin network is maintained (indication "from other network" in the BS Signal tab of the Connection Control menu), however, the query* `CONFigure:BSSignal:CCH:AUXTx:LEVel[:ABSolute]?` *will return the default value of the target network, which may differ from the actual Aux TX level.* *Changing the Aux TX level after a handover (i.e. in the CEST state of the target network) is not allowed and will cause an error message –200, "Execution error".* *If option R&S CMU-U99* (RF 1 with RF 2 Level Range) *is fitted, RF 1 takes on the level range of RF2.*				all

CONFigure:BSSignal:CCH:AUXTx:CCCHeck <*Mode*>		Aux TX – Channel Conflict Check		
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
ON | OFF	Channel conflict check switched on or off	ON	–	V3.60
Description of command				Sig. State
This command enables or disables the channel conflict check. With enabled check, the minimum channel difference between the Aux TX signal (`CONFigure:BSSignal:CCH:AUXTx:CHANnel`) and the Main TX signal (`CONFigure:BSSignal[:CSWitched][:TCH]:CHANnel`) is 4.				SON, SOFF

Subsystem NETWork

The subsystem *NETWork* defines various parameters of the network that the CMU reports to the mobile station. The subsystem corresponds to the *Network* tab in the *Connect. Control* menu.

CONFigure:NETWork:B52Mode <*Mode*> B52 Mode				
<Offset>	Description of parameters	Def. value	Def. unit	FW vers.
SCOD | **MSUP**	Speech codec reserved for audio tests Speech codec supports BLER measurement	SCOD	–	V3.10
Description of command				Sig. State
This command defines the function of the speech codec.				SOFF, Q: all

CONFigure:NETWork:BAList <*Channel*> *{,<Channel>}*				BA List
<Channel>	Description of parameters	Def. value	Def. unit	FW vers.
0 to1023 | **OFF**	BCCH ch. numbers BA list switched off	260,330,OFF,...,OFF (GSM400) 355,420,OFF,...,OFF (GSM GT800) 130,250,OFF,...,OFF (GSM850) 10,120,OFF,...,OFF (GSM900) 520,620,OFF,... (GSM1800) 550,700,OFF,... (GSM1900)	–	V1.15
Description of command				Sig. State
This command generates the list of up to 16 used channels in the adjacent cells (BA list, *BCCH allocation list)*. In the query format, the command returns the channel numbers in the BA list.				≠CEST, Q: all

CONFigure:NETWork[:CSWitched]:AOCHarge:ENABle <*Enable*> **CONFigure:NETWork[:CSWitched]:AOCHarge <*Value1*>, <*Value2*> ... , <*Value7*>**				Advice of Charge
<Enable>	Description of parameters	Def. value	Def. unit	
ON | OFF	Switch on or off data for advice of charge	ON	–	
<Value n> ...	Description of parameters	Def. value	Def. unit	FW vers.
0 to 8191	Values 1 to 7 for calculating the charges	0,0,0,0,0,0,0	–	V1.15
Description of command				Sig. State
The seven numbers denote the following:	Units per interval Seconds / time interval Scaling factor Unit increment Units per data interval Segments / data interval Initial secs / t interval			≠CEST, Q: all

CONFigure:NETWork[:CSWitched]:SOFFset <*Offset*>				Slot Offset
<Offset>	Description of parameters	Def. value	Def. unit	FW vers.
–7 to +7	Slot Offset	0	–	V3.05
Description of command				Sig. State
This command defines the DL timeslot that the mobile loops back to the uplink main timeslot.				≠CEST, Q: all

CONFigure:NETWork[:CSWitched]:EMReports <*Enable*>				Enhanced Meas. Reports
<*Enable*>	Description of parameters	Def. value	Def. unit	FW vers.
ON | OFF	Enable or disable enhanced measurement reports	OFF	–	V3.80
Description of command				Sig. State
This command specifies whether or not the R&S CMU requests the MS to provide enhanced measurement reports as defined in standard 3GPP TS 05.08, section 8.4.8.				all

Subsystem NETWork:IDENtity

The subsystem *NETWork:IDENtity* defines the identity of the mobile radio network. The subsystem corresponds to the table section *Network Identity* in the *Network* tab of the *Connection Control* menu.

CONFigure:NETWork:IDENtity:NCC <*Code*>				NCC
<*Code*>	Description of parameters	Def. value	Def. unit	FW vers.
0 to 7	Color code of mobile network	0	–	V1.15
Description of command				Sig. State
This command defines the color code of the network *(NCC = network color)* for the signals of the measuring instrument.				SOFF, SON Q: all

CONFigure:NETWork:IDENtity:MCC <*Code*>				MCC
<*Code*>	Description of parameters	Def. value	Def. unit	FW vers.
0 to 999	Mobile Country Code	001	–	V1.15
Description of command				Sig. State
This command defines the Mobile Country Code.				SOFF, SON Q: all

CONFigure:NETWork:IDENtity:MNC:DIGits <*Digits*>				MNC, Digits
<*Digits*>	Description of parameters	Def. value	Def. unit	FW vers.
2 | 3	Two- or three-digit Mobile Network Code	3 (for GSM850/1900) 2 (for all other bands)	– –	V3.60
Description of command				Sig. State
This command defines the digits of the Mobile Network Code. The default MSIN is automatically adapted (`CONFigure:NETWork[:CSWitched]:SMODe:IMSI:MSIN`) so that the sum of the MNC digits and the MSIN digits equals to 12.				SOFF, SON Q: all

CONFigure:NETWork:IDENtity:MNC <*Code*>				MNC
<*Code*>	Description of parameters	Def. value	Def. unit	FW vers.
0 to 99 **0 to 999**	Two-digit Mobile Network Code Three-digit Mobile Network Code	See below	– –	V1.15
Description of command				Sig. State
This command defines the 2- or 3-digit Mobile Network Code, depending on the selection made via `CONFigure:NETWork:IDENtity:MNC:DIGits`. The default values are (0)10 for GSM850/1900 bands, (0)01 for all other bands.				SOFF, SON Q: all

CONFigure:NETWork:IDENtity:BCC <*Code*>				BCC
<Code>	Description of parameters	Def. value	Def. unit	FW vers.
0 to 7	BTS Color Code	1	–	V1.15
Description of command				Sig. State
This command defines the Color Code of the BTS *(base transceiver station color code, BTS color code = BCC)*.				SOFF, SON Q: all

CONFigure:NETWork:IDENtity:LAC <*Code*>				LAC
<Code>	Description of parameters	Def. value	Def. unit	FW vers.
1 to 65533 and 65535	Location Area Code	1	–	V1.15
Description of command				Sig. State
This command defines the Location Area Code.				SOFF, SON Q: all

Subsystem NETWork:SYSTem (System Parameters)

The subsystem *NETWork:System* determines system parameters for the radio connection. The subsystem corresponds to the table section *System Parameters* in the *Network* tab of the *Connection Control* menu.

CONFigure:NETWork:SYSTem:CACCess <*Mode*>				Cell Access
Mode>	Description of parameters	Def. value	Def. unit	FW vers.
BARRed | **NBARred**	Radio cell disabled for all mobiles Radio cell accessible	NBARred	–	V1.15
Description of command				Sig. State
This command enables or disables the radio cell for mobiles.				SOFF, SON Q: all

CONFigure:NETWork:SYSTem:BINDicator <*Band*> Band Indicator				
<Blocks>	Description of parameters	Def. value	Def. unit	FW vers.
G18 | G19	GSM band that the mobile can use	see below	–	V3.10
Description of command				Sig. State
This command sets the band indicator of the MS under test. The default value is G18 if the current function group is GSM400/GT800/900 or GSM1800 and G19 if the current function group is GSM850 or GSM1900.				≠CEST, Q: all

CONFigure:NETWork:SYSTem:BSAGblksres <*Blocks*>				Number of Reserved Blocks
<Blocks>	Description of parameters	Def. value	Def. unit	FW vers.
0 to 7	Number of reserved blocks in the BCCH for access channel	0	–	V1.15
Description of command				Sig. State
This command determines the number of data blocks to be reserved for the granted access *(access grant channel = AGC)* within the BCCH *(basic services access grant blocks reserved)*.				≠CEST, Q: all

CONFigure:NETWork:SYSTem:BSPamfrms <*Frames*>				Paging Request Interval
<Frames>	Description of parameters	Def. value	Def. unit	FW vers.
2 to 9	Interval between two paging requests	2		V1.15
Description of command				Sig. State
This command defines the interval between two paging requests in a multiframe in frames *(basic services paging blocks available per multiframe)*.				≠CEST, Q: all

CONFigure:NETWork:SYSTem:BSPReorganis <*Mode*>				Paging Reorganisation
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
ON | OFF	Paging reorganization on/off	OFF	–	V2.00
Description of command				Sig. State
This command switches the paging reorganization parameter on and off. In the *ON* state, the mobile listens to all paging groups and is prevented from switching to the idle mode.				≠CEST, Q: all

CONFigure:NETWork:SYSTem:PLUPdate <*Value*>				TS1232, Periodic Location Update
<Value>	Description of parameters	Def. value	Def. unit	FW vers.
OFF | **0 to 255**	No periodic location update performed Value of T1232 timer	OFF	deci- hours	V3.10
Description of command				Sig. State
This command sets the value of the timer T3212 of the periodic location updating procedure. The unit decihours corresponds to 6 minutes or 360 seconds.				≠CEST, Q: all

CONFigure:NETWork:SYSTem:ACLass <*Code*>				Access Class
<Code>	Description of parameters	Def. value	Def. unit	FW vers.
0 to 2^{16}–1 **(16 bit value)**	Access classes (0 to 15) barred from network access	0	–	V3.05
Description of command				Sig. State
This command prevents mobile stations of definite access classes from making access attempts when the CMU starts transmitting its BCCH channel. The 16 bit value is written to the *RACH Control Parameter* information element and broadcast to the MS. Each true bit (no. 0 to 15, starting with the least significant bit) means that the corresponding access class is barred. Barring the network access is useful to establish an off-air connection to a mobile station with a particular access class while preventing other mobiles from making access attempts. The feature is not available in manual control. The default value (no access class barred) is restored each time the CMU is rebooted.				SON, SOFF Q: all

Subsystem NETWork[:CSWitched]:SMODe (Type of Signalling)

The subsystem *NETWork[:CSWitched]:SMODe* defines signalling parameters concerning the function of the mobile. The subsystem corresponds to the table section *Signalling Modes* in the *Network* tab of the *Connection Control* menu.

CONFigure:NETWork[:CSWitched]:SMODe:LOCupdate <*Mode*>				Location Update
<*Mode*>	Description of parameters	Def. value	Def. unit	FW vers.
ALWays | **AUTO**	Location update each time the mobile is switched on Only if necessary	ALW	–	V1.20
Description of command				Sig. State
This command determines in which cases the mobile performs a location update.				≠CEST, Q: all

CONFigure:NETWork[:CSWitched]:SMODe:PCHange <*Mode*>				Power Change Mode
<*Mode*>	Description of parameters	Def. value	Def. unit	FW vers.
FAST | **SLOW**	Fast power change Slow power change	FAST	–	V1.15
Description of command				Sig. State
This command determines the speed of power control on the mobile phone. The slow power change is controlled via SACCH *(slow associated control channel)*, the fast power change via FACCH *(fast associated control channel).*				≠CEST, Q: all

CONFigure:NETWork[:CSWitched]:SMODe:SCHannel <*Channel*>				Signalling Channel
<*Channel*>	Description of parameters	Def. value	Def. unit	FW vers.
SDCCh | **FACCh |** **NONE**	Signalling via *stand-alone dedicated control channel* Signalling via *fast associated control channel* No signalling	FACCh	–	V1.15
Description of command				Sig. State
This command determines the control channel type that the CMU uses for signalling.				≠CEST, Q: all

CONFigure:NETWork[:CSWitched]:SMODe:TRAFfic <*Mode*> PROCedure:NETWork[:CSWitched]:SMODe:TRAFfic <*Mode*>				Traffic Mode
<*Mode*>	Description of parameters	Def. value	Def. unit	FW vers.
FRV1 | **FRV2 |** **HRV1 |** **FD48 |** **FD96 |** **FD14 |** **HD24 |** **HD48 |**	Full-rate coding, Full Rate Version 1 Full Rate Version 2 (Enhanced Full Rate) Half-rate coding, Half Rate Version 1 Full Rate Data 4800 Baud Full Rate Data 9600 Baud Full Rate Data 14400 Baud Half Rate Data 2400 Baud Half Rate Data 4800 Baud	FRV1	–	V1.15
C1TM | **...** **C4TM |** **MC1Tm |** **...** **MC4Tm |**	GPRS coding scheme 1 (CS-1) ... GPRS coding scheme 4 (CS-4) EGPRS modulation and coding scheme 1 (MCS-1) ... EGPRS modulation and coding scheme 9 (MCS-9)			V3.0
AMRH | **AMRF**	Adaptive Multi-Rate (AMR) half rate (option CMU-K45) Adaptive Multi-Rate (AMR) full rate (option CMU-K45)			V3.40
Description of command				Sig. State
This command determines the speech coding and voice transmission in the traffic channels (full-rate channel, half-rate channel, packet data channel etc.).				all

CONFigure:NETWork[:CSWitched]:SMODe:TRAFfic:HRSubchannel <_Channel_> **PROCedure:NETWork[:CSWitched]:SMODe:TRAFfic:HRSubchannel <_Channel_>**				Half Rate Subchannel
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
SC0 | SC1	Subchannel 0 or 1	SC0	–	V3.60
Description of command				Sig. State
This command selects the subchannel to be used if half rate speech coding is used (see `CONFigure:NETWork[:CSWitched]:SMODe:TRAFfic` above).				all

CONFigure:NETWork[:CSWitched]:SMODe:BITStream <_Mode_> **PROCedure:NETWork[:CSWitched]:SMODe:BITStream <_Mode_>**				Bit Stream
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
ECHO | **LOOP |** **PR9 |** **PR11 |** **PR15 |** **PR16 |** **HANDset |** **HLOW** **CCAL |** **ECAL |** **DCAL**	Loop back in the CMU with delay Loop back in the CMU with minimal delay 2^9-1 PSR bit pattern 2^{11}-1 PSR bit pattern 2^{15}-1 PSR bit pattern 2^{16}-1 PSR bit pattern Handset Handset Low Codec Cal Encoder Cal Decoder Cal	ECHO	–	V3.05
Description of command				Sig. State
This command determines the type of data transmitted in the traffic channel. For BER measurements, one of the pseudo random sequences (PSR) must be used. See note on *Current vs. default values* on p. 6.199.				all

CONFigure:NETWork[:CSWitched]:SMODe:LCOMmand <_Mode_>				Loop Command
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
ENABle | **DISable |** **BER**	The CMU sends “Close Loop“ every time a connection is established The CMU never sends „Close Loop“ → Mobile never sends back Loop is closed for BER measurements only	BER	–	V1.15
Description of command				Sig. State
This command determines in which cases the open/close loop command is sent to the mobile. Closing of the loop causes the mobile to send back the bits received.				≠CEST, Q: all

CONFigure:NETWork[:CSWitched]:SMODe:STIMe <_Mode_> **PROCedure:NETWork[:CSWitched]:SMODe:STIMe <_Mode_>**				Starting Time
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
0 to 600 Frames	Starting time, number of frames transferred	0	–	V1.15
Description of command				Sig. State
The starting time is used with channel, timeslot and fast power change. The value 0 means that no start time is used. See note on *Current vs. default values* on p. 6.199.				all

CONFigure:NETWork[:CSWitched]:SMODe:IMSI:MNC <*MNC*> **CONFigure:NETWork[:CSWitched]:SMODe:IMSI:MCC <MCC>** **CONFigure:NETWork[:CSWitched]:SMODe:IMSI:MSIN <*MSIN*>**				Default IMSI: Mobile Network Code Mobile Country Code Mobile Subscriber Id. No
Parameter	Value ranges	Def. value	Def. unit	FW vers.
MCC **MNC** **MSIN**	0 to 999 0 to 99 *) (for a two-digit MNC) "0" to "9999999999" **)	001 01 *) "1000000095" **)	– – –	V1.15
Description of command				Sig. State
This command defines an international mobile subscriber identity *(IMSI)* which serves as the default setting for a call to the mobile. It consists of the mobile country code (*MCC)*, mobile network code (*MNC)* and the mobile subscriber identification no. (*MSIN)*. MSIN is a string variable and must be entered in quotation marks (' or "). The values defined here can be overwritten by the mobile parameters. The default value quoted above for MSIN applies to phase II mobiles. The default value for phase I mobiles is "1000000000". *) For a two-digit MNC (`CONFigure:NETWork:IDENtity:MNC:DIGits 2`). A three-digit MNC can vary between 0 and 999; the default value is 010. **) For a two-digit MNC. For a three-digit MNC, the MSIN comprises 9 digits only; the default value is "100000095".				≠CEST, Q: all

Subsystem NETWork[:CSWitched]:REQuest (Requested Mobile Data)

The subsystem *NETWork[:CSWitched]:REQuest* determines the signalling parameters of the mobile to be requested. The subsystem corresponds to the table section *Requested Mobile Data* in the *Network* tab of the *Connection Control* menu.

NOTE *The IMSI Request and IMEI Request settings are valid for both circuit switched and packet data connections.*

CONFigure:NETWork:REQuest:IMSI <*Mode*>				IMSI Request
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	IMSI requested No request	ON	–	V1.15
Description of command				Sig. State
This command determines whether the international mobile subscriber identity of the connected mobile phone is requested during *location update*, *call to mobile*, *call from mobile*, or *SMS transfer*.				≠CEST, ≠TEST, Q: all

CONFigure:NETWork:REQuest:IMEI <*Mode*>				IMEI Request
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	IMEI requested No request	ON	–	V1.15
Description of command				Sig. State
This command determines whether the international mobile station equipment identity (IMEI) of the connected mobile is requested during *location update*, *call to mobile*, *call from mobile*, or *SMS transfer*.				≠CEST, ≠TEST, Q: all

CONFigure:NETWork[:CSWitched]:REQuest: AUTHenticate <*Mode*>				Authentication Request
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	Authentication request No request	OFF	–	V1.15
Description of command				Sig. State
This command determines whether an authentication request of the connected mobile is made during *location update*, *call to mobile*, *call from mobile*, or *SMS transfer*.				≠CEST, Q: all

CONFigure:NETWork[:CSWitched]:REQuest:HANDover <*Mode*>				Handover Request
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	Handover request No handover request	ON	–	V1.15
Description of command				Sig. State
This command determines whether the capability to perform a handover is requested on the connected mobile during *location update*, *call to mobile*, *call from mobile*, or *SMS transfer*.				≠CEST, Q: all

CONFigure:NETWork[:CSWitched]:REQuest:CTHRee <*Mode*>				Classmark 3 R.
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	Classmark 3 request No classmark 3 request	ON	–	V3.60
Description of command				Sig. State
This command determines whether the classmark 3 element is requested during *location update*, *call to mobile*, *call from mobile*, or *SMS transfer*.				≠CEST, Q: all

Subsystem NETWork[:CSWitched]:AMR (AMR Codec Test)

The subsystem *NETWork[:CSWitched]:AMR* comprises the commands to test the AMR speech codec. The subsystem corresponds to the table section *Adaptive Multi-Rate (AMR)* in the *Network* tab of the *Connection Control* menu; the commands are reported in section *Subsystem NETWork[:CSWitched]:AMR (AMR Codec Test)* on p. 6.252 ff.

Subsystem NETWork[:CSWitched]:TIMeout

The subsystem *NETWork[:CSWitched]:TIMeout* defines timeouts for aborting an unused radio link or an unsuccessful call to the mobile. The subsystem corresponds to the table section *Timeouts* in the *Network* tab of the *Connection Control* menu.

CONFigure:NETWork[:CSWitched]:TIMeout:RLINk[:MOBile] <*Time*>				Radiolink Timeout Mobile
<Time>	Description of parameters	Def. value	Def. unit	FW vers.
4 to 64	Number of missing SACCH blocks (the step size is 4)	24	–	V1.15
Description of command				Sig. State
This command defines the maximum number of SACCH blocks which may be missing before a **mobile phone** considers the radio link to be interrupted *(radio link timeout)*				≠CEST, Q: all

CONFigure:NETWork[:CSWitched]:TIMeout:RLINk:TESTset <*Time*>	Radiolink Timeout Testset			
<Time>	Description of parameters	Def. value	Def. unit	FW vers.
4 to 64 | **OFF**	Number of missing SACCH blocks (the step size is 1) Monitoring of radio link is switched off (ie there is no Sync. Lost in the case of missing SACCH blocks)	24	–	V1.15
Description of command				Sig. State
This command determines the maximum number of SACCH blocks which may be missing before the CMU considers the radio link to be interrupted *(radio link timeout for test set)*.				≠CEST, Q: all

CONFigure:NETWork[:CSWitched]:TIMeout:MTC <*Time*>	MTC Timeout			
<Time>	Description of parameters	Def. value	Def. unit	FW vers.
0 s to 60 s **OFF**	Time limit for call to mobile No time limit (unlimited ringing)	10	s	V1.15
Description of command				Sig. State
This command determines the maximum dialing time until the mobile accepts the call *(mobile terminated call timeout)*; after this time, the attempted call setup is aborted. In the setting OFF, ringing is possible for an unlimited period of time.				≠CEST, Q: all

Subsystem NETWork:SI2Quater

The subsystem *NETWork:SI2Quater* defines the 3G (UMTS) neighbor cell description information that can be transferred to the MS in System Information 2ter. The subsystem corresponds to the table section *3G Neighbor Cell Description* in the *Network* tab of the *Connection Control* menu.

CONFigure:NETWork:SI2Quater:NC3G:ENABle <*Enable*>	3G Neighbor Cell Description – Enable			
<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | OFF	Enable or disable transmission of 3G neighbor cell information	OFF	–	V3.50
Description of command				Sig. State
This command enables or disables the transfer of 3G neighbor cell information including the selected UARFCN and primary SC.				all

CONFigure:NETWork:SI2Quater:NC3G:FDD:ARFCN <*Channel*>	FDD ARFCN Band 1			
<Channel>	Description of parameters	Def. value	Def. unit	FW vers.
10562 to 10838	ARFCN	10562	–	V3.50
Description of command				Sig. State
This command defines the UTRAN Radio Frequency Channel number of the 3G neighbor cell.				all

CONFigure:NETWork:SI2Quater:NC3G:FDD:PSCode <*Code*>	Primary Scrambling Code			
<Channel>	Description of parameters	Def. value	Def. unit	FW vers.
#H000 to #H1FF	Primary Scrambling Code	#H9	–	V3.50
Description of command				Sig. State
This command defines the Primary SC characterizing the 3G neighbor cell.				all

Connector Subsystems (External Attenuation at the Connectors)

The commands in this section configure the input and output connectors. The commands correspond to the tab *RF* in the popup menu *Connect. Control*.

INPut[:STATe] <*State*>				RF Input
<State>	Description of parameters	Def. value	Def. unit	FW vers.
RF1 **RF2** **RF4**	Connector RF1 used as input Connector RF2 used as input Connector RF4 IN used as input	RF2	–	V1.15
Description of command				Sig. State
This command determines the connector to be used for RF input signals. The bidirectional connectors RF1 and RF2 can be used both as input and output connectors in the same measurement (see `OUTPut[:STATe]`). Only one input and one output may be active at the same time, a new RF input setting overwrites the previous one.				all

OUTPut[:STATe] <*State*>				RF Output
<State>	Description of parameters	Def. value	Def. unit	FW vers.
RF1 **RF2** **RF3**	Connector RF1 used as output Connector RF2 used as output Connector RF3 OUT used as output	RF2	–	V1.15
Description of command				Sig. State
This command determines the connector to be used for RF output signals. The bidirectional connectors RF1 and RF2 can be used as input and output connectors in the same measurement (see `INPut[:STATe]`). Only one input and one output may be active at the same time, a new RF output setting overwrites the previous one.				all

[SENSe:]CORRection:LOSS:INPut<nr>[:MAGNitude] <*Attenuation* > **SOURce:CORRection:LOSS:INPut<nr>[:MAGNitude] <*Attenuation* >**				Ext. Att. Input
<Attenuation>	Description of parameters	Def. value	Def. unit	FW vers.
–50 dB to +90 dB	Ext. attenuation at input<nr> where <nr> = 1, 2, 4	0	dB	V1.15
Description of command				Sig. State
This command assigns an external attenuation value to one of the inputs defined before (see command `INPut:STATe).`				all

[SENSe:]CORRection:LOSS:OUTPut<nr>[:MAGNitude] <*Attenuation*> **SOURce:CORRection:LOSS:OUTPut<nr>[:MAGNitude] <*Attenuation*>**				Ext. Att. Output
<Attenuation>	Description of parameters	Def. value	Def. unit	FW vers.
–50 dB to +90 dB	Ext. attenuation at output<nr> where <nr> = 1, 2, 3	0	dB	V1.15
Description of command				Sig. State
This command assigns an external attenuation value to one of the outputs defined before (see command `OUTPut:STATe`).				all

ROUTe:SPENcoder[:INPut] <*Source*>				Speech Encoder
<Source>	Description of parameters	Def. value	Def. unit	FW vers.
HANDset | **GENerator**	Handset is used as source AF generator is used as source	HAND	–	V2.00
Description of command				Sig. State
This command determines the input source that feeds the CMU speech encoder (option CMU-B52).				all

ROUTe:SPDecoder[:OUTPut] <*Destination*>				Speech Decoder
<Destination>	Description of parameters	Def. value	Def. unit	FW vers.
HANDset | **ANALyzer |** **ANA2 |** **ABOTh**	Speech decoder output routed to the handset Speech dec. output routed to primary AF analyzer Speech dec. output routed to secondary AF analyzer Speech dec. output routed to both AF analyzers	HAND	–	V2.00
Description of command				Sig. State
This command routes the CMU speech decoder output (option CMU-B52). The ANA2 and ABOTh settings are provided in firmware versions ≥3.05.				all

Subsystem DM:CLOCk (Synchronization)

The subsystem *DM:CLOCk* sets a system clock specific to the network. This frequency is set in the tab *Synch.* in the popup menu *Connect. Control.*

SOURce:DM:CLOCk:STATe <*Mode*>				REF OUT 2 on/off
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
ON | OFF	Switching the system clock frequency on/off	OFF	–	V1.15
Description of command				Sig. State
This command switches the system clock frequency at output *REF OUT 2* on or off.				SOFF Q: all

SOURce:DM:CLOCk:FREQuency <*Frequency*>				REF OUT 2
<Frequency>	Description of parameters	Def. value	Def. unit	FW vers.
1.2190 MHz to 39.000 MHz	Input value for system clock frequency	13.000	MHz	V1.15
Description of command				Sig. State
This command defines the system clock frequency applied to output *REF OUT 2*. The frequency entered is rounded to one of the following discrete values: 39.000 MHz, 19.500 MHz, 13.000 MHz, 9.750 MHz, 7.800 MHz, 6.500 MHz, 5.571 MHz, 4.875 MHz, 4.333 MHz, 3.900 MHz, 3.545 MHz, 3.250 MHz, 3.000 MHz, 2.786 MHz, 2.600 MHz, 2.438 MHz, 2.294 MHz, 2.166 MHz, 2.053 MHz, 1.950 MHz, 1.857 MHz, 1.773 MHz, 1.696 MHz, 1.625 MHz, 1.560 MHz, 1.500 MHz, 1.444 MHz, 1.393 MHz, 1.349 MHz, 1.300 MHz, 1.258 MHz, 1.219 MHz				SOFF Q: all

RREPorts

The subsystem *RREPorts* contains the commands for requesting the receiver report of the mobile. Together with *NETWork[:MS]* the subsystem corresponds to the softkey *MS Rcv. Reports* in the main menu *GSMxxx-MS Overview*. The receiver characteristics do not really represent a measured value, since the values are automatically transmitted during signalling.

[SENSe:]RREPorts:RXLevel?				RX Level
Return	Description of parameters	Def. value	Def. unit	FW vers.
0 to 63	Receive signal level at the mobile phone	NAN	–	V1.15
Description of command				Sig. State
This command is always a query. It outputs the receiver level that the mobile reports to the CMU, expressed in dimensionless levels (see chapter 4).				CEST

[SENSe:]RREPorts:RXQuality?				RX Quality
Return	Description of parameters	Def. value	Def. unit	FW vers.
0 to 7	Received signal quality at the mobile	NAN	–	V1.15
Description of command				Sig. State
This command is always a query. It outputs the received signal quality that the mobile reports to the CMU, expressed in dimensionless quality levels (see chapter 4).				CEST

[SENSe:]RREPorts:RPCL?				Reported PCL
Return	Description of parameters	Def. value	Def. unit	FW vers.
	Reported power of mobile phone in PCL units,			
0 to 19	GSM400/GT800/850/900	NAN	PCL	–
0 to 31	GSM1800	NAN	PCL	–
0 to 31	GSM1900	NAN	PCL	V3.05
Description of command				Sig. State
This command is always a query. It returns the transmitter output power in PCL units that the MS reports to the network/CMU.				CEST

[SENSe:]RREPorts:NCELl?				RX Level in Neighbor Cells
Return	Description of parameters	Def. value	Def. unit	FW vers.
0 to 124 | 955 to 1023, **0 to 63 | NAN**	Channel numbers of the 6 neighbor cells RX Level in neighbor cells	NAN, NAN	–	V1.15
Description of command				Sig. State
This command is always a query. It returns the channel number and the signal level for six neighbor channels (see command `[SENSe:]RREPorts:RXLevel?` and chapter 4). The output list consists of 6 pairs of channels and corresponding RX Levels, separated by commas. The channel numbers depend on the GSM band (the parameter list quoted above is valid for GSM900), see chapter 4.				CEST

[SENSe:]RREPorts:DTX?				DTX
Returned values	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	Mobile phone transmits with interruption Mobile phone transmits without interruption	NAN	–	V1.15
Description of command				Sig. State
This command is always a query and returns the DTX mode *(discontinuous transmission mode)* currently used by the mobile phone.				CEST

[SENSe:]RREPorts:COUNt?				Number of Measurement Reports
Returned values	Description of parameters	Def. value	Def. unit	FW vers.
0 to n	Number of measurement reports received	0	–	V2.00
Description of command				Sig. State
This command is always a query and returns the number of receiver reports transmitted since the connection was established. According to GSM specifications, a receiver report is transmitted every 4 multiframes.				CEST

[SENSe:]RREPorts:CVALue?				C Value
Returned values	Description of parameters	Def. value	Def. unit	FW vers.
0 to 63	Reported C value of the mobile phone (GPRS mode)	NAN	–	V3.50
Description of command				Sig. State
This command is always a query. It returns the normalized received signal level at the MS.				CEST

[SENSe:]RREPorts:SVARiance?				Sign. Var.
Returned values	Description of parameters	Def. value	Def. unit	FW vers.
0 to 7	Reported signal variance of the mobile (GPRS mode)	NAN	–	V3.50
Description of command				Sig. State
This command is always a query. It returns the variance of the received signal level.				CEST

[SENSe:]RREPorts:GMBep? **[SENSe:]RREPorts:EMBep?** **[SENSe:]RREPorts:MBEP?**				Mean BEP, EGPRS (GMSK) Mean BEP, EGPRS (8PSK) Mean BEP, Circuit Switched
Returned values	Description of parameters	Def. value	Def. unit	FW vers.
0 to 31	Reported mean BEP	NAN	–	V3.50
Description of command				Sig. State
These commands are always queries. They return the average Bit Error Probability (BEP) of GMSK and 8PSK-modulated radio blocks, respectively. The circuit switched result is available in FW version V3.80 and higher and with enhanced measurement reports enabled (`CONFigure:NETWork[:CSWitched]:EMReports ON`).				CEST

[SENSe:]RREPorts:GCBep? **[SENSe:]RREPorts:ECBep?** **[SENSe:]RREPorts:CBEP?**				CV BEP, GMSK CV BEP, 8PSK CV BEP, Circuit Switched
Returned values	Description of parameters	Def. value	Def. unit	FW vers.
0 to 7	Reported CV BEP	NAN	–	V3.50 (EGPRS)
Description of command				Sig. State
These commands are always queries. They return the Coefficient of Variation of the Bit Error Probability (BEP) of GMSK and 8PSK-modulated radio blocks, respectively. The circuit switched result is available in FW version V3.80 and higher and with enhanced measurement reports enabled (`CONFigure:NETWork[:CSWitched]:EMReports ON`).				CEST

[SENSe:]RREPorts:NRBlocks?				Number of Received Blocks
Returned values	Description of parameters	Def. value	Def. unit	FW vers.
0 to n	Number of received blocks	NAN	–	V3.80
Description of command				Sig. State
This command is always a query. It returns the number of received blocks for a circuit switched connection with enhanced measurement reports enabled (`CONFigure:NETWork[:CSWitched]:EMReports ON`).				CEST

MSSinfo (Signalling Information of Mobile Phone)

The subsystem `MSSinfo` contains the commands for querying the parameters of the mobile. The subsystem corresponds to the *Signalling Info* output table in the main menu *GSMxxx-MS Overview.* The mobile parameters do not actually represent a measured value, they are provided by the mobile phone during location update.

The `MSSinfo` commands related to the AMR codec functionality are reported in section *MSSinfo (AMR Codec Modes)* on p. 6.256 ff.

[SENSe:]MSSinfo:IMSI:MCC? MCC
[SENSe:]MSSinfo:IMSI:MNC? MNC
[SENSe:]MSSinfo:IMSI:MSIN? MSIN

Returned parameter	Value ranges	Def. value	Def. unit	FW vers.
MCC	0 to 999	NAN	–	V1.15
MNC	0 to 99 (two-digit MNC)	NAN	–	
	0 to 999 (three-digit MNC)	NAN	–	
MSIN	"0" to "9999999999"*)	"" (empty string)	–	

Description of command	Sig. State
These commands are always queries and return the international mobile subscriber identification code (IMSI) of the mobile. It consists of the mobile country code (*MCC)*, the mobile network code (*MNC)* and the mobile subscriber identification no. (*MSIN)*. *) For a two-digit MNC (`CONFigure:NETWork:IDENtity:MNC:DIGits 2`). For a three-digit MNC, the MSIN comprises 9 digits only.	SYNC CEST

[SENSe:]MSSinfo:IMEI:FAC? Intern. mobile station equipment id.: FAC
[SENSe:]MSSinfo:IMEI:TAC? TAC
[SENSe:]MSSinfo:IMEI:SNR? SNR
[SENSe:]MSSinfo:IMEI:SVN? SVN

Returned values	***Value ranges***	Description of parameters	Def. value	Def. unit	FW vers.
TAC	**6-digit**	Type approval code	NAN	–	V1.15
FAC	**2-digit**	Final assembly code	NAN	–	
SNR	**6-digit**	Serial number	NAN	–	
SVN	**1 | 2-digit**	Software version number	NAN	–	

Description of command	Sig. State
These commands are always queries and return the international mobile station equipment identity (IMEI) of the mobile phone. It consists of a type approval code (*TCC*), the final assembly code (*FAC*), the serial number (*SNR*) and the software version number (*SVR*).	SYNC CEST

[SENSe:]MSSinfo:REVision? MS Rev. Level

Returned values	Description of parameters	Def. value	Def. unit	FW vers.
PH1 |	Phase 1	NAN	–	V1.15
PH2 |	Phase 2			
PH2P	Phase 2+			

Description of command	Sig. State
This command is always a query and returns the output (GSM phase) of the mobile.	SYNC CEST

[SENSe:]MSSinfo:DNUMber?				Dialled Number
Returned values	Description of parameters	Def. value	Def. unit	FW vers.
"Max. 20-digit"	Dialed number	NAN	–	V1.15
Description of command				Sig. State
This command is always a query and returns the number dialed at the mobile.				CEST

[SENSe:]MSSinfo:POWer:CLASs[:GMSK]? [SENSe:]MSSinfo:POWer:CLASs:EPSK?				Power Class
Returned values	Description of parameters	Def. value	Def. unit	FW vers.
1 to 5 **E1 | E2 | E3**	GMSK power class (range depending on the GSM band) 8PSK power class	INV INV	– –	V3.60
Description of command				Sig. State
These commands are always queries and return the GPRS or EGPRS power classes of the mobile.				SYNC CEST

[SENSe:]MSSinfo:MSCLass:CSWitched?				Multislot Class
Returned values	Description of parameters	Def. value	Def. unit	FW vers.
CL1 to CL29	Multislot class of mobile	NAN	–	V3.05
Description of command				Sig. State
This command is always a query and returns the multislot class of the mobile while it operates in circuit switched mode.				SYNC CEST

[SENSe:]MSSinfo:MSCLass:DTM[:GPRS]? [SENSe:]MSSinfo:MSCLass:DTM:EGPRs?				Multislot Class
Returned values	Description of parameters	Def. value	Def. unit	FW vers.
CL5 | CL6 | CL9 | CL10 | CL11	DTM multislot class of the mobile	NAN	–	V3.60
Description of command				Sig. State
This command is always a query and returns the DTM multislot class of a mobile.				SYNC CEST

[SENSe:]MSSinfo:BANDs? [<Band>]				Supported Bands and Power Classes
<Band>	Description of parameters	Def. value	Def. unit	FW vers.
G450 | G480 | G700 | G850 | G900PGSM | G900EGSM | G900RGSM | G1800 | G1900 | GGT800 | UFDD | U384TDD | U128TDD | C2000	GSM450, GSM480, GSM700, GSM850, P-GSM, E-GSM, R-GSM, GSM 1800,GSM1900, GSM GT800 UMTS FDD UMTS TDD 3.84 Mcps, UMTS TDD 1.28 Mcps, CDMA2000	–	–	V3.60
Returned values	Description of parameters	Def. value	Def. unit	FW vers.
SUPP | NSUPP, 1 to 5, E1 | E2 | E3,	GSM450 band supported or not supported GMSK power classes in GSM450 8PSK power classes in GSM450	–	–	V3.60
…,	Repeated for: GSM450, GSM480, GSM700, GSM850, P-GSM, E-GSM, R-GSM, GSM 1800,GSM1900, GSM GT800			
SUPP | NSUPP, NONE, NONE	UMTS FDD supported or not supported			
…	Repeated for: UMTS TDD 3.84 Mcps, UMTS TDD 1.28 Mcps, CDMA2000			
Description of command				Sig. State
This command is always a query and returns a list of the supported GSM, WCDMA and CDMA2000 bands and the GMSK and 8PSK power classes of the mobile. If the optional band parameter is omitted, 3 values are returned for each band. Otherwise, 3 values for the selected band are returned.				SYNC CEST

[SENSe:]MSSinfo:SBANds?				Supported Bands
Returned values	Description of parameters	Def. value	Def. unit	FW vers.
SUPP | NSUPP,	GSM450 band supported or not supported	–	–	V3.60
…,	Repeated for: GSM450, GSM480, GSM700, GSM850, P-GSM, E-GSM, R-GSM, GSM 1800,GSM1900, GSM GT800, UMTS TDD 3.84 Mcps, UMTS TDD 1.28 Mcps, CDMA2000			
Description of command				Sig. State
This command is always a query and returns a list of the supported GSM, WCDMA and CDMA2000 bands of the mobile.				SYNC CEST

ATESt (IP Address)

The subsystem `ATESt` defines the IP address information for *(E)GPRS Application Tests* (with option R&S CMU-K92). The subsystem corresponds to the *Application Testing* parameter section in the *Misc.* tab of the *Connection Control* menu.

CONFigure:ATESt:WSIPaddress ***<IP Address 1>, <IP Address 2>, <IP Address 3>, <IP Address 4>***				IP Address Workstation
<IP Address 1>	Description of parameters	Def. value	Def. unit	FW vers.
0 to 255,	First segment of IP address	192	–	V3.80
<IP Address 2>	Description of parameters	Def. value	Def. unit	FW vers.
0 to 255,	Second segment of IP address	168	–	V3.80
<IP Address 3>	Description of parameters	Def. value	Def. unit	FW vers.
0 to 255,	Third segment of IP address	168	–	V3.80
<IP Address 4>	Description of parameters	Def. value	Def. unit	FW vers.
0 to 255	Fourth segment of IP address	169	–	V3.80
Description of command				
This command sets the IP address of the PC used to control option R&S CMU-K92.				

CONFigure:ATESt:PORT *<Port_no>*				Port
<Port_no>	Description of parameters	Def. value	Def. unit	FW vers.
0 to 65535	Port number	3000	–	V3.80
Description of command				
This command sets the port number assigned to a particular application test.				

File Management – System MMEMory

The `MMEMory` system provides mass storage capabilities for the CMU. The functionality of this system is included in the *Data* menu; see CMU200/300 operating manual.

The mass storage of the CMU may be internal or external. The internal mass storage device is a section on the internal hard disk that is reserved for mass storage (directory c:\temp). The external mass storage device is either a floppy disk or a PCMCIA memory card, depending on the instrument configuration. The <*msus*> (mass storage unit specifier) parameter in the `MMEMory` commands denotes the root directory of the *INTernal* or *EXTernal* mass storage device.

The <FileName> parameter is a string. The contents of the string may contain characters for specifying subdirectories, e.g. "\TEMP\TRASH\test.txt" for the file named *test.txt* in the *TEMP\TRASH* subdirectory of the root directory or "TEMP\TRASH\test.txt" for the file named *test.txt* in the *TEMP\TRASH* subdirectory of the current directory, to be queried with the base system command `MMEMory:DIRectory [:CURRent]?`. The file name itself may contain the period as a separator for extensions.

MMEMory:SAVE:CURRent *<FileName> [,<msus>]*

Save configurations in current function group and test mode

Parameters	Parameter description	Def. value	Def. unit	FW vers.
"<FileName>",	Name of the config. file to be created	–	–	V3.10
INTernal | EXTernal	Storage device of the config. file	INTernal	–	

Command description

This command saves the configuration of the current function group and test mode to a configuration file. A "?" in the specified file name will be replaced by current numbers that are automatically incremented, starting with zero. The auto-increment function overwrites an existing file with a "9" in its file name. For instrument settings that may be different in manual and remote control (e.g. the repetition mode for many measurements) the manual setting is saved. The command is available in all function groups. This command is CMU-specific.

MMEMory:RECall:CURRent *<FileName> [,<msus>]*

Recall configurations in current function group and test mode

Parameters	Parameter description	Def. value	Def. unit	FW vers.
"<FileName>",	Name of the config. file to be recalled	–	–	V3.10
INTernal | EXTernal	Storage device of the config. file	INTernal	–	

Command description

This command recalls the configuration of the current function group and test mode from a configuration file. The command is available in all function groups. This command is CMU-specific.

MMEMory:L3MSg:CDEStination *<FileName>* Change Destination

Parameters	Parameter description	Def. value	Def. unit	FW vers.
"<FileName>"	Default file name	–	–	V3.10

Description of command

This command has no query form. It changes the default file name and path for logging files in the current storage device. The command is CMU-specific.

MMEMory:L3MSg:SAVE *[<FileName>] [,<msus>]*				Save to File
Parameters	Parameter description	Def. value	Def. unit	FW vers.
"<FileName>",	Name of the file to be saved	see description	–	–
INTernal | EXTernal	Storage device of the file to be saved	INTernal	–	V3.10

Description of command

This command has no query form. It saves the current ring buffer content to the default logging file INTERNAL\LOG\GSM_L3_?.LOG (if no parameter is specified, see command `MMEMory:L3MSg:CDEStination`) or to the specified file and storage device. In the default file name "GSM_L3_?.LOG" the "?" is replaced by current numbers that are automatically incremented, starting with zero. The auto-increment function overwrites an existing file with a "9" in its file name. The command is CMU-specific.

Note: *The default directory for logging files* INTERNAL\LOG *is fixed and can not be overwritten by the base system command* `MMEMory:CDIRectory`.

MMEMory:L3MSg:BWRiting *<Enable>*				Buffer Writing
Parameters	Parameter description	Def. value	Def. unit	FW vers.
ON | OFF	Activate or deactivate buffer writing	OFF	–	V3.10

Description of command

This command controls data recording into the ring buffer. The command is CMU-specific.

MMEMory:L3MSg:BEMPty?				Buffer Empty
Ret. Parameters	Parameter description	Def. value	Def. unit	FW vers.
EMPT |	Buffer contains no data	–	–	V3.10
FULL	Buffer contains data			

Description of command

This command is always a query and returns whether or not the buffer is empty. The command is CMU-specific and has no equivalent in manual control.

Options and Extensions

The features described in this section require the installation of additional software options; for a complete list of deliverable options refer to the data sheet.

GPRS and EGPRS Signalling (with Options R&S CMU-K42 and R&S CMU-K43)

The remote-control commands presented in this section control the setup and release of a TBF connection, configure the MS and BS Signals and define the network parameters for packet data services. They correspond to the settings in the *Connect. Control* popup menu that are related to packet data services.

Note 1: Current vs. default values

Some parameters of the CMU can assume two independent values: The ***default*** *value is used to set up a connection; it can be modified in the signalling states* Signal Off*,* Idle *and* Attached*. The* ***current*** *value is valid during the connection (signalling state* TBF Established*). Whenever the CMU goes into the* TBF Established *state the default value overwrites the current value. The current value during the connection can still be changed, however, modifying this current value does not alter the default value. An example for such a double parameter in packet data mode is the bit stream.*

Default values are set with a `CONFigure ...` command, current values are set with the corresponding `PROCedure ...` command.

Note 2: Receiver Quality measurements

Several additional commands have been introduced for Receiver Quality measurements on packet-data (GPRS) channels. These commands contain the `PDATa` keyword but are described in section Receiver Quality *for systematic reasons.*

Signalling – Subsystem SIGNalling:PDATa

The subsystem *SIGNalling:PDATa* controls the connection between the CMU and the MS under test and changes the test mode parameters while a GPRS TBF connection is established (current parameters). In manual control, these functions are distributed over the different *Signalling* tabs (for different signalling states, see command `PROCedure: SIGNalling:PDATa:ACTion`) and the *MS Signal, BS Signal* and *Network* tabs in the popup menu *Connect. Control*.

PROCedure:SIGNalling:PDATa:ACTion *<Action>*				GPRS Signalling Control
<Action>	Description of parameters	Def. value	Def. unit	FW vers.
SOFF |	Switch off BCCH signal *(signal off)*	–	–	V3.05
SON |	Switch on BCCH signal *(signal on)*			
CTMA |	Connect Test Mode A			
CTMB |	Connect Test Mode B			
CLBS |	Connect EGPRS Loopback symmetric			
CLBA |	Connect EGPRS Loopback asymmetric			
CRA |	Connect Reduced Signalling Mode A			
CRSignalling |	Connect Reduced Signalling Mode B			
CDLonly |	Connect Downlink only			
CBLer |	Connect Block Error Rate (BLER)			
DISConnect |	Disconnect			
HANDover |	Dual-band handover (to target network defined via `CONFigure:HANDover:TARGet`)			V3.40
CRES |	Connect reduced signaling EGPRS symmetrical			
CREA	Connect reduced signaling EGPRS asymmetrical			
Description of command				Sig. State
This command has no query form. It changes between the different packet data signalling states of the CMU. The current state can be queried via `SIGN:PDAT:STAT?`				See below

Important Note: Signalling States and Local to Remote Switchover

The default signalling state of the CMU in remote control is SOFF (see Fig. 6-2 below). This state is automatically reached on switchover from manual to remote control; an existing connection to the MS under test is dropped.

To suspend this default behavior of the CMU, the base system command `SYSTem:GTRM:COMP` has been introduced. `SYSTem:GTRM:COMP OFF` prevents the instrument from changing the signalling state local to remote switchover. In particular, an existing connection is maintained. The default behavior of the CMU is restored each time the instrument is rebooted. For more information see the documentation of the base system commands in the CMU manual.

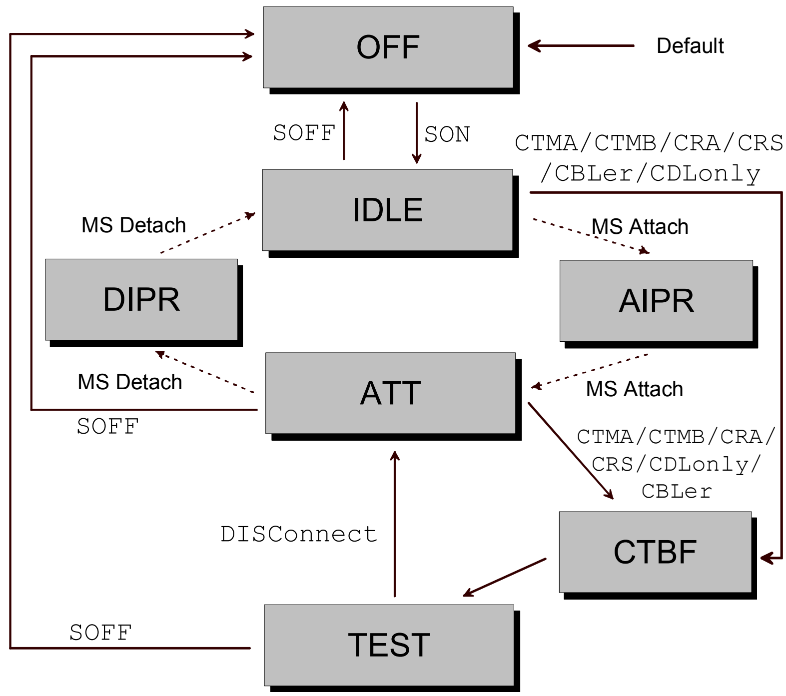


Fig. 6-2 GPRS signalling states of the CMU and transitions

Signalling states: See command `[SENSe:]SIGNalling:PDATa:STATe?` below.

Actions:	*initiated from the CMU:*	*initiated from the mobile phone:*	
	See description of command `PROC:SIGN:PDAT:ACT`	MS Attach	MS initiates GPRS-attach
		MS Detach	MS initiates GPRS-detach

Further transitions between the signalling states (not shown in Fig. 6-2) may occur, e.g. in case of errors. Handover transitions can be performed in analogy to the circuit-switched case; see Fig. 6-1 on p. 6.203.

[SENSe:]SIGNalling:PDATa:STATe?		GPRS Signalling State		
Return	Description of parameters	Def. value	Def. unit	FW vers.
OFF |	CMU transmits no control channel signal	OFF	–	V3.01
IDLE |	No GPRS-attach performed yet			
ATT |	GPRS-attach succeeded			
RAUP |	Routing area update in progress			
AIPR |	GPRS-attach is currently being performed			
CTBF |	CMU attempts a TBF connection			
TEST |	TBF connection established			
DIPR |	GPRS-detach is currently being performed			
FPEN |	Fallback pending			
TPEN |	TBF pending			
TED	TBF established dual band			
Description of command				Sig. State
This command is always a query. It returns the current (E)GPRS signalling state.				all
Note: *All commands that operate in TEST state can also be used in TED state and vice versa.*				

[SENSe:]SIGNalling:PDATa:SERVice?				Service Selection
Return	Description of parameters	Def. value	Def. unit	FW vers.
TMA | **TMB |** **LBS |** **LBA |** **RSA |** **RSIG** **RSCS |** **RSCA |** **DLON |** **BLER**	Test Mode A Test Mode B EGPRS Loopback symmeterical EGPRS Loopback asymmetrical Reduced Signalling Mode A Reduced Signalling Mode B Reduced Signalling – EGPRS symmetrical Reduced Signalling – EGPRS asymmetrical Downlink only Block Error Rate	TMA	–	V3.05
Description of command				Sig. State
This command is always a query. It returns the current GPRS service. The different test modes are accessed via *PROCedure:SIGNalling:PDATa:ACTion* (see p. 6.240).				TEST

PROCedure:SIGNalling:PDATa[:TCH]:MSLot:CHANnel *<Number>*				RF Channel
<Number>	Description of parameters	Def. value	Def. unit	FW vers.
259 to 293 | 306 to 340	Number of traffic channel, GSM400	275	–	V3.10
350 to 425	Number of traffic channel, GSM GT800	392	–	
128 to 251	Number of traffic channel, GSM850	192	–	
0 to 124 | 955 to 1023	Number of traffic channel, GSM900	62	–	
512 to 885	Number of traffic channel, GSM1800	740	–	
512 to 810	Number of traffic channel, GSM1900	610	–	
Description of command				Sig. State
This command changes the RF channel that the CMU uses for data transfer while it is in test mode (current parameter).				TEST, Q: all

PROCedure:SIGNalling:PDATa[:TCH]:MSLot:SCONfig Slot Configuration: Uplink/Downlink
<Main_TS>,<DL_Enable_0>,..., <DL_Enable_7>, <DL_Power_0>, ..., <DL_Power_7> <UL_Enable_0>,..., <UL_Enable_7>, <UL_Gamma_0>, ..., <UL_Gamma_7>

<Main_TS>	Description of parameters	Def. value	Def. unit	FW vers.
0 to 7	Main timeslot used for signalling	3	–	V3.10
<DL_Enable_n>	Description of parameters	Def. value	Def. unit	
ON | OFF	Enable or disable timeslot no. n	ON (slots 3 and 4) OFF (other slots)	–	
<DL_Power_n>	Description of parameters	Def. value	Def. unit	
–127.0 dB to +127.0 dB	Individual BS level in timeslot no. n:	0.0 (all active DL slots)	dB	
<UL_Enable_n>	Description of parameters	Def. value	Def. unit	
ON | OFF	Enable or disable timeslot no. n	ON (slot 3) OFF (other slots)	–	
<UL_Gamma_n>	Description of parameters	Def. value	Def. unit	Sig. State
0 to 31	Power control parameter Γ_{CH} in timeslot no. n	13 (slot 3)	–	TEST

Description of command

This command changes the main timeslot, the levels in all active or inactive timeslots slots of the BS signal, and the channel-specific power control parameters Γ_{CH} that the MS uses in test mode (current values, see *Slot Configuration Editor* in manual control). This command overwrites the main timeslot defined via *CONFigure:BSSignal:PDATa[:TCH]:MSLot:MTIMeslot* (see p. 6.245).

For the DL signal all GSM timeslots are available if the control channel mode is set to BOTC (see command *CONFigure:BSSignal:CCH[:TX]:MODE* on p. 6.212). Their levels are set individually relative to the *Reference Level* queried via *[SENSe:]BSSignal:PDATa[:TCH]:MSLot:RLEVel?* (see p. 6.245). The DL level range quoted above is restricted by the condition that the absolute level (calculated from the reference level and the relative individual levels) must not exceed the level ranges of the RF connectors.

Example: With output connector RF2 and a reference level of –85 dBm, the individual DL timeslot levels can be set in the range –52 dB to +75 dB, corresponding to an absolute level of –137 dBm to –10 dBm.

The UL signal settings must be compatible with the capabilities of the MS under test (multislot class, power class).

PROCedure:SIGNalling:PDATa[:TCH]:MSLot:MS:SCONfig:GAMMa Change of Γ_{CH}
<UL_Enable_0>,..., <UL_Enable_7>, <UL_Gamma_0>, ..., <UL_Gamma_7>

<UL_Enable_n>	Description of parameters	Def. value	Def. unit	
ON | OFF	Enable or disable timeslot no. n	ON (slot 3) OFF (other slots)	–	
<UL_Gamma_n>	Description of parameters	Def. value	Def. unit	FW vers.
0 to 31	Power control parameter Γ_{CH} in timeslot no. n	13 (slot 3)	–	V3.40

Description of command	Sig. State
This command changes the channel-specific power control parameters Γ_{CH} that the MS uses in test mode (current values, see *Slot Configuration Editor* in manual control).	TEST

PROCedure:SIGNalling:PDATa[:TCH]:MSLot:FHOPping:ENABle *<Enable>*				Enable Frequency Hopping
<Sequence>	Description of parameters	Def. value	Def. unit	FW vers.
ON | OFF	Enable or disable frequency hopping	OFF	–	V3.40
Description of command				Sig. State
This command enables or disables frequency hopping in the downlink traffic channel. The hopping sequences are defined via `CONFigure:BSSignal:PDATa[:TCH]:MSLot:FHOPping:SEQuence`; see p. 6.245.				TEST Q: all

CONFigure:SIGNalling:PDATa:ASConfig:ENABle *<Enable>*				Auto Slot Config.
<Sequence>	Description of parameters	Def. value	Def. unit	FW vers.
ON | OFF	Enable or disable automatic slot configuration	OFF	–	V3.50
Description of command				Sig. State
This command enables or disables automatically activation of an appropriate number of slots that is suitable for a particular measurement and supported by the connected MS.				≠TEST, Q: all

Subsystem MSSignal:PDATa (RF Signal of MS under Test)

The subsystem *MSSignal:PDATa* configures the RF signal that the MS under test is to transmit in GPRS test mode. It corresponds to the *Packet Data* section in the *MS Signal* tab of the popup menu *Connect. Control*.

CONFigure:MSSignal:PDATa[:TCH]:MSLot:SCONfig *<Enable_0>,..., <Enable_7>, <Gamma_0>,... <Gamma_7>*				Uplink Slot Configuration
<Enable_n>	Description of parameters	Def. value	Def. unit	
ON | OFF	Enable or disable uplink timeslot no. n	n = 3: ON	–	
<Gamma_n>	Description of parameters	Def. value	Def. unit	FW vers.
0 to 31	Power control parameter Γ_{CH} in timeslot no. n	3	–	V3.05
Description of command				Sig. State
This command defines the slot configuration and the channel-specific power control parameters Γ_{CH} that the MS is to use in test mode (default parameters). In the default setting, only slot 3 is enabled. Slot no. 3 is also the main timeslot; see *CONFigure:BSSignal:PDATa[:TCH]:MSLot:MTIMeslot* on p. 6.245.				≠TEST, Q: all

Subsystem BSSignal:PDATa (RF Signal of Base Station/CMU)

The subsystem *BSSignal:PDATa* configures the RF signal that the CMU transmits in packet data transfer mode. It corresponds to the *Packet Data* section in the *BS Signal* tab of the popup menu *Connect. Control*.

CONFigure:BSSignal:PDATa[:TCH]:MSLot:PZERo *<P0>*				P0 Parameter
<P0>	Description of parameter	Def. value	Def. unit	FW vers.
0 dB to 31 dB	Value of P0	5	dB	V3.05
Description of command				Sig. State
This command defines the downlink power control parameter P0.				all

CONFigure:BSSignal:PDATa[:TCH]:MSLot:CHANnel <*Number*> RF Channel

<Number>	Description of parameters	Def. value	Def. unit	FW vers.
259 to 293 | 306 to 340	Number of traffic channel, GSM400	275	–	–
350 to 425	Number of traffic channel, GSM GT800	392	–	–
128 to 251	Number of traffic channel, GSM850	192	–	–
0 to 124 | 955 to 1023	Number of traffic channel, GSM900	62	–	–
512 to 885	Number of traffic channel, GSM1800	740	–	V3.05
512 to 810	Number of traffic channel, GSM1900	610		

Description of command	Sig. State
This command changes the RF channel that the CMU shall use for data transfer once it is in test mode (default parameter).	≠TEST, Q: all

CONFigure:BSSignal:PDATa[:TCH]:MSLot:FHOPping:SEQuence <*Sequence*> Hopping Sequence

<Sequence>	Description of parameters	Def. value	Def. unit	FW vers.
0 to 124, 955 to 1023 | OFF	Sequence of up to 7 GSM channels, depending on the GSM band used (example: GSM900), undefined channel number	see below	–	V3.40

Description of command	Sig. State
This command defines a hopping sequence containing up to 7 channel numbers. The list must contain 7 entries, however, *Off* can be used to reduce the number of channels. Frequency hopping of the downlink traffic channel must be enabled explicitly using `PROCedure:SIGNalling:PDATa[:TCH]:MSLot:FHOPping:ENABle` (see p. 6.244). The default hopping sequences depend on the network:	CEST Q: all

GSM400	306	323	340	OFF	OFF	OFF	OFF
GSM GT800	350	388	425	OFF	OFF	OFF	OFF
GSM850	128	190	251	OFF	OFF	OFF	OFF
GSM900	1	62	124	OFF	OFF	OFF	OFF
GSM1800	512	698	885	OFF	OFF	OFF	OFF
GSM1850	512	660	810	OFF	OFF	OFF	OFF

[SENSe:]BSSignal:PDATa[:TCH]:MSLot:RLEVel? <*Level*> Reference Level

<Level>	Description of parameter	Def. value	Def. unit	FW vers.
–116 dBm to –85 dBm	Reference level for all downlink channels	–90	dBm	V3.05

Description of command	Sig. State
This command is always a query. It returns the reference level for all downlink *(BS Signal)* channels, calculated according to *RLEVel = –85 dB – PZERo*. Both the current and the default levels in all downlink timeslots are defined relative to the reference level (see command `CONFigure:BSSignal:PDATa[:TCH]:MSLot:SCONfig`).	all

CONFigure:BSSignal:PDATa[:TCH]:MSLot:MTIMeslot <*Number*> Main Timeslot

<Number>	Description of parameters	Def. value	Def. unit	FW vers.
0 to 7	Main timeslot	3	–	V3.05

Description of command	Sig. State
This command changes the main timeslot that the CMU uses for signalling (default parameter). Changing the main timeslot also overwrites the *Meas. Slot* (command `CONFigure:MCONtrol:MSLot:MESLot`).	≠TEST, Q: all

CONFigure:BSSignal:PDATa[:TCH]:MSLot:SCONfig *<Enable_0>,..., <Enable_7>, <Level_0>,... <Level_7>*				Downlink Slot Configuration
<Enable_n>	Description of parameters	Def. value	Def. unit	
ON | OFF	Enable or disable downlink timeslot no. n (the MS is instructed to listen to this TS)	see below	–	
<Level_n>	Description of parameters	Def. value	Def. unit	FW vers.
–127 dB to +127 dB	Power of CMU in timeslot no. n (the CMU actually transmits a signal in this TS)	see below	dB	V3.05
Description of command				Sig. State
This command changes the downlink slot configuration and the RF levels that the CMU uses in test mode (default parameters). All levels are relative to the reference level queried via *[SENSe:]BSSignal:PDATa[:TCH]:MSLot:RLEVel?*. The level range quoted above is restricted by the condition that the absolute level (calculated from the reference level and the relative individual levels) must not exceed the level ranges of the RF connectors. **Example:** With output connector RF2 and a reference level of –90 dBm, the individual timeslot levels can be set in the range –47 dB to +80 dB, corresponding to an absolute level of –137 dBm to –10 dBm. In the default setting, only slot 3 is enabled, the level is 0 dB. By default, slot no. 3 is also the main timeslot; see *CONFigure:BSSignal:PDATa[:TCH]:MSLot:MTIMeslot* command on p. 6.245. ***Note: Reserved BCCH Slot*** *If the control channel mode is set to BATC (see command* *CONFigure:BSSignal:CCH[:TX]:MODE* on p. 6.212), *slots 2 to 6 can be configured as traffic channels. The settings for slots 0, 1 and 7 are ignored; a query returns BCCH for slot no. 0.*				≠TEST, Q: all

Subsystem NETWork

The subsystem *NETWork* determines the parameters of the radio network and the existing radio link. The subsystem corresponds to the *Network* tab in the popup menu *Connect. Control*. The following commands are related to packet data transfer:

CONFigure:NETWork:NSUPport				Network Support
Return	Description of parameters	Def. value	Def. unit	FW vers.
GSM | **GGPR |** **GEGP**	Circuit-switched GSM without (E)GPRS support Circuit-switched GSM plus GPRS support Circuit-switched GSM plus EPRS support	GSM	–	V3.01
Description of command				Sig. State
This command defines whether or not the CMU currently supports GPRS. It is available with option CMU-K42, *GPRS Software Extension,* only. The option GEGP is available for firmware versions ≥V3.10 and with option CMU-K43.				SOFF IDLE Q: all

[SENSe:]NETWork:MSERvice?				Main Service
Return	Description of parameters	Def. value	Def. unit	FW vers.
CSWitched | **PDATa**	Circuit switched GSM (E)GPRS packet data service	CSW	–	V3.05
Description of command				Sig. State
This command is always a query and returns whether the MS under test operates in GSM or (E)GPRS mode. If DTM functionality is available (with option R&S CMU-K44) the main service can be set explicitly (`CONFigure:NETWork:MSERvice?`).				all

Subsystem NETWork:IDENtity

The subsystem *NETWork:IDENtity* defines the identity of the mobile radio network. The subsystem corresponds to the table section *Network Identity* in the *Network* tab. The following commands are related to packet data transfer:

CONFigure:NETWork:IDENtity:RAC <*Code*>				Routing Area Code
<Code>	Description of parameters	Def. value	Def. unit	FW vers.
0 to 255	Routing area code	0	–	V3.05
Description of command				Sig. State
This command defines the routing area code for GPRS services.				SOFF, IDLE Q: all

Subsystem NETWork:PDATa

The subsystem *NETWork:PDATa* defines the GPRS test mode and the traffic data channel coding scheme. The subsystem corresponds to the table section *Network Identity* in the *Network* tab. The following commands are related to packet data transfer:

CONFigure:NETWork:PDATa:CSCHeme <*Coding_Scheme*> **PROCedure:NETWork:PDATa:CSCHeme <*Coding_Scheme*>**				Coding Scheme
<Coding_Scheme>	Description of parameters	Def. value	Def. unit	FW vers.
CS1 to CS4 | **MCS1 to MCS 9**	GPRS channel coding scheme CS-1 to CS-4 EGPRS modulation and coding scheme MCS-1 to MCS-4	CS1	–	V3.05
Description of command				Sig. State
This command selects the GPRS coding scheme for packet data channels. The EGPRS modulation and coding schemes and the `PROCedure...` command are available in FW versions ≥V3.10. See note on *Current vs. default values* on p. 6.239.				all

CONFigure:NETWork:PDATa:EGPRs:PSCHeme <*PS_1*>, ... <*PS_12*> **PROCedure:NETWork:PDATa:EGPRs:PSCHeme <*PS_1*>, ... <*PS_12*>**				Puncturing Scheme
Parameters	Description of parameters	Def. value	Def. unit	FW vers.
P1 | P2,	Puncturing scheme for MCS-1	P1	–	V3.40
P1 | P2,	Puncturing scheme for MCS-2			
P1 | P2 | P3,	Puncturing scheme for MCS-3			
P1 | P2 | P3,	Puncturing scheme for MCS-4			
P1 | P2,	Puncturing scheme for MCS-5			
P1 | P2,	Puncturing scheme for MCS-6			
P1 | P2 | P3,	Puncturing scheme for MCS-7 block 1			
P1 | P2 | P3,	Puncturing scheme for MCS-7 block 2			
P1 | P2 | P3,	Puncturing scheme for MCS-8 block 1			
P1 | P2 | P3,	Puncturing scheme for MCS-8 block 2			
P1 | P2 | P3,	Puncturing scheme for MCS-9 block 1			
P1 | P2 | P3	Puncturing scheme for MCS-9 block 2			
Description of command				Sig. State
This command selects the EGPRS puncturing scheme for packet data channels. See note on *Current vs. default values* on p. 6.239.				all

CONFigure:NETWork:PDATa:EGPPRs:PSCHeme:IREDundancy <*Enable*>				Incremental Redundancy
<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | OFF	Enable or disable incremental redundancy	ON	–	V3.40
Description of command				Sig. State
This command enables or disables incremental redundancy RLC mode for the downlink.				all

CONFigure:NETWork:PDATa:PCMChannel <*Type*>				PC Meas. Channel
<Type>	Description of parameters	Def. value	Def. unit	FW vers.
BCCH | PDCH	PC measurement channel	BCCH	–	V3.05
Description of command				Sig. State
This command defines the channel type that the mobile uses to determine the received signal strength and quality.				SOFF, IDLE Q: all

CONFigure:NETWork:PDATa:USF <*Code*>				Uplink State Flag
<Code>	Description of parameters	Def. value	Def. unit	FW vers.
0 to 7	Uplink State Flag	0	–	V3.05
Description of command				Sig. State
This command defines the Uplink State Flag (USF) in the blocks transmitted to the MS while the CMU is in GPRS test mode.				SOFF, IDLE Q: all

PROCedure:NETWork:PDATa:UDCYcle <*Code*>				USF Duty Cycle
<Code>	Description of parameters	Def. value	Def. unit	FW vers.
A100 | **A000 |** **A012**	100 % assigned 0 % assigned, 100 % random 12.5 % assigned, 87.5 % random	A100	–	V3.40
Description of command				Sig. State
This command defines the percentage of downlink radio blocks that are transmitted with the USF assigned to the MS. The value is reset to 100% each time that a connection is set up.				TEST Q: all

CONFigure:NETWork:PDATa:EDALlocation <*Enable*>				Extend. Dyn. Alloc..
<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | OFF | **AUTO**	Enable or disable extended dynamic allocation Enable only if the MS supports extended dynamic allocation	AUTO	–	V3.05
Description of command				Sig. State
This command enables or disables extended dynamic allocation of the mobile.				SOFF, IDLE Q: all

CONFigure:NETWork:PDATa:NOPDus <*Number*>				Number of PDUs
<Number>	Description of parameters	Def. value	Def. unit	FW vers.
1 to 4095	Number of PDUs	4095	–	V3.05
Description of command				Sig. State
This command defines the number of Protocol Data Units (PDUs) that the MS is to transmit in the uplink during GPRS test mode A.				SOFF, IDLE Q: all

CONFigure:NETWork:PDATa:SOFFset <*Offset*>				Slot Offset
<Code>	Description of parameters	Def. value	Def. unit	FW vers.
0 to 7	Slot Offset	0	–	V3.05
Description of command				Sig. State
This command defines the timeslot to be taken as the first downlink timeslot when the MS is in multislot operation.				SOFF, IDLE Q: all

CONFigure:NETWork:PDATa:TWACk <*Enable*>				Testmode with ACK
<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | OFF	Enable or disable test mode with ACK	OFF	–	V3.05
Description of command				Sig. State
This command enables or disables the operating mode where the mobile periodically transmits a PACKET_UPLINK_ACK_NACK message (GSM 04.60) while it is in test mode B.				SOFF, IDLE Q: all

CONFigure:NETWork:PDATa:CATYpe <*Mode*> **PROCedure:NETWork:PDATa:CATYpe <*Mode*>**				Control ACK Type
<*Mode*>	Description of parameters	Def. value	Def. unit	FW vers.
NBUR | **ABUR**	Normal bursts (RLC/MAC blocks) Access bursts	NBUR	–	V3.60
Description of command				Sig. State
This command specifies whether a mobile in test mode A sends its CONTROL_ACK_TYPE messages (TS 44.060) on four access bursts *(Access Bursts)* or in an RLC/MAC block (Packet Control Acknowledgement message, *Normal Bursts).*				all

CONFigure:NETWork:PDATa:RLCMode <*Mode*>				RLC Mode (Testmode B)
<*Mode*>	Description of parameters	Def. value	Def. unit	FW vers.
ACKN | **UNAC**	Acknowledged mode (for special applications) Unacknowledged mode	UNAC	–	V3.10
Description of command				Sig. State
This command defines the downlink RLC mode for a packet data connection in test mode B. According to standard GSM 04.14, test mode B corresponds to *Unacknowledged* operation where the MS loops back all data received.				SOFF, IDLE, ATT Q: all

CONFigure:NETWork:PDATa:PDPContext <*Mode*>				PDP Context Activation
<*Mode*>	Description of parameters	Def. value	Def. unit	FW vers.
ACC | **REJ**	Accept PDP context activation Reject PDP context activation	ACC	–	V3.50
Description of command				Sig. State
This command determines how the CMU reacts to a PDP context activation initiated by the MS.				all

CONFigure:NETWork:PDATa:TAVGt <*Value*>				T_{AVG_T}
<*Value*>	Description of parameters	Def. value	Def. unit	FW vers.
0 to 31	T_{AVG_T} parameter	2	–	V3.60
Description of command				Sig. State
This command specifies the signal level filter period for power control in packet transfer mode. The values 0 through 25 are specified in standard 3GPP TS 45.008.				all

CONFigure:NETWork:PDATa:BPERiod <*Value*>				BEP Period
<*Value*>	Description of parameters	Def. value	Def. unit	FW vers.
0 to 15	BEP_PERIOD parameter	2	–	V3.80
Description of command				Sig. State
This command specifies the BEP_PERIOD, a four-bit value defined in standard 3GPP TS 05.08, section 10.2.3.2.1.				all

CONFigure:NETWork:PDATa:TRFL <*Enable*>				Test Mode RF Level Reporting
<Value>	Description of parameters	Def. value	Def. unit	FW vers.
ON | OFF	Enable or disable test mode	OFF	–	V3.60
Description of command				Sig. State
Enables or disables the transfer of the packet data receiver reports in the uplink signal. While the test mode is *Off*, the control blocks carrying the receiver reports are eliminated so that the BER measurement is slightly faster.				all

CONFigure:NETWork:PDATa:BITStream <*Mode*> **PROCedure:NETWork:PDATa:BITStream <*Mode*>**				Bit Stream
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
PR9 | **PR11 |** **PR15 |** **PR16**	2^{9}-1 PSR bit pattern 2^{11}-1 PSR bit pattern 2^{15}-1 PSR bit pattern 2^{16}-1 PSR bit pattern	PR9	–	V3.05
Description of command				Sig. State
This command defines the pseudo random bit sequence that the CMU transmits to the MS in GPRS test mode. See note on *Current vs. default values* on p. 6.239.				all

MSSinfo
(Signalling information of mobile phone)

The subsystem *MSSinfo* contains the commands for querying the parameters of the mobile. The subsystem corresponds to the *Signalling Info* output table in the main menu *GSMxxx-MS Overview.* The mobile parameters do not actually represent a measured value, they are provided by the mobile phone during location update. The following parameters are related to packet data transfer.

[SENSe:]MSSinfo:MSCLass:PDATa[:GPRS]? **[SENSe:]MSSinfo:MSCLass:PDATa:EGPRs?**				Multislot Class
Returned values	Description of parameters	Def. value	Def. unit	FW vers.
CL1 to CL29	Multislot class of the mobile	NAN	–	V3.05
Description of command				Sig. State
This command is always a query and returns the multislot class of a GPRS or EGPRS mobile.				ATT TEST

Adaptive Multi-Rate (AMR) Speech Codec (Option R&S CMU-K45)

With option R&S CMU-K45, the CMU provides the functionality for AMR speech codec tests. The additional commands belong the the *NETWork[:CSWitched]…* and *MSSinfo* subsystems.

Note: *In addition to the commands reported in this section, some RXQuality commands are related to the AMR speech codec (AMR inband FER tests). Furthermore, the AMR codecs must be selected via* `CONFigure:NETWork[:CSWitched]:SMODe:TRAFfic AMRF | AMRH`.

Subsystem NETWork[:CSWitched]:AMR (AMR Codec Test)

The subsystem *NETWork[:CSWitched]:AMR* comprises the commands to configure and test the AMR speech codec. The subsystem corresponds to the table section *Adaptive Multi-Rate (AMR)* in the *Network* tab of the *Connection Control* menu.

CONFigure:NETWork[:CSWitched]:AMR:NSUPpression <*Enable*>				Noise Suppression
<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | OFF	Noise suppression switched on or off	ON	–	V3.40
Description of command				Sig. State
This command switches noise suppression at the AMR speech codec of the MS on or off.				≠CEST, Q: all

CONFigure:NETWork[:CSWitched]:AMR:HRATe:DLCMode <*Mode*> **PROCedure:NETWork[:CSWitched]:AMR:HRATe:DLCMode <*Mode*>**				Codec Mode DL, Half Rate
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
CM1 | CM2 | CM3 | CM4	DL codec mode 1, 2, 3, 4	CM3	–	V3.40
Description of command				Sig. State
This command sets the codec mode that the CMU uses to generate the speech data transmitted to the MS under test. The setting is valid for Half Rate AMR speech coder tests; see command `CONFigure:NETWork[:CSWitched]:SMODe:TRAFfic` on p. 6.223. To query the DL codec mode that the MS requests use `[SENSe:]MSSinfo:AMR:HRATe:DLCMode?` (p. 6.256).				all

CONFigure:NETWork[:CSWitched]:AMR:FRATe:DLCMode <*Mode*> **PROCedure:NETWork[:CSWitched]:AMR:FRATe:DLCMode <*Mode*>**				Codec Mode DL, Full Rate
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
CM1 | CM2 | CM3 | CM4	DL codec mode 1, 2, 3, 4	CM3	–	V3.40
Description of command				Sig. State
This command sets the codec mode that the CMU uses to generate the speech data transmitted to the MS under test. The setting is valid for Full Rate AMR speech coder tests; see command `CONFigure:NETWork[:CSWitched]:SMODe:TRAFfic` on p. 6.223. To query the DL codec mode that the MS requests use `[SENSe:]MSSinfo:AMR:FRATe:DLCMode?` (see p. 6.256).				all

CONFigure:NETWork[:CSWitched]:AMR:HRATe:ULCMode *<Mode>* PROCedure:NETWork[:CSWitched]:AMR:HRATe:ULCMode *<Mode>*				Codec Mode UL, Half Rate
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
CM1 | CM2 | CM3 | CM4	UL codec mode 1, 2, 3, 4	CM3	–	V3.40
Description of command				Sig. State
This command sets the codec mode that the mobile under test shall use in uplink direction. The setting is valid for Half Rate AMR speech coder tests; see command `CONFigure:NETWork[:CSWitched]:SMODe:TRAFfic` on p. 6.223. To query the UL codec mode that is actually used by the MS use `[SENSe:]MSSinfo:AMR:HRATe:ULCMode?` (see p. 6.256).				all

CONFigure:NETWork[:CSWitched]:AMR:FRATe:ULCMode *<Mode>* PROCedure:NETWork[:CSWitched]:AMR:FRATe:ULCMode *<Mode>*				Codec Mode UL, Full Rate
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
CM1 | CM2 | CM3 | CM4	UL codec mode 1, 2, 3, 4	CM3	–	V3.40
Description of command				Sig. State
This command sets the codec mode that the mobile under test shall use in uplink direction. The setting is valid for Full Rate AMR speech coder tests; see command `CONFigure:NETWork[:CSWitched]:SMODe:TRAFfic` on p. 6.223. To query the UL codec mode that is actually used by the MS use `[SENSe:]MSSinfo:AMR:FRATe:ULCMode?` (see p. 6.256).				all

CONFigure:NETWork[:CSWitched]:AMR:HRATe:RSETting AMR Rate Set, Half Rate
PROCedure:NETWork[:CSWitched]:AMR:HRATe:RSETting
<CM4>, <CM3>, CM2>, <CM1>,
<ThrDown4>, <ThrUp3>, <ThrDown3>, <ThrUp2>, <ThrDown2>, <ThrUp1>

<CM4>, <CM3>, <CM2>, CM1>	Description of parameters	Def. value	Def. unit	FW vers.
C1220 | C1020 | C0795 | C0740 | C0670 | C0590 | C0515 | C0475 | **OFF**	User bit rate for codec modes 4 to 1. The rates must be in descending order so that <CM4> is the largest bit rate. Mode switched off.	C0795, C0670, C0590, C0515,	–	
<ThrDown4>	Description of parameters	Def. value	Def. unit	
0.0 dB to 31.5 dB (in 0.5 dB steps)	Lower decision threshold for switching between modes 4 and 3	15.0,	dB	
<ThrUp3>	Description of parameters	Def. value	Def. unit	
0.0 dB to 31.5 dB (in 0.5 dB steps)	Upper decision threshold for switching between modes 3 and 4	17.0,	dB	
<ThrDown3>	Description of parameters	Def. value	Def. unit	
0.0 dB to 31.5 dB (in 0.5 dB steps)	Lower decision threshold for switching between modes 3 and 2	12.5,	dB	
<ThrUp2>	Description of parameters	Def. value	Def. unit	
0.0 dB to 31.5 dB (in 0.5 dB steps)	Upper decision threshold for switching between modes 2 and 3	15.0,	dB	
<ThrDown2>	Description of parameters	Def. value	Def. unit	
0.0 dB to 31.5 dB (in 0.5 dB steps)	Lower decision threshold for switching between modes 2 and 1	11.0,	dB	
<ThrUp1>	Description of parameters	Def. value	Def. unit	FW vers.
0.0 dB to 31.5 dB (in 0.5 dB steps)	Upper decision threshold for switching between modes 1 and 2	13.0	dB	V3.40

Description of command	Sig. State
These commands select four codec modes and define the decision thresholds for changing the codec mode. The settings are valid for Half Rate AMR speech coder tests; see command `CONFigure:NETWork[:CSWitched]:SMODe:TRAFfic` on p. 6.223. The instrument rejects the settings (SCPI error –221, Settings conflict) unless the values meet all of the following conditions: • The rates must be in descending order so that <CM4> is the largest bit rate. • Up to 3 codec modes can be switched off. OFF must be the first values of the parameter list, preceding the used codec modes. • Thresholds must be in descending order so that <ThrDown2> ≤ <ThrDown3> ≤ <ThrDown4> and <ThrUp1> ≤ <ThrUp2> ≤ <ThrUp3>. • The hysteresis must be positive so that Up (j) ≥ Down (j + 1) for j= 1 to 3 To query the DL codec mode requested by the MS use `[SENSe:]MSSinfo:AMR:HRATe:DLCMode?` (see p. 6.256).	all

CONFigure:NETWork[:CSWitched]:AMR:FRATe:RSETting **PROCedure:NETWork[:CSWitched]:AMR:FRATe:RSETting** ***<CM4>, <CM3>, CM2>, <CM1>,*** ***<ThrDown4>, <ThrUp3>, <ThrDown3>, <ThrUp2>, <ThrDown2>, <ThrUp1>***		AMR Rate Set, Full Rate		
<CM4>, <CM3>, <CM2>, CM1>	Description of parameters	Def. value	Def. unit	
C1220 | C1020 | C0795 | C0740 | C0670 | C0590 | C0515 | C0475 | OFF	User bit rate for codec modes 4 to 1. The rates must be in descending order so that <CM4> is the largest bit rate. Mode switched off.	C1220, C0795, C0590, C0475,	–	
<ThrDown4>	Description of parameters	Def. value	Def. unit	
0.0 dB to 31.5 dB (in 0.5 dB steps)	Lower decision threshold for switching between modes 4 and 3	16.5,	dB	
<ThrUp3>	Description of parameters	Def. value	Def. unit	
0.0 dB to 31.5 dB (in 0.5 dB steps)	Upper decision threshold for switching between modes 3 and 4	18.5,	dB	
<ThrDown3>	Description of parameters	Def. value	Def. unit	
0.0 dB to 31.5 dB (in 0.5 dB steps)	Lower decision threshold for switching between modes 3 and 2	11.5,	dB	
<ThrUp2>	Description of parameters	Def. value	Def. unit	
0.0 dB to 31.5 dB (in 0.5 dB steps)	Upper decision threshold for switching between modes 2 and 3	13.5,	dB	
<ThrDown2>	Description of parameters	Def. value	Def. unit	
0.0 dB to 31.5 dB (in 0.5 dB steps)	Lower decision threshold for switching between modes 2 and 1	6.5,	dB	
<ThrUp1>	Description of parameters	Def. value	Def. unit	FW vers.
0.0 dB to 31.5 dB (in 0.5 dB steps)	Upper decision threshold for switching between modes 1 and 2	8.5	dB	V3.40
Description of command				Sig. State
These commands select four codec modes and define the decision thresholds for changing the codec mode. The settings are valid for Full Rate AMR speech coder tests; see command `CONFigure:NETWork[:CSWitched]:SMODe:TRAFfic` on p. 6.223. The instrument rejects the settings (SCPI error –221, Settings conflict) unless the values meet all of the following conditions: • The rates must be in descending order so that <CM4> is the largest bit rate. • Up to 3 codec modes can be switched off. OFF must be the first values of the parameter list, preceding the used codec modes. • Thresholds must be in descending order so that <ThrDown2> ≤ <ThrDown3> ≤ <ThrDown4> and <ThrUp1> ≤ <ThrUp2> ≤ <ThrUp3>. • The hysteresis must be positive so that Up (j) ≥ Down (j + 1) for j= 1 to 3 To query the DL codec mode requested by the MS use `[SENSe:]MSSinfo:AMR:FRATe:DLCMode?` (see p. 6.256).				all

MSSinfo (AMR Codec Modes)

The subsystem *MSSinfo* contains the commands to query the AMR codec modes used and requested by the mobile. The information is provided in the *Network* tab of the *Connection Control* menu.

[SENSe:]MSSinfo:AMR:HRATe:DLCMode?	Codec Mode DL, requested by MS (Half Rate)			
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
CM1 | CM2 | CM3 | CM4	DL codec mode 1, 2, 3, 4	NAN	–	V3.40
Description of command				Sig. State
This command is always a query and returns the codec mode that the MS requests according to the *AMR Rate Set* settings (see command `CONFigure:NETWork[:CSWitched]:AMR:HRATe:RSETting` (see p. 6.254). The setting is valid for Half Rate AMR speech coder tests; see command `CONFigure:NETWork[:CSWitched]:SMODe:TRAFfic` on p. 6.223.				CEST

[SENSe:]MSSinfo:AMR:FRATe:DLCMode?	Codec Mode DL, requested by MS (Full Rate)			
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
CM1 | CM2 | CM3 | CM4	DL codec mode 1, 2, 3, 4	NAN	–	V3.40
Description of command				Sig. State
This command is always a query and returns the codec mode that the MS requests according to the *AMR Rate Set* settings (see command `CONFigure:NETWork[:CSWitched]:AMR:FRATe:RSETting` (see p. 6.255). The setting is valid for Full Rate AMR speech coder tests; see command `CONFigure:NETWork[:CSWitched]:SMODe:TRAFfic` on p. 6.223.				CEST

[SENSe:]MSSinfo:AMR:HRATe:ULCMode?	Codec Mode UL, used by MS (Half Rate)			
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
CM1 | CM2 | CM3 | CM4	UL codec mode 1, 2, 3, 4	NAN	–	V3.40
Description of command				Sig. State
This command is always a query and returns the actual UL codec mode used by the MS, irrespective of the commanded codec mode (see command `CONFigure:NETWork[:CSWitched]:AMR:HRATe:ULCMode` on p. 6.253). The setting is valid for Half Rate AMR speech coder tests; see command `CONFigure:NETWork[:CSWitched]:SMODe:TRAFfic` on p. 6.223.				CEST

[SENSe:]MSSinfo:AMR:FRATe:ULCMode?	Codec Mode UL, used by MS (Full Rate)			
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
CM1 | CM2 | CM3 | CM4	UL codec mode 1, 2, 3, 4	NAN	–	V3.40
Description of command				Sig. State
This command is always a query and returns the actual UL codec mode used by the MS, irrespective of the commanded codec mode (see command `CONFigure:NETWork[:CSWitched]:AMR:FRATe:ULCMode` on p. 6.253). The setting is valid for Full Rate AMR speech coder tests; see command `CONFigure:NETWork[:CSWitched]:SMODe:TRAFfic` on p. 6.223.				CEST

List of Commands

In the following, all remote control commands of the function group GSM900/1800/1900-MS are listed with their parameters and page numbers. They are arranged alphabetically according to the **second** keyword of the command so that related commands belong to the same group. The commands for the two test modes *Non Signalling* and *Signalling* are listed separately.

Commands for GSM Module Tests

Table 6-1 Remote control commands: Non Signalling

Command, Non Signalling	Parameters	Types	Page
Inputs and outputs			
[SENSe:]CORRection:LOSS:INPut<nr>[:MAGNitude]	–50 dB to +90 dB	with query	6.9
SOURce:CORRection:LOSS:INPut<nr>[:MAGNitude]	–50 dB to +90 dB	with query	6.9
[SENSe:]CORRection:LOSS:OUTPut<nr>:AUXTx: OLEVel[:MAGNitude]	–50 dB to 90 dB	with query	6.10
SOURce:CORRection:LOSS:OUTPut<nr>:AUXTx: OLEVel[:MAGNitude]	–50 dB to 90 dB	with query	6.10
[SENSe:]CORRection:LOSS:OUTPut<nr>:AUXTx[:MAGNitude]	–50 dB to 90 dB	with query	6.10
SOURce:CORRection:LOSS:OUTPut<nr>:AUXTx[:MAGNitude]	–50 dB to 90 dB	with query	6.10
[SENSe:]CORRection:LOSS:OUTPut<nr>[:MAGNitude]	–50 dB to +90 dB	with query	6.9
SOURce:CORRection:LOSS:OUTPut<nr>[:MAGNitude]	–50 dB to +90 dB	with query	6.9
SOURce:DM:CLOCk:FREQuency	1.219 MHz to 39.000 MHz	with query	6.11
SOURce:DM:CLOCk:STATe	ON | OFF	with query	6.11
INPut[:STATe]	RF1 | RF2 | RF4	with query	6.9
OUTPut[:STATe]	RF1 | RF2 | RF3	with query	6.9
OUTPut:AUXTx[:STATe]	ON | OFF	with query	6.10
OUTPut:AUXTx:OLEVel[:STATe]	ON | OFF	with query	6.10
I/Q-IF Inputs and Outputs			
IQIF:DEFault	ON | OFF	with query	6.74
CONFigure:IQIF:RXPath	BYP | BYIQ | XOIO | IOIO | IOXO	with query	6.74
CONFigure:IQIF:RXTXcombined	BYP | BYIQ | XOIO | IOIO | IOXO | FPAT | UDEF	with query	6.73
CONFigure:IQIF:TXPath	BYP | BYIQ | XOIO | IOIO | IOXO	with query	6.74
Input and output level			
[SENSe:]LEVel:ATTenuation	NORMal | LNOise | LDIStortion	with query	6.2
[SENSe:]LEVel:DEFault	ON | OFF	with query	6.2
[SENSe:]LEVel:MAXimum	<Level>	with query	6.2
[SENSe:]LEVel:MODE	MANual | AUTomatic	with query	6.1
File Management			
MMEMory:RECall:CURRent	<FileName> [,<msus>]	no query	6.13
MMEMory:SAVE:CURRent	<FileName> [,<msus>]	no query	6.13
Modulation measurement: 8PSK Modulation, Error Vector Magnitude			
INITiate:MODulation:EVMagnitude:EPSK	–	no query	6.128
ABORt:MODulation:EVMagnitude:EPSK	–	no query	6.128

Command, Non Signalling	Parameters	Types	Page
STOP:MODulation:EVMagnitude:EPSK	–	no query	6.128
CONTinue:MODulation:EVMagnitude:EPSK	–	no query	6.128
CONFigure:SUBarrays:MODulation:EVMagnitude:EPSK	ALL | ARIThmetical | MINimum | MAXimum | IVAL,<Start>,<Samples>{,<Start>, <Samples>}	with query	6.130
READ:ARRay:MODulation:EVMagnitude:EPSK:AVERage?	0.0 % to +100.0 %	query only	6.132
FETCh:ARRay:MODulation:EVMagnitude:EPSK:AVERage?	0.0 % to +100.0 %	query only	6.132
SAMPle:ARRay:MODulation:EVMagnitude:EPSK:AVERage?	0.0 % to +100.0 %	query only	6.132
READ:SUBarrays:MODulation:EVMagnitude:EPSK:AVERage?	0.0 % to +100.0 %	query only	6.132
FETCh:SUBarrays:MODulation:EVMagnitude:EPSK:AVERage?	0.0 % to +100.0 %	query only	6.132
SAMPle:SUBarrays:MODulation:EVMagnitude:EPSK:AVERage ?	0.0 % to +100.0 %	query only	6.132
CONFigure:MODulation:EVMagnitude:EPSK:CONTrol	SCALar | ARRay, 1 to 1000 | NONE	with query	6.129
CONFigure:MODulation:EVMagnitude:EPSK:CONTrol:DEFault	ON | OFF	with query	6.130
CONFigure:MODulation:EVMagnitude:EPSK:CONTrol :REPetition	CONTinuous | SINGleshot | 1 to 10000, SONerror | NONE, STEP | NONE	with query	6.129
READ[:SCALar]:MODulation:EVMagnitude:EPSK:DBITS:PEAK?	0 to 7	query only	6.133
FETCh[:SCALar]:MODulation:EVMagnitude:EPSK:DBITS :PEAK?	0 to 7	query only	6.133
SAMPle[:SCALar]:MODulation:EVMagnitude:EPSK:DBITS :PEAK?	0 to 7	query only	6.133
READ[:SCALar]:MODulation:EVMagnitude:EPSK:DBITS?	0 to 7	query only	6.133
FETCh[:SCALar]:MODulation:EVMagnitude:EPSK:DBITS?	0 to 7	query only	6.133
SAMPle[:SCALar]:MODulation:EVMagnitude:EPSK:DBITS?	0 to 7	query only	6.133
READ:ARRay:MODulation:EVMagnitude:EPSK:DBITS?	0 to 7, …	query only	6.134
FETCh:ARRay:MODulation:EVMagnitude:EPSK:DBITS?	0 to 7, …	query only	6.134
SAMPle:ARRay:MODulation:EVMagnitude:EPSK:DBITS?	0 to 7, …	query only	6.134
CONFigure:MODulation:EVMagnitude:EPSK:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.128
CALCulate:MODulation:EVMagnitude:EPSK:LIMit:MATChing?	<Result>	query only	6.131
READ:ARRay:MODulation:EVMagnitude:EPSK:MMAXimum?	0.0 % to +100.0 %	query only	6.132
FETCh:ARRay:MODulation:EVMagnitude:EPSK:MMAXimum?	0.0 % to +100.0 %	query only	6.132
SAMPle:ARRay:MODulation:EVMagnitude:EPSK:MMAXimum?	0.0 % to +100.0 %	query only	6.132
READ:SUBarrays:MODulation:EVMagnitude:EPSK :MMAXimum?	0.0 % to +100.0 %	query only	6.132
FETCh:SUBarrays:MODulation:EVMagnitude:EPSK :MMAXimum?	0.0 % to +100.0 %	query only	6.132
SAMPle:SUBarrays:MODulation:EVMagnitude:EPSK :MMAXimum?	0.0 % to +100.0 %	query only	6.132
FETCh:MODulation:EVMagnitude:EPSK:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 1 to 10000 | NONE , 1 to 1000 | NONE	query only	6.128
READ[:SCALar]:MODulation:EVMagnitude:EPSK?	<Result>	query only	6.131
FETCh[:SCALar]:MODulation:EVMagnitude:EPSK?	<Result>	query only	6.131
SAMPle[:SCALar]:MODulation:EVMagnitude:EPSK?	<Result>	query only	6.131
READ:ARRay:MODulation:EVMagnitude:EPSK[:CURRent]?	0.0 % to +100.0 %	query only	6.132
FETCh:ARRay:MODulation:EVMagnitude:EPSK[:CURRent]?	0.0 % to +100.0 %	query only	6.132
SAMPle:ARRay:MODulation:EVMagnitude:EPSK[:CURRent]?	0.0 % to +100.0 %	query only	6.132

Command, Non Signalling	Parameters	Types	Page
READ:SUBarrays:MODulation:EVMagnitude:EPSK[:CURRent]?	0.0 % to +100.0 %	query only	6.132
FETCh:SUBarrays:MODulation:EVMagnitude:EPSK[:CURRent]?	0.0 % to +100.0 %	query only	6.132
SAMPle:SUBarrays:MODulation:EVMagnitude:EPSK[:CURRent]?	0.0 % to +100.0 %	query only	6.132
Modulation measurement: 8PSK Modulation, I/Q Analyzer			
INITiate:MODulation:IQANalyzer:EPSK	–	no query	6.149
ABORt:MODulation:IQANalyzer:EPSK	–	no query	6.149
STOP:MODulation:IQANalyzer:EPSK	–	no query	6.149
CONTinue:MODulation:IQANalyzer:EPSK	–	no query	6.149
DEFault:MODulation:IQANalyzer:EPSK:CONTrol	ON | OFF	with query	6.150
CONFigure:MODulation:IQANalyzer:EPSK:CONTrol:REPetition	CONTinuous | SINGleshot | 1 to 10000, NONE, STEP | NONE	with query	6.150
CONFigure:MODulation:IQANalyzer:EPSK:CONTrol:RMODe	SCALar | ARRay	with query	6.150
CONFigure:MODulation:IQANalyzer:EPSK:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.149
READ:ARRay:MODulation:IQANalyzer:EPSK:IPHase?	–2.0 to +2.0 (568 values)	query only	6.151
FETCh:ARRay:MODulation:IQANalyzer:EPSK:IPHase?	–2.0 to +2.0 (568 values)	query only	6.151
SAMPle:ARRay:MODulation:IQANalyzer:EPSK:IPHase?	–2.0 to +2.0 (568 values)	query only	6.151
CONFigure:MODulation:IQANalyzer:EPSK:IQFilter	ISIRemoved | UNFiltered	with query	6.150
READ:ARRay:MODulation:IQANalyzer:EPSK:QPHase?	–2.0 to +2.0 (568 values)	query only	6.151
FETCh:ARRay:MODulation:IQANalyzer:EPSK:QPHase?	–2.0 to +2.0 (568 values)	query only	6.151
SAMPle:ARRay:MODulation:IQANalyzer:EPSK:QPHase?	–2.0 to +2.0 (568 values)	query only	6.151
CONFigure:MODulation:IQANalyzer:EPSK:ROTation	P38 | P38R	with query	6.150
FETCh:MODulation:IQANalyzer:EPSK:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 1 to 10000 | NONE , 1 to 1000 | NONE	query only	6.149
READ[:SCALar]:MODulation:IQANalyzer:EPSK?	<Result>	query only	6.151
FETCh[:SCALar]:MODulation:IQANalyzer:EPSK?	<Result>	query only	6.151
SAMPle[:SCALar]:MODulation:IQANalyzer:EPSK?	<Result>	query only	6.151
Modulation measurement: 8PSK Modulation, Magnitude Error			
INITiate:MODulation:MERRor:EPSK	–	no query	6.142
ABORt:MODulation:MERRor:EPSK	–	no query	6.142
STOP:MODulation:MERRor:EPSK	–	no query	6.142
CONTinue:MODulation:MERRor:EPSK	–	no query	6.142
CONFigure:SUBarrays:MODulation:MERRor:EPSK	ALL | ARIThmetical | MINimum | MAXimum | IVAL,<Start>,<Samples>{,<Start>, <Samples>}	with query	6.144
READ:ARRay:MODulation:MERRor:EPSK:AVERage?	–100 % to +100 %	query only	6.146
FETCh:ARRay:MODulation:MERRor:EPSK:AVERage?	–100 % to +100 %	query only	6.146
SAMPle:ARRay:MODulation:MERRor:EPSK:AVERage?	–100 % to +100 %	query only	6.146
READ:SUBarrays:MODulation:MERRor:EPSK:AVERage?	–100 % to +100 %	query only	6.146
FETCh:SUBarrays:MODulation:MERRor:EPSK:AVERage?	–100 % to +100 %	query only	6.146
SAMPle:SUBarrays:MODulation:MERRor:EPSK:AVERage?	–100 % to +100 %	query only	6.146
CONFigure:MODulation:MERRor:EPSK:CONTrol	SCALar | ARRay, 1 to 1000 | NONE	with query	6.143
CONFigure:MODulation:MERRor:EPSK:CONTrol:DEFault	ON | OFF	with query	6.144
CONFigure:MODulation:MERRor:EPSK:CONTrol:REPetition	CONTinuous | SINGleshot | 1 to 10000, SONerror | NONE, STEP |	with query	6.143

Command, Non Signalling	Parameters	Types	Page
	NONE		
CONFigure:MODulation:MERRor:EPSK:DBITs	ON | OFF	with query	6.147
READ[:SCALar]:MODulation:MERRor:EPSK:DBITS:PEAK?	0 to 7	query only	6.147
FETCh[:SCALar]:MODulation:MERRor:EPSK:DBITS:PEAK?	0 to 7	query only	6.147
SAMPle[:SCALar]:MODulation:MERRor:EPSK:DBITS:PEAK?	0 to 7	query only	6.147
READ[:SCALar]:MODulation:MERRor:EPSK:DBITS?	0 to 7	query only	6.147
FETCh[:SCALar]:MODulation:MERRor:EPSK:DBITS?	0 to 7	query only	6.147
SAMPle[:SCALar]:MODulation:MERRor:EPSK:DBITS?	0 to 7	query only	6.147
READ:ARRay:MODulation:MERRor:EPSK:DBITS?	0 to 7, …	query only	6.148
FETCh:ARRay:MODulation:MERRor:EPSK:DBITS?	0 to 7, …	query only	6.148
SAMPle:ARRay:MODulation:MERRor:EPSK:DBITS?	0 to 7, …	query only	6.148
CONFigure:MODulation:MERRor:EPSK:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.142
CALCulate:MODulation:MERRor:EPSK:LIMit:MATChing?	<Result>	query only	6.145
READ:ARRay:MODulation:MERRor:EPSK:MMAXimum?	–100 % to +100 %	query only	6.146
FETCh:ARRay:MODulation:MERRor:EPSK:MMAXimum?	–100 % to +100 %	query only	6.146
SAMPle:ARRay:MODulation:MERRor:EPSK:MMAXimum?	–100 % to +100 %	query only	6.146
READ:SUBarrays:MODulation:MERRor:EPSK:MMAXimum?	–100 % to +100 %	query only	6.146
FETCh:SUBarrays:MODulation:MERRor:EPSK:MMAXimum?	–100 % to +100 %	query only	6.146
SAMPle:SUBarrays:MODulation:MERRor:EPSK:MMAXimum?	–100 % to +100 %	query only	6.146
FETCh:MODulation:MERRor:EPSK:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 1 to 10000 | NONE , 1 to 1000 | NONE	query only	6.142
READ[:SCALar]:MODulation:MERRor:EPSK?	<Result>	query only	6.145
FETCh[:SCALar]:MODulation:MERRor:EPSK?	<Result>	query only	6.145
SAMPle[:SCALar]:MODulation:MERRor:EPSK?	<Result>	query only	6.145
READ:ARRay:MODulation:MERRor:EPSK[:CURRent]?	–100 % to +100 %	query only	6.146
FETCh:ARRay:MODulation:MERRor:EPSK[:CURRent]?	–100 % to +100 %	query only	6.146
SAMPle:ARRay:MODulation:MERRor:EPSK[:CURRent]?	–100 % to +100 %	query only	6.146
READ:SUBarrays:MODulation:MERRor:EPSK[:CURRent]?	–100 % to +100 %	query only	6.146
FETCh:SUBarrays:MODulation:MERRor:EPSK[:CURRent]?	–100 % to +100 %	query only	6.146
SAMPle:SUBarrays:MODulation:MERRor:EPSK[:CURRent]?	–100 % to +100 %	query only	6.146
Modulation measurement: Common commands			
CONFigure:MODulation:OEMP:EPSK:CONTrol:RPMode	CURRent | AVERage | DCOMpens	with query	6.125
CONFigure:MODulation:OEMP:EPSK:LIMit:AVERage	<PhaseErrorPeak>, <PhaseErrorRMS>, <MagnErrorPeak>, <MagnErrorRMS>,<EVMErrorPeak>, <EVMErrorRMS>, <OriginOffset>, <IQImbalance>, <FreqError>	with query	6.124
CONFigure:MODulation:OEMP:EPSK:LIMit:DEFault	ON | OFF	with query	6.125
CONFigure:MODulation:OEMP:EPSK:LIMit:P95Th	<EVM95%>, <MError95%>, <PError95%>	with query	6.125
CONFigure:MODulation:OEMP:EPSK:LIMit[:CURRent]	<PhaseErrorPeak>, <PhaseErrorRMS>, <MagnErrorPeak>, <MagnErrorRMS>,<EVMErrorPeak>, <EVMErrorRMS>, <OriginOffset>, <IQImbalance>, <FreqError>	with query	6.124
Modulation measurement: 8PSK Modulation, Overview			

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INITiate:MODulation:OVERview:EPSK	–	no query	6.122
ABORt:MODulation:OVERview:EPSK	–	no query	6.122
STOP:MODulation:OVERview:EPSK	–	no query	6.122
CONTinue:MODulation:OVERview:EPSK	–	no query	6.122
CONFigure:MODulation:OVERview:EPSK:CONTrol	SCALar | ARRay, 1 to 1000 | NONE	with query	6.123
CONFigure:MODulation:OVERview:EPSK:CONTrol:DEFault	ON | OFF	with query	6.124
CONFigure:MODulation:OVERview:EPSK:CONTrol:REPetition	CONTinuous | SINGleshot | 1 to 10000, SONerror | NONE, STEP | NONE	with query	6.123
CONFigure:MODulation:OVERview:EPSK:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.122
CALCulate:MODulation:OVERview:EPSK:LIMit:MATChing?	<Result>	query only	6.127
FETCh:MODulation:OVERview:EPSK:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 1 to 10000 | NONE , 1 to 1000 | NONE	query only	6.122
READ[:SCALar]:MODulation:OVERview:EPSK?	<Result>	query only	6.126
FETCh[:SCALar]:MODulation:OVERview:EPSK?	<Result>	query only	6.126
SAMPle[:SCALar]:MODulation:OVERview:EPSK?	<Result>	query only	6.126
Modulation measurement: Common commands			
CONFigure:MODulation:PVT:IRDTimeout	NORMal | MEDium | SHORt	with query	6.105
Modulation measurement: GMSK Modulation, Extended Phase Error			
INITiate:MODulation:XPERror[:GMSK]	–	no query	6.114
ABORt:MODulation:XPERror[:GMSK]	–	no query	6.114
STOP:MODulation:XPERror[:GMSK]	–	no query	6.114
CONTinue:MODulation:XPERror[:GMSK]	–	no query	6.114
CONFigure:SUBarrays:MODulation:XPERror[:GMSK]	ALL | ARIThmetical | MINimum | MAXimum | IVAL,<Start>,<Samples>{,<Start>, <Samples>}	with query	6.118
READ:ARRay:MODulation:XPERror[:GMSK]:AVERage?	–100.0 dB to +100.0 dB	query only	6.120
FETCh:ARRay:MODulation:XPERror[:GMSK]:AVERage?	–100.0 dB to +100.0 dB	query only	6.120
SAMPle:ARRay:MODulation:XPERror[:GMSK]:AVERage?	–100.0 dB to +100.0 dB	query only	6.120
READ:SUBarrays:MODulation:XPERror[:GMSK]:AVERage?	–100.0 dB to +20.0 dB	query only	6.121
FETCh:SUBarrays:MODulation:XPERror[:GMSK]:AVERage?	–100.0 dB to +20.0 dB	query only	6.121
SAMPle:SUBarrays:MODulation:XPERror[:GMSK]:AVERage?	–100.0 dB to +20.0 dB	query only	6.121
CONFigure:MODulation:XPERror[:GMSK]:CONTrol	SCALar | ARRay, 1 to 1000 | NONE	with query	6.115
CONFigure:MODulation:XPERror[:GMSK]:CONTrol:DEFault	ON | OFF	with query	6.116
CONFigure:MODulation:XPERror[:GMSK]:CONTrol:REPetition	CONTinuous | SINGleshot | 1 to 10000, SONerror | NONE, STEP | NONE	with query	6.116
CONFigure:MODulation:XPERror[:GMSK]:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.114
CONFigure:MODulation:XPERror[:GMSK]:FILTer	G500 | B600	with query	6.115
CONFigure:MODulation:XPERror[:GMSK]:LIMit:AVERage	0.0 deg to 50.0 deg, 0.0 deg to 50.0 deg, –100 dB to 0 dB, –100 dB to 0 dB, 0 Hz to 999 Hz	with query	6.117
CONFigure:MODulation:XPERror[:GMSK]:LIMit:DEFault	ON | OFF	with query	6.117
CONFigure:MODulation:XPERror[:GMSK]:LIMit:LOWer:MODE	ON | OFF	with query	6.117
CALCulate:MODulation:XPERror[:GMSK]:LIMit:MATChing?	<Result>	query only	6.120
CONFigure:MODulation:XPERror[:GMSK]:LIMit:UPPer:MODE	ON | OFF	with query	6.117

Command, Non Signalling	Parameters	Types	Page
CONFigure:MODulation:XPERror[:GMSK]:LIMit[:CURRent]	0.0 deg to 50.0 deg, 0.0 deg to 50.0 deg, –100 dB to 0 dB, –100 dB to 0 dB, 0 Hz to 999 Hz	with query	6.116
READ:ARRay:MODulation:XPERror[:GMSK]:MMAXimum?	–100.0 dB to +100.0 dB	query only	6.120
FETCh:ARRay:MODulation:XPERror[:GMSK]:MMAXimum?	–100.0 dB to +100.0 dB	query only	6.120
SAMPle:ARRay:MODulation:XPERror[:GMSK]:MMAXimum?	–100.0 dB to +100.0 dB	query only	6.120
READ:SUBarrays:MODulation:XPERror[:GMSK]:MMAXimum?	–100.0 dB to +20.0 dB	query only	6.121
FETCh:SUBarrays:MODulation:XPERror[:GMSK]:MMAXimum?	–100.0 dB to +20.0 dB	query only	6.121
SAMPle:SUBarrays:MODulation:XPERror[:GMSK]:MMAXimum?	–100.0 dB to +20.0 dB	query only	6.121
CONFigure:MODulation:XPERror[:GMSK]:RSTRecovery	NON **|** TSC	with query	6.115
FETCh:MODulation:XPERror[:GMSK]:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 1 to 10000 | NONE, 1 to 1000 | NONE	query only	6.114
CONFigure:MODulation:XPERror[:GMSK]:TIME:DECode	STANdard **|** GTBits	with query	6.115
READ[:SCALar]:MODulation:XPERror[:GMSK]?	<Result>	query only	6.119
FETCh[:SCALar]:MODulation:XPERror[:GMSK]?	<Result>	query only	6.119
SAMPle[:SCALar]:MODulation:XPERror[:GMSK]?	<Result>	query only	6.119
READ:ARRay:MODulation:XPERror[:GMSK][:CURRent]?	–100.0 dB to +100.0 dB	query only	6.120
FETCh:ARRay:MODulation:XPERror[:GMSK][:CURRent]?	–100.0 dB to +100.0 dB	query only	6.120
SAMPle:ARRay:MODulation:XPERror[:GMSK][:CURRent]?	–100.0 dB to +100.0 dB	query only	6.120
READ:SUBarrays:MODulation:XPERror[:GMSK][:CURRent]?	–100.0 dB to +20.0 dB	query only	6.121
FETCh:SUBarrays:MODulation:XPERror[:GMSK][:CURRent]?	–100.0 dB to +20.0 dB	query only	6.121
SAMPle:SUBarrays:MODulation:XPERror[:GMSK][:CURRent]?	–100.0 dB to +20.0 dB	query only	6.121
Modulation measurement: 8PSK Modulation, Phase Error			
INITiate:MODulation[:PERRor]:EPSK	–	no query	6.135
ABORt:MODulation[:PERRor]:EPSK	–	no query	6.135
STOP:MODulation[:PERRor]:EPSK	–	no query	6.135
CONTinue:MODulation[:PERRor]:EPSK	–	no query	6.135
CONFigure:SUBarrays:MODulation[:PERRor]:EPSK	ALL | ARIThmetical | MINimum | MAXimum | IVAL,<Start>,<Samples>{,<Start>, <Samples>}	with query	6.137
READ:ARRay:MODulation[:PERRor]:EPSK:AVERage?	–100.0 deg to +100.0 deg	query only	6.139
FETCh:ARRay:MODulation[:PERRor]:EPSK:AVERage?	–100.0 deg to +100.0 deg	query only	6.139
SAMPle:ARRay:MODulation[:PERRor]:EPSK:AVERage?	–100.0 deg to +100.0 deg	query only	6.139
READ:SUBarrays:MODulation[:PERRor]:EPSK:AVERage?	–100 deg to +100 deg	query only	6.139
FETCh:SUBarrays:MODulation[:PERRor]:EPSK:AVERage?	–100 deg to +100 deg	query only	6.139
SAMPle:SUBarrays:MODulation[:PERRor]:EPSK:AVERage?	–100 deg to +100 deg	query only	6.139
CONFigure:MODulation[:PERRor]:EPSK:CONTrol	SCALar | ARRay, 1 to 1000 | NONE	with query	6.136
CONFigure:MODulation[:PERRor]:EPSK:CONTrol:DEFault	ON | OFF	with query	6.137
CONFigure:MODulation[:PERRor]:EPSK:CONTrol:REPetition	CONTinuous | SINGleshot | 1 to 10000, SONerror | NONE, STEP | NONE	with query	6.136
CONFigure:MODulation[:PERRor]:EPSK:DBITs	ON | OFF	with query	6.133
CONFigure:MODulation[:PERRor]:EPSK:DBITs	ON | OFF	with query	6.140
READ[:SCALar]:MODulation[:PERRor]:EPSK:DBITS:PEAK?	0 to 7	query only	6.140
FETCh[:SCALar]:MODulation[:PERRor]:EPSK:DBITS:PEAK?	0 to 7	query only	6.140
SAMPle[:SCALar]:MODulation[:PERRor]:EPSK:DBITS:PEAK?	0 to 7	query only	6.140

Command, Non Signalling	Parameters	Types	Page
READ[:SCALar]:MODulation[:PERRor]:EPSK:DBITS?	0 to 7	query only	6.140
FETCh[:SCALar]:MODulation[:PERRor]:EPSK:DBITS?	0 to 7	query only	6.140
SAMPle[:SCALar]:MODulation[:PERRor]:EPSK:DBITS?	0 to 7	query only	6.140
READ:ARRay:MODulation[:PERRor]:EPSK:DBITS?	0 to 7, …	query only	6.141
FETCh:ARRay:MODulation[:PERRor]:EPSK:DBITS?	0 to 7, …	query only	6.141
SAMPle:ARRay:MODulation[:PERRor]:EPSK:DBITS?	0 to 7, …	query only	6.141
CONFigure:MODulation[:PERRor]:EPSK:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.135
CALCulate:MODulation[:PERRor]:EPSK:LIMit:MATChing?	<Result>	query only	6.138
READ:ARRay:MODulation[:PERRor]:EPSK:MMAXimum?	–100.0 deg to +100.0 deg	query only	6.139
FETCh:ARRay:MODulation[:PERRor]:EPSK:MMAXimum?	–100.0 deg to +100.0 deg	query only	6.139
SAMPle:ARRay:MODulation[:PERRor]:EPSK:MMAXimum?	–100.0 deg to +100.0 deg	query only	6.139
READ:SUBarrays:MODulation[:PERRor]:EPSK:MMAXimum?	–100 deg to +100 deg	query only	6.139
FETCh:SUBarrays:MODulation[:PERRor]:EPSK:MMAXimum?	–100 deg to +100 deg	query only	6.139
SAMPle:SUBarrays:MODulation[:PERRor]:EPSK:MMAXimum?	–100 deg to +100 deg	query only	6.139
FETCh:MODulation[:PERRor]:EPSK:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 1 to 10000 | NONE , 1 to 1000 | NONE	query only	6.135
READ[:SCALar]:MODulation[:PERRor]:EPSK?	<Result>	query only	6.138
FETCh[:SCALar]:MODulation[:PERRor]:EPSK?	<Result>	query only	6.138
SAMPle[:SCALar]:MODulation[:PERRor]:EPSK?	<Result>	query only	6.138
READ:ARRay:MODulation[:PERRor]:EPSK[:CURRent]?	–100.0 deg to +100.0 deg	query only	6.139
FETCh:ARRay:MODulation[:PERRor]:EPSK[:CURRent]?	–100.0 deg to +100.0 deg	query only	6.139
SAMPle:ARRay:MODulation[:PERRor]:EPSK[:CURRent]?	–100.0 deg to +100.0 deg	query only	6.139
READ:SUBarrays:MODulation[:PERRor]:EPSK[:CURRent]?	–100 deg to +100 deg	query only	6.139
FETCh:SUBarrays:MODulation[:PERRor]:EPSK[:CURRent]?	–100 deg to +100 deg	query only	6.139
SAMPle:SUBarrays:MODulation[:PERRor]:EPSK[:CURRent]?	–100 deg to +100 deg	query only	6.139
Modulation measurement: GMSK Modulation, Phase Error			
INITiate:MODulation[:PERRor][:GMSK]	–	no query	6.105
ABORt:MODulation[:PERRor][:GMSK]	–	no query	6.105
STOP:MODulation[:PERRor][:GMSK]	–	no query	6.105
CONTinue:MODulation[:PERRor][:GMSK]	–	no query	6.105
CONFigure:SUBarrays:MODulation[:PERRor][:GMSK]	ALL | ARIThmetical | MINimum | MAXimum | IVAL,<Start>,<Samples>{,<Start>, <Samples>}	with query	6.110
READ:ARRay:MODulation[:PERRor][:GMSK]:AVERage?	–100.0 dB to +100.0 dB	query only	6.112
FETCh:ARRay:MODulation[:PERRor][:GMSK]:AVERage?	–100.0 dB to +100.0 dB	query only	6.112
SAMPle:ARRay:MODulation[:PERRor][:GMSK]:AVERage?	–100.0 dB to +100.0 dB	query only	6.112
READ:SUBarrays:MODulation[:PERRor][:GMSK]:AVERage?	–100.0 dB to +20.0 dB	query only	6.113
FETCh:SUBarrays:MODulation[:PERRor][:GMSK]:AVERage?	–100.0 dB to +20.0 dB	query only	6.113
SAMPle:SUBarrays:MODulation[:PERRor][:GMSK]:AVERage?	–100.0 dB to +20.0 dB	query only	6.113
CONFigure:MODulation[:PERRor][:GMSK]:CONTrol	SCALar | ARRay, 1 to 1000 | NONE	with query	6.107
CONFigure:MODulation[:PERRor][:GMSK]:CONTrol:DEFault	ON | OFF	with query	6.107
CONFigure:MODulation[:PERRor][:GMSK]:CONTrol:REPetition	CONTinuous | SINGleshot | 1 to 10000, SONerror | NONE, STEP | NONE	with query	6.107
CONFigure:MODulation[:PERRor][:GMSK]:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.106

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CONFigure:MODulation[:PERror][:GMSK]:FILTer	G500 | B600	with query	6.106
CONFigure:MODulation[:PERRor][:GMSK]:LIMit:AVERage	0.0 deg to 50.0 deg, 0.0 deg to 50.0 deg, 0 Hz to 999 Hz	with query	6.108
CONFigure:MODulation[:PERRor][:GMSK]:LIMit:DEFault	ON | OFF	with query	6.109
CONFigure:MODulation[:PERRor][:GMSK]:LIMit:LOWer:MODE	ON | OFF	with query	6.108
CALCulate:MODulation[:PERRor][:GMSK]:LIMit:MATChing?	<Result>	query only	6.112
CONFigure:MODulation[:PERRor][:GMSK]:LIMit:UPPer:MODE	ON | OFF	with query	6.108
CONFigure:MODulation[:PERRor][:GMSK]:LIMit[:CURRent]	0.0 deg to 50.0 deg, 0.0 deg to 50.0 deg, 0 Hz to 999 Hz	with query	6.108
READ:ARRay:MODulation[:PERRor][:GMSK]:MMAXimum?	–100.0 dB to +100.0 dB	query only	6.112
FETCh:ARRay:MODulation[:PERRor][:GMSK]:MMAXimum?	–100.0 dB to +100.0 dB	query only	6.112
SAMPle:ARRay:MODulation[:PERRor][:GMSK]:MMAXimum?	–100.0 dB to +100.0 dB	query only	6.112
READ:SUBarrays:MODulation[:PERRor][:GMSK]:MMAXimum?	–100.0 dB to +20.0 dB	query only	6.113
FETCh:SUBarrays:MODulation[:PERRor][:GMSK]:MMAXimum?	–100.0 dB to +20.0 dB	query only	6.113
SAMPle:SUBarrays:MODulation[:PERRor][:GMSK]:MMAXimum ?	–100.0 dB to +20.0 dB	query only	6.113
FETCh:MODulation[:PERRor][:GMSK]:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 1 to 10000 | NONE, 1 to 1000 | NONE	query only	6.106
CONFigure:MODulation[:PERRor][:GMSK]:TIME:DECode	STANdard | GTBits	with query	6.109
READ[:SCALar]:MODulation[:PERRor][:GMSK]?	<Result>	query only	6.111
FETCh[:SCALar]:MODulation[:PERRor][:GMSK]?	<Result>	query only	6.111
SAMPle[:SCALar]:MODulation[:PERRor][:GMSK]?	<Result>	query only	6.111
READ:ARRay:MODulation[:PERRor][:GMSK][:CURRent]?	–100.0 dB to +100.0 dB	query only	6.112
FETCh:ARRay:MODulation[:PERRor][:GMSK][:CURRent]?	–100.0 dB to +100.0 dB	query only	6.112
SAMPle:ARRay:MODulation[:PERRor][:GMSK][:CURRent]?	–100.0 dB to +100.0 dB	query only	6.112
READ:SUBarrays:MODulation[:PERRor][:GMSK][:CURRent]?	–100.0 dB to +20.0 dB	query only	6.113
FETCh:SUBarrays:MODulation[:PERRor][:GMSK][:CURRent]?	–100.0 dB to +20.0 dB	query only	6.113
SAMPle:SUBarrays:MODulation[:PERRor][:GMSK][:CURRent]?	–100.0 dB to +20.0 dB	query only	6.113
NPOWer measurement			
INITiate:NPOWer	–	no query	6.79
ABORt:NPOWer	–	no query	6.79
STOP:NPOWer	–	no query	6.79
CONTinue:NPOWer	–	no query	6.79
CONFigure:NPOWer:CONTrol	1 to 1000 | NONE,CONTinuous | SINGleshot | 1 ... 10000, SONerror | NONE,STEP | NONE	with query	6.80
CONFigure:NPOWer:CONTrol:REPetition	CONTinuous | SINGleshot | 1 ... 10000, SONerror | NONE,STEP | NONE	with query	6.81
CONFigure:NPOWer:CONTrol:STATistics	1 to 1000 | NONE	with query	6.80
CONFigure:NPOWer:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.79
FETCh:NPOWer:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 1 to 10000 | NONE, 1 to 1000 | NONE	query only	6.79
READ[:SCALar]:NPOWer?	–30 dBm to +30 dBm	query only	6.81
FETCh[:SCALar]:NPOWer?	–30 dBm to +30 dBm	query only	6.81
SAMPle[:SCALar]:NPOWer?	–30 dBm to +30 dBm	query only	6.81
Options			

Command, Non Signalling	Parameters	Types	Page
SYSTem:OPTions:INFO:CURRent?		query only	6.73
POWer:FRAMe measurement			
INITiate:POWer:FRAMe	–	no query	6.91
ABORt:POWer:FRAMe	–	no query	6.91
STOP:POWer:FRAMe	–	no query	6.91
CONTinue:POWer:FRAMe	–	no query	6.91
CONFigure:SUBarrays:POWer:FRAMe	ALL | ARIThmetical | MINimum | MAXimum | IVAL,<Start>,<Samples>{,<Start>, <Samples>}	with query	6.93
CONFigure:POWer:FRAMe:CONTrol:DEFault	ON | OFF	with query	6.92
CONFigure:POWer:FRAMe:CONTrol:REPetition	CONTinuous | SINGleshot | 1 to 10000, SONerror | NONE, STEP | NONE	with query	6.92
CONFigure:POWer:FRAMe:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.91
CONFigure:POWer:FRAMe:FCOunt	1 to 128	with query	6.91
READ[:SCALar]:POWer:FRAMe:FPOWer<nr>?	<Result>	query only	6.94
FETCh[:SCALar]:POWer:FRAMe:FPOWer<nr>?	<Result>	query only	6.94
SAMPle[:SCALar]:POWer:FRAMe:FPOWer<nr>?	<Result>	query only	6.94
FETCh:POWer:FRAMe:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 1 to 10000 | NONE	query only	6.91
READ:ARRay:POWer:FRAMe?	<Result>	query only	6.94
FETCh:ARRay:POWer:FRAMe?	<Result>	query only	6.94
SAMPle:ARRay:POWer:FRAMe?	<Result>	query only	6.94
READ:SUBarrays:POWer:FRAMe?	<Result>	query only	6.94
FETCh:SUBarrays:POWer:FRAMe?	<Result>	query only	6.94
SAMPle:SUBarrays:POWer:FRAMe?	<Result>	query only	6.94
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INITiate:POWer:MSLot	–	no query	6.95
ABORt:POWer:MSLot	–	no query	6.95
STOP:POWer:MSLot	–	no query	6.95
CONTinue:POWer:MSLot	–	no query	6.95
CONFigure:SUBarrays:POWer:MSLot	ALL | ARITHmetical | MINimum | MAXimum,<Start>,<Samples>{,<Start>,<Samples>}	with query	6.99
[SENSe:]ARRay:POWer:MSLot:AREA:LIMit:INFO:STIMe?	<Start_Time>	query only	6.104
[SENSe:]ARRay:POWer:MSLot:AREA:LIMit:LOWer:INFO?	<Result>	query only	6.103
[SENSe:]ARRay:POWer:MSLot:AREA:LIMit:LOWer:LEVel?	<Result>	query only	6.103
[SENSe:]ARRay:POWer:MSLot:AREA:LIMit:LOWer:TIME?	<Result>	query only	6.103
CALCulate:ARRay:POWer:MSLot:AREA:LIMit: MATChing:MINimum?	<Matching>	query only	6.102
CALCulate:ARRay:POWer:MSLot:AREA:LIMit: MATChing[:CURRent]?	<Matching>	query only	6.102
[SENSe:]ARRay:POWer:MSLot:AREA:LIMit:UPPer:INFO?	<Result>	query only	6.103
[SENSe:]ARRay:POWer:MSLot:AREA:LIMit:UPPer:LEVel?	<Result>	query only	6.103
[SENSe:]ARRay:POWer:MSLot:AREA:LIMit:UPPer:TIME?	<Result>	query only	6.103
READ:ARRay:POWer:MSLot:AVERage?	–100.0 dB to +20.0 dB	query only	6.101
FETCh:ARRay:POWer:MSLot:AVERage?	–100.0 dB to +20.0 dB	query only	6.101
SAMPle:ARRay:POWer:MSLot:AVERage?	–100.0 dB to +20.0 dB	query only	6.101

Command, Non Signalling	Parameters	Types	Page
READ:SUBarrays:POWer:MSLot:AVERage?	–100.0 dB to +20.0 dB	query only	6.102
FETCh:SUBarrays:POWer:MSLot:AVERage?	–100.0 dB to +20.0 dB	query only	6.102
SAMPle:SUBarrays:POWer:MSLot:AVERage?	–100.0 dB to +20.0 dB	query only	6.102
CONFigure:POWer:MSLot:CONTrol	SCALar | ARRay, 1 to 1000 | NONE	with query	6.96
CONFigure:POWer:MSLot:CONTrol:DEFault	ON | OFF	with query	6.97
DISPlay:POWer:MSLot:CONTrol:GRID	ON | OFF	with query	6.96
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CONFigure:POWer:MSLot:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.95
CONFigure:POWer:MSLot:FILTer	G500 | B600	with query	6.98
CONFigure:POWer:MSLot:LIMit:LINE:GLEVel	0.00 dB to +10.00 dB	with query	6.98
CONFigure:POWer:MSLot:LIMit:LINE:OTEMPlate	RMAX | RSK	with query	6.98
CALCulate:ARRay:POWer:MSLot:LIMit:MATChing:MINimum?	<Matching>	query only	6.102
CALCulate:POWer:MSLot:LIMit:MATChing?	AvgBurstPowerCurr, PeakBurstPowerCurr, BurstMatching, AvgBurstPowerAvg	query only	6.100
CALCulate:ARRay:POWer:MSLot:LIMit:MATChing[:CURRent]?	<Matching>	query only	6.102
READ:ARRay:POWer:MSLot:MAXimum?	–100.0 dB to +20.0 dB	query only	6.101
FETCh:ARRay:POWer:MSLot:MAXimum?	–100.0 dB to +20.0 dB	query only	6.101
SAMPle:ARRay:POWer:MSLot:MAXimum?	–100.0 dB to +20.0 dB	query only	6.101
READ:SUBarrays:POWer:MSLot:MAXimum?	–100.0 dB to +20.0 dB	query only	6.102
FETCh:SUBarrays:POWer:MSLot:MAXimum?	–100.0 dB to +20.0 dB	query only	6.102
SAMPle:SUBarrays:POWer:MSLot:MAXimum?	–100.0 dB to +20.0 dB	query only	6.102
READ:ARRay:POWer:MSLot:MINimum?	–100.0 dB to +20.0 dB	query only	6.101
FETCh:ARRay:POWer:MSLot:MINimum?	–100.0 dB to +20.0 dB	query only	6.101
SAMPle:ARRay:POWer:MSLot:MINimum?	–100.0 dB to +20.0 dB	query only	6.101
READ:SUBarrays:POWer:MSLot:MINimum?	–100.0 dB to +20.0 dB	query only	6.102
FETCh:SUBarrays:POWer:MSLot:MINimum?	–100.0 dB to +20.0 dB	query only	6.102
SAMPle:SUBarrays:POWer:MSLot:MINimum?	–100.0 dB to +20.0 dB	query only	6.102
CONFigure:POWer:MSLot:MVIew	<Mod_-1>,<Mod_0>, <Mod_1>, <Mod_2>	with query	6.97
CONFigure:POWer:MSLot:SCOunt	1 to 4	with query	6.97
FETCh:POWer:MSLot:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 1 to 10000 | NONE , 1 to 1000 | NONE	query only	6.95
CONFigure:POWer:MSLot:TOFFset	–4.00 to +4.00	with query	6.97
CONFigure:POWer:MSLot:TSALevel	–4.00 to +4.00	with query	6.98
READ[:SCALar]:POWer:MSLot?	<Result>	query only	6.100
FETCh[:SCALar]:POWer:MSLot?	<Result>	query only	6.100
SAMPle[:SCALar]:POWer:MSLot?	<Result>	query only	6.100
READ:ARRay:POWer:MSLot[:CURRent]?	–100.0 dB to +20.0 dB	query only	6.101
FETCh:ARRay:POWer:MSLot[:CURRent]?	–100.0 dB to +20.0 dB	query only	6.101
SAMPle:ARRay:POWer:MSLot[:CURRent]?	–100.0 dB to +20.0 dB	query only	6.101
READ:SUBarrays:POWer:MSLot[:CURRent]?	–100.0 dB to +20.0 dB	query only	6.102
FETCh:SUBarrays:POWer:MSLot[:CURRent]?	–100.0 dB to +20.0 dB	query only	6.102
SAMPle:SUBarrays:POWer:MSLot[:CURRent]?	–100.0 dB to +20.0 dB	query only	6.102

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POWer: Common commands			
CONFigure:POWer:PVT:IRDTimeout	NORMal | MEDium | SHORt	with query	6.82
POWer:SLOT measurement			
INITiate:POWer:SLOT	–	no query	6.82
ABORt:POWer:SLOT	–	no query	6.82
STOP:POWer:SLOT	–	no query	6.82
CONTinue:POWer:SLOT	–	no query	6.82
CONFigure:SUBarrays:POWer:SLOT	ALL | ARIThmetical | MINimum | MAXimum | IVAL,<Start>,<Samples>{,<Start>,<Samples>}	with query	6.84
CONFigure:POWer:SLOT:CONTrol:DEFault	ON | OFF	with query	6.83
CONFigure:POWer:SLOT:CONTrol:REPetition	CONTinuous | SINGleshot | 1 to 10000, SONerror | NONE, STEP | NONE	with query	6.83
CONFigure:POWer:SLOT:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.82
READ[:SCALar]:POWer:SLOT:SPOWer<nr>?	<Result>	query only	6.84
FETCh[:SCALar]:POWer:SLOT:SPOWer<nr>?	<Result>	query only	6.84
SAMPle[:SCALar]:POWer:SLOT:SPOWer<nr>?	<Result>	query only	6.84
FETCh:POWer:SLOT:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 1 to 10000 | NONE	query only	6.83
READ:ARRay:POWer:SLOT?	<Result>	query only	6.85
FETCh:ARRay:POWer:SLOT?	<Result>	query only	6.85
SAMPle:ARRay:POWer:SLOT?	<Result>	query only	6.85
READ:SUBarrays:POWer:SLOT?	<Result>	query only	6.85
FETCh:SUBarrays:POWer:SLOT?	<Result>	query only	6.85
SAMPle:SUBarrays:POWer:SLOT?	<Result>	query only	6.85
POWer:XSLOT measurement			
INITiate:POWer:XSLot	–	no query	6.86
ABORt:POWer:XSLot	–	no query	6.86
STOP:POWer:XSLot	–	no query	6.86
CONTinue:POWer:XSLot	–	no query	6.86
CONFigure:SUBarrays:POWer:XSLot	ALL | ARIThmetical | MINimum | MAXimum | IVAL,<Start>,<Samples>{,<Start>,<Samples>}	with query	6.89
CONFigure:POWer:XSLot:CONTrol:DEFault	ON | OFF	with query	6.87
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CONFigure:POWer:XSLot:MMODe	NORMal | RETRiggered	with query, Non Sig. only	6.88
CONFigure:POWer:XSLot:RETRiggered:DPOWer	0 dB to 20 dB	with query Non Sig. only	6.88
CONFigure:POWer:XSLot:RETRiggered:PLEVel	–40 dBm to +53 dBm	with query Non Sig. only	6.88
CONFigure:POWer:XSLot:RETRiggered:TIMeout	0.1 s … 100 s	with query Non Sig. only	6.89
CONFigure:POWer:XSLot:SCOunt	S128 | S256 | S384 | S512[,1 to 512]	with query	6.88

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READ[:SCALar]:POWer:XSLot:SPOWer<nr>?	<Result>	query only	6.90
FETCh[:SCALar]:POWer:XSLot:SPOWer<nr>?	<Result>	query only	6.90
SAMPle[:SCALar]:POWer:XSLot:SPOWer<nr>?	<Result>	query only	6.90
FETCh:POWer:XSLot:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 1 to 10000 | NONE	query only	6.86
READ:ARRay:POWer:XSLot?	<Result>	query only	6.90
FETCh:ARRay:POWer:XSLot?	<Result>	query only	6.90
SAMPle:ARRay:POWer:XSLot?	<Result>	query only	6.90
READ:SUBarrays:POWer:XSLot?	<Result>	query only	6.90
FETCh:SUBarrays:POWer:XSLot?	<Result>	query only	6.90
SAMPle:SUBarrays:POWer:XSLot?	<Result>	query only	6.90
POWer versus time measurement: 8PSK modulation			
INITiate:POWer[:NORMal]:EPSK	–	no query	6.14
ABORt:POWer[:NORMal]:EPSK	–	no query	6.14
STOP:POWer[:NORMal]:EPSK	–	no query	6.14
CONTinue:POWer[:NORMal]:EPSK	–	no query	6.14
CONFigure:SUBarrays:POWer[:NORMal]:EPSK	ALL | ARIThmetical | MINimum | MAXimum | IVAL,<Start>,<Samples>{,<Start>, <Samples>}	with query	6.24
CALCulate:ARRay:POWer[:NORMal]:EPSK:AREA:LIMit: MATChing:AVERage?	<Matching>	query only	6.28
CALCulate:ARRay:POWer[:NORMal]:EPSK:AREA:LIMit: MATChing:MAXimum?	<Matching>	query only	6.28
CALCulate:ARRay:POWer[:NORMal]:EPSK:AREA:LIMit: MATChing:MINimum?	<Matching>	query only	6.28
CALCulate:ARRay:POWer[:NORMal]:EPSK:AREA:LIMit: MATChing[:CURRent]?	<Matching>	query only	6.28
READ:ARRay:POWer[:NORMal]:EPSK:AVERage?	–100.0 dB to +20.0 dB	query only	6.26
FETCh:ARRay:POWer[:NORMal]:EPSK:AVERage?	–100.0 dB to +20.0 dB	query only	6.26
SAMPle:ARRay:POWer[:NORMal]:EPSK:AVERage?	–100.0 dB to +20.0 dB	query only	6.26
READ:SUBarrays:POWer[:NORMal]:EPSK:AVERage?	–100.0 dB to +20.0 dB	query only	6.27
FETCh:SUBarrays:POWer[:NORMal]:EPSK:AVERage?	–100.0 dB to +20.0 dB	query only	6.27
SAMPle:SUBarrays:POWer[:NORMal]:EPSK:AVERage?	–100.0 dB to +20.0 dB	query only	6.27
CONFigure:POWer[:NORMal]:EPSK:CONTrol	SCALar | ARRay, 1 to 1000 | NONE	with query	6.16
CONFigure:POWer[:NORMal]:EPSK:CONTrol:DEFault	ON | OFF	with query	6.17
DISPlay:POWer[:NORMal]:EPSK:CONTrol:GRID	ON | OFF	with query	6.16
CONFigure:POWer[:NORMal]:EPSK:CONTrol:REPetition	CONTinuous | SINGleshot | 1 to 10000, SONerror | NONE,STEP | NONE	with query	6.16
CONFigure:POWer[:NORMal]:EPSK:CONTrol:RPMode	CURRent | AVERage | DCOMpens	with query	6.17
CONFigure:POWer[:NORMal]:EPSK:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.14
CONFigure:POWer[:NORMal]:EPSK:FILTer	G500 | B600	with query	6.15
CONFigure:POWer[:NORMal]:EPSK:LIMit:LINE:DEFault	ON | OFF	with query	6.22
CONFigure:POWer[:NORMal]:EPSK:LIMit: LINE:LOWer:ALL:DYNamic:ENABle	ON | OFF	with query	6.22
CONFigure:POWer[:NORMal]:EPSK:LIMit: LINE:LOWer<AreaNr>:ALL:DYNamic:ENABle	ON | OFF	with query	6.21
CONFigure:POWer[:NORMal]:EPSK:LIMit:	<fromTPCL>, <toTPCL>,	with query	6.21

Command, Non Signalling	Parameters	Types	Page
LINE:LOWer<nr>:DYNamic<RgNr>	<Correction>, ON | OFF		
CONFigure:POWer[:NORMal]:EPSK:LIMit: LINE:LOWer<nr>[:STATic]	<StartTime>, <EndTime>, <StartRelLevel>, <EndRelLevel>, <StartAbsLevel>, <EndAbsLevel>, <Visibility>	with query	6.19
CONFigure:POWer[:NORMal]:EPSK:LIMit: LINE:LOWer<nr>[:STATic]:ENABle	ON | OFF	with query	6.19
CONFigure:POWer[:NORMal]:EPSK:LIMit: LINE:UPPer:ALL:DYNamic:ENABle	ON | OFF	with query	6.21
CONFigure:POWer[:NORMal]:EPSK:LIMit: LINE:UPPer<nr>:ALL:DYNamic:ENABle	ON | OFF	with query	6.20
CONFigure:POWer[:NORMal]:EPSK:LIMit: LINE:UPPer<nr>:DYNamic<nr>	<fromTPCL>, <toTPCL>, <Correction>, ON | OFF	with query	6.20
CONFigure:POWer[:NORMal]:EPSK:LIMit: LINE:UPPer<nr>:DYNamic<nr>:ENABle	ON | OFF	with query	6.20
CONFigure:POWer[:NORMal]:EPSK:LIMit: LINE:UPPer<nr>[:STATic]	<StartTime>, <EndTime>, <StartRelLevel>, <EndRelLevel>, <StartAbsLevel>, <EndAbsLevel>, <Visibility>	with query	6.17
CONFigure:POWer[:NORMal]:EPSK:LIMit: LINE:UPPer<nr>[:STATic]:ENABle	ON | OFF	with query	6.17
CALCulate:ARRay:POWer[:NORMal]:EPSK:LIMit: MATChing:AVERage?	MATC | NMAT | INV | NTSC | OUT	query only	6.28
CALCulate:ARRay:POWer[:NORMal]:EPSK:LIMit: MATChing:MAXimum?	MATC | NMAT | INV | NTSC | OUT	query only	6.28
CALCulate:ARRay:POWer[:NORMal]:EPSK:LIMit: MATChing:MINimum?	MATC | NMAT | INV | NTSC | OUT	query only	6.28
CALCulate[:SCALar]:POWer[:NORMal]:EPSK:LIMit: MATChing?	AvgBurstPowerCurr, PeakBurstPowerCurr, BurstMatching, AvgBurstPowerAvg	query only	6.25
CALCulate:ARRay:POWer[:NORMal]:EPSK:LIMit: MATChing[:CURRent]?	MATC | NMAT | INV | NTSC | OUT	query only	6.28
READ:ARRay:POWer[:NORMal]:EPSK:MAXimum?	–100.0 dB to +20.0 dB	query only	6.26
FETCh:ARRay:POWer[:NORMal]:EPSK:MAXimum?	–100.0 dB to +20.0 dB	query only	6.26
SAMPle:ARRay:POWer[:NORMal]:EPSK:MAXimum?	–100.0 dB to +20.0 dB	query only	6.26
READ:SUBarrays:POWer[:NORMal]:EPSK:MAXimum?	–100.0 dB to +20.0 dB	query only	6.27
FETCh:SUBarrays:POWer[:NORMal]:EPSK:MAXimum?	–100.0 dB to +20.0 dB	query only	6.27
SAMPle:SUBarrays:POWer[:NORMal]:EPSK:MAXimum?	–100.0 dB dB to +20.0 dB	query only	6.27
READ:ARRay:POWer[:NORMal]:EPSK:MINimum?	–100.0 dB to +20.0 dB	query only	6.26
FETCh:ARRay:POWer[:NORMal]:EPSK:MINimum?	–100.0 dB to +20.0 dB	query only	6.26
SAMPle:ARRay:POWer[:NORMal]:EPSK:MINimum?	–100.0 dB to +20.0 dB	query only	6.26
READ:SUBarrays:POWer[:NORMal]:EPSK:MINimum?	–100.0 dB to +20.0 dB	query only	6.27
FETCh:SUBarrays:POWer[:NORMal]:EPSK:MINimum?	–100.0 dB to +20.0 dB	query only	6.27
SAMPle:SUBarrays:POWer[:NORMal]:EPSK:MINimum?	–100.0 dB to +20.0 dB	query only	6.27
FETCh:POWer[:NORMal]:EPSK:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 1 to 10000 | NONE , 1 to 1000 | NONE	query only	6.15
CONFigure:POWer[:NORMal]:EPSK:TOFFset	–4.00 to +4.00	with query	6.15
READ[:SCALar]:POWer[:NORMal]:EPSK?	<Result>	query only	6.24
FETCh[:SCALar]:POWer[:NORMal]:EPSK?	<Result>	query only	6.24
SAMPle[:SCALar]:POWer[:NORMal]:EPSK?	<Result>	query only	6.24
READ:ARRay:POWer[:NORMal]:EPSK[:CURRent]?	–100.0 dB to +20.0 dB	query only	6.26

Command, Non Signalling	Parameters	Types	Page
FETCh:ARRay:POWer[:NORMal]:EPSK[:CURRent]?	–100.0 dB to +20.0 dB	query only	6.26
SAMPle:ARRay:POWer[:NORMal]:EPSK[:CURRent]?	–100.0 dB to +20.0 dB	query only	6.26
READ:SUBarrays:POWer[:NORMal]:EPSK[:CURRent]?	–100.0 dB to +20.0 dB	query only	6.27
FETCh:SUBarrays:POWer[:NORMal]:EPSK[:CURRent]?	–100.0 dB to +20.0 dB	query only	6.27
SAMPle:SUBarrays:POWer[:NORMal]:EPSK[:CURRent]?	–100.0 dB to +20.0 dB	query only	6.27
POWer versus time measurement: GMSK modulation			
INITiate:POWer[:NORMal][:GMSK]	–	no query	6.14
ABORt:POWer[:NORMal][:GMSK]	–	no query	6.14
STOP:POWer[:NORMal][:GMSK]	–	no query	6.14
CONTinue:POWer[:NORMal][:GMSK]	–	no query	6.14
CONFigure:SUBarrays:POWer[:NORMal][:GMSK]	ALL | ARIThmetical | MINimum | MAXimum | IVAL,<Start>,<Samples>{,<Start>, <Samples>}	with query	6.24
CALCulate:ARRay:POWer[:NORMal][:GMSK]:AREA:LIMit: MATChing:AVERage?	<Matching>	query only	6.28
CALCulate:ARRay:POWer[:NORMal][:GMSK]:AREA:LIMit: MATChing:MAXimum?	<Matching>	query only	6.28
CALCulate:ARRay:POWer[:NORMal][:GMSK]:AREA:LIMit: MATChing:MINimum?	<Matching>	query only	6.28
CALCulate:ARRay:POWer[:NORMal][:GMSK]:AREA:LIMit: MATChing[:CURRent]?	<Matching>	query only	6.28
READ:ARRay:POWer[:NORMal][:GMSK]:AVERage?	–100.0 dB to +20.0 dB	query only	6.26
FETCh:ARRay:POWer[:NORMal][:GMSK]:AVERage?	–100.0 dB to +20.0 dB	query only	6.26
SAMPle:ARRay:POWer[:NORMal][:GMSK]:AVERage?	–100.0 dB to +20.0 dB	query only	6.26
READ:SUBarrays:POWer[:NORMal][:GMSK]:AVERage?	–100.0 dB to +20.0 dB	query only	6.27
FETCh:SUBarrays:POWer[:NORMal][:GMSK]:AVERage?	–100.0 dB to +20.0 dB	query only	6.27
SAMPle:SUBarrays:POWer[:NORMal][:GMSK]:AVERage?	–100.0 dB to +20.0 dB	query only	6.27
CONFigure:POWer[:NORMal][:GMSK]:CONTrol	SCALar | ARRay, 1 to 1000 | NONE	with query	6.16
CONFigure:POWer[:NORMal][:GMSK]:CONTrol:DEFault	ON | OFF	with query	6.17
DISPlay:POWer[:NORMal][:GMSK]:CONTrol:GRID	ON | OFF	with query	6.16
CONFigure:POWer[:NORMal][:GMSK]:CONTrol:REPetition	CONTinuous | SINGleshot | 1 to 10000, SONerror | NONE,STEP | NONE	with query	6.16
CONFigure:POWer[:NORMal][:GMSK]:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.14
CONFigure:POWer[:NORMal][:GMSK]:FILTer	G500 | B600	with query	6.15
CONFigure:POWer[:NORMal][:GMSK]:LIMit:ABPower<nr>	ON | OFF	with query	6.23
CONFigure:POWer[:NORMal][:GMSK]:LIMit: ABPower<nr>:ENABle	ON | OFF	with query	6.23
CONFigure:POWer[:NORMal][:GMSK]:LIMit: LINE:DEFault	ON | OFF	with query	6.22
CONFigure:POWer[:NORMal][:GMSK]:LIMit: LINE:LOWer:ALL:DYNamic:ENABle	ON | OFF	with query	6.22
CONFigure:POWer[:NORMal][:GMSK]:LIMit: LINE:LOWer<AreaNr>:ALL:DYNamic:ENABle	ON | OFF	with query	6.21
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FETCh:SUBarrays:POWer[:NORMal][:GMSK]:MAXimum?	–100.0 dB to +20.0 dB	query only	6.27
SAMPle:SUBarrays:POWer[:NORMal][:GMSK]:MAXimum?	–100.0 dB dB to +20.0 dB	query only	6.27
READ:ARRay:POWer[:NORMal][:GMSK]:MINimum?	–100.0 dB to +20.0 dB	query only	6.26
FETCh:ARRay:POWer[:NORMal][:GMSK]:MINimum?	–100.0 dB to +20.0 dB	query only	6.26
SAMPle:ARRay:POWer[:NORMal][:GMSK]:MINimum?	–100.0 dB to +20.0 dB	query only	6.26
READ:SUBarrays:POWer[:NORMal][:GMSK]:MINimum?	–100.0 dB to +20.0 dB	query only	6.27
FETCh:SUBarrays:POWer[:NORMal][:GMSK]:MINimum?	–100.0 dB to +20.0 dB	query only	6.27
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READ:ARRay:POWer[:NORMal][:GMSK]:MPR:MINimum?	–100.0 dB to +20.0 dB	query only	6.32
FETCh:ARRay:POWer[:NORMal][:GMSK]:MPR:MINimum?	–100.0 dB to +20.0 dB	query only	6.32
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READ:SUBarrays:POWer[:NORMal][:GMSK]:MPR:MINimum?	–100.0 dB to +20.0 dB	query only	6.33
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FETCh:POWer[:NORMal][:GMSK]:MPR:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 1 to 10000 | NONE , 1 to 1000 | NONE	query only	6.29
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READ:ARRay:POWer[:NORMal][:GMSK]:MPR[:CURRent]?	–100.0 dB to +20.0 dB	query only	6.32
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SAMPle:ARRay:POWer[:NORMal][:GMSK]:MPR[:CURRent]?	–100.0 dB to +20.0 dB	query only	6.32
READ:SUBarrays:POWer[:NORMal][:GMSK]:MPR[:CURRent]?	–100.0 dB to +20.0 dB	query only	6.33
FETCh:SUBarrays:POWer[:NORMal][:GMSK]:MPR[:CURRent]?	–100.0 dB to +20.0 dB	query only	6.33
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FETCh:SUBarrays:POWer[:NORMal][:GMSK][:CURRent]?	–100.0 dB to +20.0 dB	query only	6.27
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[SENSe:]RFANalyzer:MODulation	GMSK | EPSK	with query	6.3
CONFigure:RFANalyzer:TPCL	0 to 31	with query	6.3
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RF Signal generated			
INITiate:RFGenerator:AUXTx	–	no query	6.7
ABORt:RFGenerator:AUXTx	–	no query	6.7
SOURce:RFGenerator:AUXTx:FREQuency	350 MHz to 550 MHz | 700 MHz to 1100 MHz | 1400 MHz to 2200 MHz	with query	6.8
SOURce:RFGenerator:AUXTx:LEVel	–110 dBm to –60 dBm	with query	6.7
SOURce:RFGenerator:AUXTx:OLEVel	-124.0 dBm to + +13.0 dBm	with query	6.8
FETCh:RFGenerator:AUXTx:STATus?	OFF | RUN | ERR	query only	6.7
SOURce:RFGenerator:FM:DEViation	–100 kHz to 100 kHz	with query	6.5
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SOURce:RFGenerator[:TX]:FREQuency	0.2 MHz to 2700 MHz	with query	6.6
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CONTinue:SPECtrum:MODulation	–	no query	6.153
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CONFigure:SPECtrum:MODulation:EPSK:LIMit: LINE:UPPer<nr>:ENABle	ON | OFF	with query	6.156
CONFigure:SPECtrum:MODulation:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.153
[SENSe:]SPECtrum:MODulation:LIMit:LINE:USED?	GMSK | EPSK	query only	6.156
FETCh:SPECtrum:MODulation:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 1 to 10000 | NONE , 1 to 1000 | NONE	only query	6.153
CONFigure:SPECtrum:MODulation:TDFSelect	N180|N160|N140|N120|N100|N080 |N060|N040|N025|N020|N010 | REF | P010|P020|P025|P040|P060|P080| P100|P120|P140|P160|P180|NV4| NV3|NV2|NV1|PV1|PV2|PV3|PV4| OFF|ON	with query	6.155
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READ:SUBarrays:SPECtrum:MODulation:TDOMain?	–100.0 dB to +20.0 dB, ...	query only	6.162
FETCh:SUBarrays:SPECtrum:MODulation:TDOMain?	–100.0 dB to +20.0 dB, ...	query only	6.162
SAMPle:SUBarrays:SPECtrum:MODulation:TDOMain?	–100.0 dB to +20.0 dB, ...	query only	6.162
READ[:SCALar]:SPECtrum:MODulation?	<Result>	only query	6.159
FETCh[:SCALar]:SPECtrum:MODulation?	<Result>	only query	6.159
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CONFigure:SUBarrays:SPECtrum:MODulation[:FDOMain]	ALL | ARIThmetical | MINimum | MAXimum | IVAL,<Start>,<Samples>{,<Start>, <Samples>}	with query	6.158
CALCulate:ARRay:SPECtrum:MODulation[:FDOMain]:AREA :LIMit:MATChing?	<Matching>	query only	6.161
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READ:ARRay:SPECtrum:MODulation[:FDOMain]?	–100.0 dB to +20.0 dB, ...	query only	6.160
FETCh:ARRay:SPECtrum:MODulation[:FDOMain]?	–100.0 dB to +20.0 dB, ...	query only	6.160
SAMPle:ARRay:SPECtrum:MODulation[:FDOMain]?	–100.0 dB to +20.0 dB, ...	query only	6.160
READ:SUBarrays:SPECtrum:MODulation[:FDOMain]?	–100.0 dB to +20.0 dB, ...	query only	6.161
FETCh:SUBarrays:SPECtrum:MODulation[:FDOMain]?	–100.0 dB to +20.0 dB, ...	query only	6.161
SAMPle:SUBarrays:SPECtrum:MODulation[:FDOMain]?	–100.0 dB to +20.0 dB, ...	query only	6.161
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INITiate:SPECtrum:MSWitching	–	no query	6.174
ABORt:SPECtrum:MSWitching	–	no query	6.174
STOP:SPECtrum:MSWitching	–	no query	6.174
CONTinue:SPECtrum:MSWitching	–	no query	6.174
CALCulate:ARRay:SPECtrum:MSWitching:AREA:LIMit: MATChing?	<Matching>	query only	6.178
CONFigure:SPECtrum:MSWitching:CONTrol	SCALar | ARRay	with query	6.175
CONFigure:SPECtrum:MSWitching:CONTrol:REPetition	CONTinuous | SINGleshot | 1 to 10000, SONerror | NONE, STEP | NONE	with query	6.176
CONFigure:SPECtrum:MSWitching:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.174
[SENSe:]SPECtrum:MSWitching:LIMit:LINE:USED?	GMSK | EPSK	query only	6.176
FETCh:SPECtrum:MSWitching:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 1 to 1000 | NONE, 1 to 10000 | NONE, 1 to 10000 | NONE	only query	6.175
READ:ARRay:SPECtrum:MSWitching:VMPoint?	–100.0 dBm to +100.0 dBm, ...	query only	6.178
FETCh:ARRay:SPECtrum:MSWitching:VMPoint?	–100.0 dBm to +100.0 dBm, ...	query only	6.178
SAMPle:ARRay:SPECtrum:MSWitching:VMPoint?	–100.0 dBm to +100.0 dBm, ...	query only	6.178
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FETCh[:SCALar]:SPECtrum:MSWitching?	<Result>	only query	6.177
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FETCh:ARRay:SPECtrum:MSWitching?	<32 results>	only query	6.177
SAMPle:ARRay:SPECtrum:MSWitching?	<32 results>	only query	6.177
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INITiate:SPECtrum:SWITching	–	no query	6.163
ABORt:SPECtrum:SWITching	–	no query	6.163
STOP:SPECtrum:SWITching	–	no query	6.163
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CONFigure:SPECtrum:SWITching:EPSK:LIMit: LINE:MODE[:UPPer]	ON | OFF	with query	6.168
CONFigure:SPECtrum:SWITching:EPSK:LIMit: LINE:UPPer<nr>	<Power level>, <Limit at 0.4 MHz>, <Limit at 0.6 MHz>, <Limit at 1.2 MHz>, <Limit at 1.8 MHz>,<Enable>	with query	6.167
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<tr><td>READ:ARRay:SPECtrum:SWITching:TDOMain?</td><td>–100.0 dB to +100.0 dBm, ...</td><td>query only</td><td>6.173</td></tr>
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<tr><td>FETCh:SUBarrays:SPECtrum:SWITching:TDOMain?</td><td>–100.0 dBm to +100.0 dBm, ...</td><td>query only</td><td>6.173</td></tr>
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<tr><td>READ[:SCALar]:SPECtrum:SWITching?</td><td><Result></td><td>only query</td><td>6.171</td></tr>
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<tr><td>SAMPle[:SCALar]:SPECtrum:SWITching?</td><td><Result></td><td>only query</td><td>6.171</td></tr>
<tr><td>CONFigure:SUBarrays:SPECtrum:SWITching[:FDOMain]</td><td>ALL | ARIThmetical | MINimum | MAXimum | IVAL,<Start>,<Samples>{,<Start>, <Samples>}</td><td>with query</td><td>6.169</td></tr>
<tr><td>CALCulate:ARRay:SPECtrum:SWITching[:FDOMain] :AREA:LIMit:MATChing?</td><td><Matching></td><td>query only</td><td>6.172</td></tr>
<tr><td>READ:ARRay:SPECtrum:SWITching[:FDOMain]:VMPoint?</td><td>–100.0 dBm to +100.0 dBm, ...</td><td>query only</td><td>6.172</td></tr>
<tr><td>FETCh:ARRay:SPECtrum:SWITching[:FDOMain]:VMPoint?</td><td>–100.0 dBm to +100.0 dBm, ...</td><td>query only</td><td>6.172</td></tr>
<tr><td>SAMPle:ARRay:SPECtrum:SWITching[:FDOMain]:VMPoint?</td><td>–100.0 dBm to +100.0 dBm, ...</td><td>query only</td><td>6.172</td></tr>
<tr><td>READ:ARRay:SPECtrum:SWITching[:FDOMain]?</td><td>–100.0 dBm to +100.0 dBm</td><td>only query</td><td>6.171</td></tr>
<tr><td>FETCh:ARRay:SPECtrum:SWITching[:FDOMain]?</td><td>–100.0 dBm to +100.0 dBm</td><td>only query</td><td>6.171</td></tr>
<tr><td>SAMPle:ARRay:SPECtrum:SWITching[:FDOMain]?</td><td>–100.0 dBm to +100.0 dBm</td><td>only query</td><td>6.171</td></tr>
<tr><td>READ:SUBarrays:SPECtrum:SWITching[:FDOMain]?</td><td>–100.0 dBm to +100.0 dBm, ...</td><td>query only</td><td>6.172</td></tr>
<tr><td>FETCh:SUBarrays:SPECtrum:SWITching[:FDOMain]?</td><td>–100.0 dBm to +100.0 dBm, ...</td><td>query only</td><td>6.172</td></tr>
<tr><td>SAMPle:SUBarrays:SPECtrum:SWITching[:FDOMain]?</td><td>–100.0 dBm to +100.0 dBm, ...</td><td>query only</td><td>6.172</td></tr>
<tr><td>CONFigure:SPECtrum:SWITching[:GMSK]:LIMit:LINE:DEFault</td><td>ON | OFF</td><td>with query</td><td>6.168</td></tr>
<tr><td>CONFigure:SPECtrum:SWITching[:GMSK]:LIMit: LINE:MODE[:UPPer]</td><td>ON | OFF</td><td>with query</td><td>6.168</td></tr>
<tr><td>CONFigure:SPECtrum:SWITching[:GMSK]:LIMit: LINE:UPPer<nr></td><td><Power level>, <Limit at 0.4 MHz>, <Limit at 0.6 MHz>, <Limit at 1.2 MHz>, <Limit at 1.8 MHz>,<Enable></td><td>with query</td><td>6.167</td></tr>
<tr><td>CONFigure:SPECtrum:SWITching[:GMSK]:LIMit: LINE:UPPer<nr>:ENABle</td><td>ON | OFF</td><td>with query</td><td>6.167</td></tr>
<tr><td colspan="4">Symbolic Status Register Evaluation</td></tr>
<tr><td>STATus:OPERation:SYMBolic:ENABle</td><td><Event>{,<Event>}</td><td>with query</td><td>6.76</td></tr>
<tr><td>STATus:OPERation:SYMBolic[:EVENt]?</td><td>NONE | <Event>{,<Event>}</td><td>query only</td><td>6.76</td></tr>
<tr><td colspan="4">Trigger</td></tr>
<tr><td>TRIGger[:SEQuence]:DEFault</td><td>ON | OFF</td><td>with query</td><td>6.12</td></tr>
<tr><td>TRIGger[:SEQuence]:SLOPe</td><td>POSitive | NEGative</td><td>with query</td><td>6.12</td></tr>
</table>

Command, Non Signalling	Parameters	Types	Page
TRIGger[:SEQuence]:SOURce	FRUN | RFPower | IFPower | EXTern	with query	6.11
TRIGger[:SEQuence]:SOURce:EXTernal	PIN6 | PIN7 | PIN8	with query	6.12
TRIGger[:SEQuence]:THReshold:IFPower	<Threshold>	with query	6.12
TRIGger[:SEQuence]:THReshold:RFPower	LOW | MEDium | HIGH	with query	6.12
Wideband Power			
INITiate:WPOWer	–	no query	6.77
ABORt:WPOWer	–	no query	6.77
STOP:WPOWer	–	no query	6.77
CONTinue:WPOWer	–	no query	6.77
CONFigure:WPOWer:CONTrol:REPetition	CONTinuous | SINGleshot | 1 ... 10000, SONerror | NONE,STEP | NONE	with query	6.78
CONFigure:WPOWer:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.77
FETCh:WPOWer:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 1 ... 10000 | NONE	query only	6.77
READ[:SCALar]:WPOWer?	–30 dBm to +30 dBm	query only	6.78
FETCh[:SCALar]:WPOWer?	–30 dBm to +30 dBm	query only	6.78
SAMPle[:SCALar]:WPOWer?	–30 dBm to +30 dBm	query only	6.78

Commands for GSM Mobile Tests

Table 6-2 Remote control commands: Signalling mode

Command, Signalling	Parameter	Types	Page
Application Testing			
CONFigure:ATESt:PORT	0 to 65535	with query	6.236
CONFigure:ATESt:WSIPaddress	<IP Address 1>, <IP Address 2>, <IP Address 3>, <IP Address 4>	with query	6.236
BS signal of CMU			
CONFigure:BSSignal:CCH:AUXTx:CCCHeck	ION | OFF	with query	6.218
CONFigure:BSSignal:CCH:AUXTx:CHANnel	<Channel>	with query	6.218
CONFigure:BSSignal:CCH:AUXTx:CHTYpe	OFF | BCCH | BPBC	with query	6.217
CONFigure:BSSignal:CCH:AUXTx:LEVel[:ABSolute]	<Level>	with query	6.218
CONFigure:BSSignal:CCH[:TX]:CHANnel	<Channel>	with query	6.212
CONFigure:BSSignal:CCH[:TX]:LEVel[:ABSolute]	<Level>	with query	6.213
CONFigure:BSSignal:CCH[:TX]:MODE	BATC | BOTC	with query	6.212
CONFigure:BSSignal:FM:DEViation	–100 kHz to +100 kHz	with query	6.212
PROCedure:BSSignal:FM:DEViation	–100 kHz to +100 kHz	with query	6.212
PROCedure:BSSignal:FM:DEViation:RANDom:ENABle	ON | OFF	with query	6.212
CONFigure:BSSignal:PDATa[:TCH]:MSLot:CHANnel	<Number>	with query	6.245
CONFigure:BSSignal:PDATa[:TCH]:MSLot:FHOPping:SEQuence	<7 channels>	with query	6.245
CONFigure:BSSignal:PDATa[:TCH]:MSLot:MTIMeslot	<Number>	with query	6.245
CONFigure:BSSignal:PDATa[:TCH]:MSLot:PZERo	<P0>	with query	6.244
[SENSe:]BSSignal:PDATa[:TCH]:MSLot:RLEVel?	<Level>	query only	6.245
CONFigure:BSSignal:PDATa[:TCH]:MSLot:SCONfig	<Enable_0>,..., <Enable_7>, <Level_0>,... <Level_7>	with query	6.246
CONFigure:BSSignal[:CSWitched][:TCH]:CHANnel	<TCHChannel>	with query	6.213
CONFigure:BSSignal[:CSWitched][:TCH]:LEVel:UNTimeslot	<Level>	with query	6.214
PROCedure:BSSignal[:CSWitched][:TCH]:LEVel:UNTimeslot	<Level>	with query	6.214
CONFigure:BSSignal[:CSWitched][:TCH]:LEVel:UTIMeslot	<Level>	with query	6.213
PROCedure:BSSignal[:CSWitched][:TCH]:LEVel:UTIMeslot	<Level>	with query	6.213
CONFigure:BSSignal[:CSWitched][:TCH]:MSLot:LMODe	UUN | IND	with query	6.216
CONFigure:BSSignal[:CSWitched][:TCH]:MSLot:MTIMeslot	0 to 7	with query	6.216
CONFigure:BSSignal[:CSWitched][:TCH]:MSLot:RLEVel	<Level>	with query	6.215
PROCedure:BSSignal[:CSWitched][:TCH]:MSLot:RLEVel	<Level>	with query	6.215
CONFigure:BSSignal[:CSWitched][:TCH]:MSLot:SCONfig:INDividual	<Enable_0>,<Enable_1>, ..., <Enable_7>, <PCL_0>, ..., <PCL_7>	with query	6.217
CONFigure:BSSignal[:CSWitched][:TCH]:MSLot:SCONfig:UUNused	<Enable_0>,<Enable_1>, ..., <Enable_7>	with query	6.216
CONFigure:BSSignal[:CSWitched][:TCH][:SSLot]:FHOPping:A	<Channel>{,<Channel>}	with query	6.214
CONFigure:BSSignal[:CSWitched][:TCH][:SSLot]:FHOPping:B	Channel>{,<Channel>}	with query	6.214
CONFigure:BSSignal[:CSWitched][:TCH][:SSLot]:FHOPping:C	Channel>{,<Channel>}	with query	6.214
CONFigure:BSSignal[:CSWitched][:TCH][:SSLot]:FHOPping:D	Channel>{,<Channel>}	with query	6.214
CONFigure:BSSignal[:CSWitched][:TCH][:SSLot]:TIMeslot	2 to 6 | 0 to 7	with query	6.214
[SENSe:]CORRection:LOSS:INPut<nr>[:MAGNitude]	-50 dB to +90 dB	with query	6.228
SOURce:CORRection:LOSS:INPut<nr>[:MAGNitude]	-50 dB to +90 dB	with query	6.228

Command, Signalling	Parameter	Types	Page
[SENSe:]CORRection:LOSS:OUTPut<nr>[:MAGNitude]	-50 dB to +90 dB	with query	6.228
SOURce:CORRection:LOSS:OUTPut<nr>[:MAGNitude]	-50 dB to +90 dB	with query	6.228
Inputs and Outputs			
SOURce:DM:CLOCk:FREQuency	1.2190 MHz to 39.000 MHz	with query	6.229
SOURce:DM:CLOCk:STATe	ON | OFF	with query	6.229
INPut[:STATe]	RF1 | RF2 | RF4	with query	6.228
OUTPut[:STATe]	RF1 | RF2 | RF3	with query	6.228
Handover			
CONFigure:HANDover:ALERting	<Target>	with query	6.208
CONFigure:HANDover:CSYNc	FSYN | NSYN	with query	6.209
CONFigure:HANDover:TARGet	<Target>	with query	6.208
STATus:HANDover:TARGet:LIST?	<List>	query only	6.208
I/Q-IF Inputs and Outputs			
IQIF:DEFault	ON | OFF	with query	6.37
CONFigure:IQIF:RXPath	BYP | BYIQ | XOIO | IOIO | IOXO	with query	6.37
CONFigure:IQIF:RXTXcombined	BYP | BYIQ | XOIO | IOIO | IOXO | FPAT | UDEF	with query	6.36
CONFigure:IQIF:TXPath	BYP | BYIQ | XOIO | IOIO | IOXO	with query	6.37
Input Power			
[SENSe:]LEVel:ATTenuation	NORMal | LNOise | LDIStortion	with query	6.200
[SENSe:]LEVel:DEFault	ON | OFF	with query	6.200
[SENSe:]LEVel:MAXimum	<Level>	with query	6.199
[SENSe:]LEVel:MODE	MANual | PCLevel | AUTomatic	with query	6.199
Measurement Control			
MCONTrol:DEFault	ON | OFF	with query	6.209
CONFigure:MCONtrol:MSLot:MESLot	0 to 7	with query	6.209
Configuration and Message File Management			
MMEMory:L3MSg:BEMPty	ON | OFF	query only	6.238
MMEMory:L3MSg:BWRiting	ON | OFF	with query	6.238
MMEMory:L3MSg:CDEStination	<FileName>	no query	6.237
MMEMory:L3MSg:SAVE	[<FileName>] [,<msus>]	no query	6.238
MMEMory:RECall:CURRent	<FileName> [,<msus>]	no query	6.237
MMEMory:SAVE:CURRent	<FileName> [,<msus>]	no query	6.237
Modulation measurement: 8PSK Modulation, Error Vector Magnitude			
INITiate:MODulation:EVMagnitude:EPSK	–	no query	6.90
ABORt:MODulation:EVMagnitude:EPSK	–	no query	6.90
STOP:MODulation:EVMagnitude:EPSK	–	no query	6.90
CONTinue:MODulation:EVMagnitude:EPSK	–	no query	6.90
CONFigure:SUBarrays:MODulation:EVMagnitude:EPSK	ALL | ARIThmetical | MINimum | MAXimum | IVAL,<Start>,<Samples>{,<Start>,<Samples>}	with query	6.92
READ:ARRay:MODulation:EVMagnitude:EPSK:AVERage?	0.0 % to +100.0 %	query only	6.94
FETCh:ARRay:MODulation:EVMagnitude:EPSK:AVERage?	0.0 % to +100.0 %	query only	6.94
SAMPle:ARRay:MODulation:EVMagnitude:EPSK:AVERage?	0.0 % to +100.0 %	query only	6.94

Command, Signalling	Parameter	Types	Page
READ:SUBarrays:MODulation:EVMagnitude:EPSK:AVERage?	0.0 % to +100.0 %	query only	6.94
FETCh:SUBarrays:MODulation:EVMagnitude:EPSK:AVERage?	0.0 % to +100.0 %	query only	6.94
SAMPle:SUBarrays:MODulation:EVMagnitude:EPSK:AVERage?	0.0 % to +100.0 %	query only	6.94
CONFigure:MODulation:EVMagnitude:EPSK:CONTrol	SCALar | ARRay, 1 to 1000 | NONE	with query	6.91
CONFigure:MODulation:EVMagnitude:EPSK:CONTrol:DEFault	ON | OFF	with query	6.92
CONFigure:MODulation:EVMagnitude:EPSK:CONTrol:REPetition	CONTinuous | SINGleshot | 1 to 10000, SONerror | NONE, STEP | NONE	with query	6.91
READ[:SCALar]:MODulation:EVMagnitude:EPSK:DBITS:PEAK?	0 to 7	query only	6.95
FETCh[:SCALar]:MODulation:EVMagnitude:EPSK:DBITS:PEAK?	0 to 7	query only	6.95
SAMPle[:SCALar]:MODulation:EVMagnitude:EPSK:DBITS:PEAK?	0 to 7	query only	6.95
READ[:SCALar]:MODulation:EVMagnitude:EPSK:DBITS?	0 to 7	query only	6.95
FETCh[:SCALar]:MODulation:EVMagnitude:EPSK:DBITS?	0 to 7	query only	6.95
SAMPle[:SCALar]:MODulation:EVMagnitude:EPSK:DBITS?	0 to 7	query only	6.95
READ:ARRay:MODulation:EVMagnitude:EPSK:DBITS?	0 to 7, …	query only	6.96
FETCh:ARRay:MODulation:EVMagnitude:EPSK:DBITS?	0 to 7, …	query only	6.96
SAMPle:ARRay:MODulation:EVMagnitude:EPSK:DBITS?	0 to 7, …	query only	6.96
CONFigure:MODulation:EVMagnitude:EPSK:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.90
CALCulate:MODulation:EVMagnitude:EPSK:LIMit:MATChing?	<Result>	query only	6.93
READ:ARRay:MODulation:EVMagnitude:EPSK:MMAXimum?	0.0 % to +100.0 %	query only	6.94
FETCh:ARRay:MODulation:EVMagnitude:EPSK:MMAXimum?	0.0 % to +100.0 %	query only	6.94
SAMPle:ARRay:MODulation:EVMagnitude:EPSK:MMAXimum?	0.0 % to +100.0 %	query only	6.94
READ:SUBarrays:MODulation:EVMagnitude:EPSK:MMAXimum?	0.0 % to +100.0 %	query only	6.94
FETCh:SUBarrays:MODulation:EVMagnitude:EPSK:MMAXimum?	0.0 % to +100.0 %	query only	6.94
SAMPle:SUBarrays:MODulation:EVMagnitude:EPSK:MMAXimum?	0.0 % to +100.0 %	query only	6.94
FETCh:MODulation:EVMagnitude:EPSK:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 1 to 10000 | NONE , 1 to 1000 | NONE	query only	6.90
READ[:SCALar]:MODulation:EVMagnitude:EPSK?	<Result>	query only	6.93
FETCh[:SCALar]:MODulation:EVMagnitude:EPSK?	<Result>	query only	6.93
SAMPle[:SCALar]:MODulation:EVMagnitude:EPSK?	<Result>	query only	6.93
READ:ARRay:MODulation:EVMagnitude:EPSK[:CURRent]?	0.0 % to +100.0 %	query only	6.94
FETCh:ARRay:MODulation:EVMagnitude:EPSK[:CURRent]?	0.0 % to +100.0 %	query only	6.94
SAMPle:ARRay:MODulation:EVMagnitude:EPSK[:CURRent]?	0.0 % to +100.0 %	query only	6.94
READ:SUBarrays:MODulation:EVMagnitude:EPSK[:CURRent]?	0.0 % to +100.0 %	query only	6.94
FETCh:SUBarrays:MODulation:EVMagnitude:EPSK[:CURRent]?	0.0 % to +100.0 %	query only	6.94
SAMPle:SUBarrays:MODulation:EVMagnitude:EPSK[:CURRent]?	0.0 % to +100.0 %	query only	6.94
Modulation measurement: 8PSK Modulation, I/Q Analyzer			
INITiate:MODulation:IQANalyzer:EPSK	–	no query	6.111
ABORt:MODulation:IQANalyzer:EPSK	–	no query	6.111
STOP:MODulation:IQANalyzer:EPSK	–	no query	6.111
CONTinue:MODulation:IQANalyzer:EPSK	–	no query	6.111
DEFault:MODulation:IQANalyzer:EPSK:CONTrol	ON | OFF	with query	6.112
CONFigure:MODulation:IQANalyzer:EPSK:CONTrol:REPetition	CONTinuous | SINGleshot | 1 to 10000, NONE, STEP | NONE	with query	6.112
CONFigure:MODulation:IQANalyzer:EPSK:CONTrol:RMODe	SCALar | ARRay	with query	6.112

Command, Signalling	Parameter	Types	Page
CONFigure:MODulation:IQANalyzer:EPSK:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.111
READ:ARRay:MODulation:IQANalyzer:EPSK:IPHase?	–2.0 to +2.0 (568 values)	query only	6.113
FETCh:ARRay:MODulation:IQANalyzer:EPSK:IPHase?	–2.0 to +2.0 (568 values)	query only	6.113
SAMPle:ARRay:MODulation:IQANalyzer:EPSK:IPHase?	–2.0 to +2.0 (568 values)	query only	6.113
CONFigure:MODulation:IQANalyzer:EPSK:IQFilter	ISIRemoved | UNFiltered	with query	6.112
READ:ARRay:MODulation:IQANalyzer:EPSK:QPHase?	–2.0 to +2.0 (568 values)	query only	6.113
FETCh:ARRay:MODulation:IQANalyzer:EPSK:QPHase?	–2.0 to +2.0 (568 values)	query only	6.113
SAMPle:ARRay:MODulation:IQANalyzer:EPSK:QPHase?	–2.0 to +2.0 (568 values)	query only	6.113
CONFigure:MODulation:IQANalyzer:EPSK:ROTation	P38 | P38R	with query	6.112
FETCh:MODulation:IQANalyzer:EPSK:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 1 to 10000 | NONE , 1 to 1000 | NONE	query only	6.111
READ[:SCALar]:MODulation:IQANalyzer:EPSK?	<Result>	query only	6.113
FETCh[:SCALar]:MODulation:IQANalyzer:EPSK?	<Result>	query only	6.113
SAMPle[:SCALar]:MODulation:IQANalyzer:EPSK?	<Result>	query only	6.113
Modulation measurement: 8PSK Modulation, Magnitude Error			
INITiate:MODulation:MERRor:EPSK	–	no query	6.104
ABORt:MODulation:MERRor:EPSK	–	no query	6.104
STOP:MODulation:MERRor:EPSK	–	no query	6.104
CONTinue:MODulation:MERRor:EPSK	–	no query	6.104
CONFigure:SUBarrays:MODulation:MERRor:EPSK	ALL | ARIThmetical | MINimum | MAXimum | IVAL,<Start>,<Samples>{,<Start>,<Samples>}	with query	6.106
READ:ARRay:MODulation:MERRor:EPSK:AVERage?	–100 % to +100 %	query only	6.108
FETCh:ARRay:MODulation:MERRor:EPSK:AVERage?	–100 % to +100 %	query only	6.108
SAMPle:ARRay:MODulation:MERRor:EPSK:AVERage?	–100 % to +100 %	query only	6.108
READ:SUBarrays:MODulation:MERRor:EPSK:AVERage?	–100 % to +100 %	query only	6.108
FETCh:SUBarrays:MODulation:MERRor:EPSK:AVERage?	–100 % to +100 %	query only	6.108
SAMPle:SUBarrays:MODulation:MERRor:EPSK:AVERage?	–100 % to +100 %	query only	6.108
CONFigure:MODulation:MERRor:EPSK:CONTrol	SCALar | ARRay, 1 to 1000 | NONE	with query	6.105
CONFigure:MODulation:MERRor:EPSK:CONTrol:DEFault	ON | OFF	with query	6.106
CONFigure:MODulation:MERRor:EPSK:CONTrol:REPetition	CONTinuous | SINGleshot | 1 to 10000, SONerror | NONE, STEP | NONE	with query	6.105
CONFigure:MODulation:MERRor:EPSK:DBITs	ON | OFF	with query	6.109
READ[:SCALar]:MODulation:MERRor:EPSK:DBITS:PEAK?	0 to 7	query only	6.109
FETCh[:SCALar]:MODulation:MERRor:EPSK:DBITS:PEAK?	0 to 7	query only	6.109
SAMPle[:SCALar]:MODulation:MERRor:EPSK:DBITS:PEAK?	0 to 7	query only	6.109
READ[:SCALar]:MODulation:MERRor:EPSK:DBITS?	0 to 7	query only	6.109
FETCh[:SCALar]:MODulation:MERRor:EPSK:DBITS?	0 to 7	query only	6.109
SAMPle[:SCALar]:MODulation:MERRor:EPSK:DBITS?	0 to 7	query only	6.109
READ:ARRay:MODulation:MERRor:EPSK:DBITS?	0 to 7, …	query only	6.110
FETCh:ARRay:MODulation:MERRor:EPSK:DBITS?	0 to 7, …	query only	6.110
SAMPle:ARRay:MODulation:MERRor:EPSK:DBITS?	0 to 7, …	query only	6.110
CONFigure:MODulation:MERRor:EPSK:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.104
CALCulate:MODulation:MERRor:EPSK:LIMit:MATChing?	<Result>	query only	6.107

Command, Signalling	Parameter	Types	Page
READ:ARRay:MODulation:MERRor:EPSK:MMAXimum?	–100 % to +100 %	query only	6.108
FETCh:ARRay:MODulation:MERRor:EPSK:MMAXimum?	–100 % to +100 %	query only	6.108
SAMPle:ARRay:MODulation:MERRor:EPSK:MMAXimum?	–100 % to +100 %	query only	6.108
READ:SUBarrays:MODulation:MERRor:EPSK:MMAXimum?	–100 % to +100 %	query only	6.108
FETCh:SUBarrays:MODulation:MERRor:EPSK:MMAXimum?	–100 % to +100 %	query only	6.108
SAMPle:SUBarrays:MODulation:MERRor:EPSK:MMAXimum?	–100 % to +100 %	query only	6.108
FETCh:MODulation:MERRor:EPSK:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 1 to 10000 | NONE , 1 to 1000 | NONE	query only	6.104
READ[:SCALar]:MODulation:MERRor:EPSK?	<Result>	query only	6.107
FETCh[:SCALar]:MODulation:MERRor:EPSK?	<Result>	query only	6.107
SAMPle[:SCALar]:MODulation:MERRor:EPSK?	<Result>	query only	6.107
READ:ARRay:MODulation:MERRor:EPSK[:CURRent]?	–100 % to +100 %	query only	6.108
FETCh:ARRay:MODulation:MERRor:EPSK[:CURRent]?	–100 % to +100 %	query only	6.108
SAMPle:ARRay:MODulation:MERRor:EPSK[:CURRent]?	–100 % to +100 %	query only	6.108
READ:SUBarrays:MODulation:MERRor:EPSK[:CURRent]?	–100 % to +100 %	query only	6.108
FETCh:SUBarrays:MODulation:MERRor:EPSK[:CURRent]?	–100 % to +100 %	query only	6.108
SAMPle:SUBarrays:MODulation:MERRor:EPSK[:CURRent]?	–100 % to +100 %	query only	6.108
Modulation measurement: 8PSK Modulation, General commands			
CONFigure:MODulation:OEMP:EPSK:CONTrol:RPMode	CURRent | AVERage | DCOMpens	with query	6.87
CONFigure:MODulation:OEMP:EPSK:LIMit:AVERage	<PhaseErrorPeak>, <PhaseErrorRMS>, <MagnErrorPeak>, <MagnErrorRMS>,<EVMErrorPeak>, <EVMErrorRMS>, <OriginOffset>, <IQImbalance>, <FreqError>	with query	6.86
CONFigure:MODulation:OEMP:EPSK:LIMit:DEFault	ON | OFF	with query	6.87
CONFigure:MODulation:OEMP:EPSK:LIMit:P95Th	<EVM95%>, <MError95%>, <PError95%>	with query	6.87
CONFigure:MODulation:OEMP:EPSK:LIMit[:CURRent]	<PhaseErrorPeak>, <PhaseErrorRMS>, <MagnErrorPeak>, <MagnErrorRMS>,<EVMErrorPeak>, <EVMErrorRMS>, <OriginOffset>, <IQImbalance>, <FreqError>	with query	6.86
Modulation measurement: 8PSK Modulation, Overview			
INITiate:MODulation:OVERview:EPSK	–	no query	6.84
ABORt:MODulation:OVERview:EPSK	–	no query	6.84
STOP:MODulation:OVERview:EPSK	–	no query	6.84
CONTinue:MODulation:OVERview:EPSK	–	no query	6.84
CONFigure:MODulation:OVERview:EPSK:CONTrol	SCALar | ARRay, 1 to 1000 | NONE	with query	6.85
CONFigure:MODulation:OVERview:EPSK:CONTrol:DEFault	ON | OFF	with query	6.86
CONFigure:MODulation:OVERview:EPSK:CONTrol:REPetition	CONTinuous | SINGleshot | 1 to 10000, SONerror | NONE, STEP | NONE	with query	6.85
CONFigure:MODulation:OVERview:EPSK:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.84
CALCulate:MODulation:OVERview:EPSK:LIMit:MATChing?	<Result>	query only	6.89
FETCh:MODulation:OVERview:EPSK:STATus?	OFF | RUN | STOP | ERR |	query only	6.84

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	STEP | RDY, 1 to 10000 | NONE , 1 to 1000 | NONE		
READ[:SCALar]:MODulation:OVERview:EPSK?	<Result>	query only	6.88
FETCh[:SCALar]:MODulation:OVERview:EPSK?	<Result>	query only	6.88
SAMPle[:SCALar]:MODulation:OVERview:EPSK?	<Result>	query only	6.88
Modulation measurement: GMSK Modulation, Common commands			
CONFigure:MODulation:PVT:IRDTimeout	NORMal | MEDium | SHORt	with query	6.67
Modulation measurement: GMSK Modulation, Extended Phase Error			
INITiate:MODulation:XPERror[:GMSK]	–	no query	6.76
ABORt:MODulation:XPERror[:GMSK]	–	no query	6.76
STOP:MODulation:XPERror[:GMSK]	–	no query	6.76
CONTinue:MODulation:XPERror[:GMSK]	–	no query	6.76
CONFigure:SUBarrays:MODulation:XPERror[:GMSK]	ALL | ARIThmetical | MINimum | MAXimum | IVAL,<Start>,<Samples>{,<Start>,<Samples>}	with query	6.80
READ:ARRay:MODulation:XPERror[:GMSK]:AVERage?	–100.0 dB to +100.0 dB	query only	6.82
FETCh:ARRay:MODulation:XPERror[:GMSK]:AVERage?	–100.0 dB to +100.0 dB	query only	6.82
SAMPle:ARRay:MODulation:XPERror[:GMSK]:AVERage?	–100.0 dB to +100.0 dB	query only	6.82
READ:SUBarrays:MODulation:XPERror[:GMSK]:AVERage?	–100.0 dB to +20.0 dB	query only	6.83
FETCh:SUBarrays:MODulation:XPERror[:GMSK]:AVERage?	–100.0 dB to +20.0 dB	query only	6.83
SAMPle:SUBarrays:MODulation:XPERror[:GMSK]:AVERage?	–100.0 dB to +20.0 dB	query only	6.83
CONFigure:MODulation:XPERror[:GMSK]:CONTrol	SCALar | ARRay, 1 to 1000 | NONE	with query	6.77
CONFigure:MODulation:XPERror[:GMSK]:CONTrol:DEFault	ON | OFF	with query	6.78
CONFigure:MODulation:XPERror[:GMSK]:CONTrol:REPetition	CONTinuous | SINGleshot | 1 to 10000, SONerror | NONE, STEP | NONE	with query	6.78
CONFigure:MODulation:XPERror[:GMSK]:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.76
CONFigure:MODulation:XPERror[:GMSK]:FILTer	G500 | B600	with query	6.77
CONFigure:MODulation:XPERror[:GMSK]:LIMit:AVERage	0.0 deg to 50.0 deg, 0.0 deg to 50.0 deg, –100 dB to 0 dB, –100 dB to 0 dB, 0 Hz to 999 Hz	with query	6.79
CONFigure:MODulation:XPERror[:GMSK]:LIMit:DEFault	ON | OFF	with query	6.79
CONFigure:MODulation:XPERror[:GMSK]:LIMit:LOWer:MODE	ON | OFF	with query	6.79
CALCulate:MODulation:XPERror[:GMSK]:LIMit:MATChing?	<Result>	query only	6.82
CONFigure:MODulation:XPERror[:GMSK]:LIMit:UPPer:MODE	ON | OFF	with query	6.79
CONFigure:MODulation:XPERror[:GMSK]:LIMit[:CURRent]	0.0 deg to 50.0 deg, 0.0 deg to 50.0 deg, –100 dB to 0 dB, –100 dB to 0 dB, 0 Hz to 999 Hz	with query	6.78
READ:ARRay:MODulation:XPERror[:GMSK]:MMAXimum?	–100.0 dB to +100.0 dB	query only	6.82
FETCh:ARRay:MODulation:XPERror[:GMSK]:MMAXimum?	–100.0 dB to +100.0 dB	query only	6.82
SAMPle:ARRay:MODulation:XPERror[:GMSK]:MMAXimum?	–100.0 dB to +100.0 dB	query only	6.82
READ:SUBarrays:MODulation:XPERror[:GMSK]:MMAXimum?	–100.0 dB to +20.0 dB	query only	6.83
FETCh:SUBarrays:MODulation:XPERror[:GMSK]:MMAXimum?	–100.0 dB to +20.0 dB	query only	6.83
SAMPle:SUBarrays:MODulation:XPERror[:GMSK]:MMAXimum?	–100.0 dB to +20.0 dB	query only	6.83
CONFigure:MODulation:XPERror[:GMSK]:RSTRecovery	NON | TSC	with query	6.77
FETCh:MODulation:XPERror[:GMSK]:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 1 to 10000 | NONE, 1 to 1000 | NONE	query only	6.76

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CONFigure:MODulation:XPERror[:GMSK]:TIME:DECode	STANdard | GTBits	with query	6.77
READ[:SCALar]:MODulation:XPERror[:GMSK]?	<Result>	query only	6.81
FETCh[:SCALar]:MODulation:XPERror[:GMSK]?	<Result>	query only	6.81
SAMPle[:SCALar]:MODulation:XPERror[:GMSK]?	<Result>	query only	6.81
READ:ARRay:MODulation:XPERror[:GMSK][:CURRent]?	–100.0 dB to +100.0 dB	query only	6.82
FETCh:ARRay:MODulation:XPERror[:GMSK][:CURRent]?	–100.0 dB to +100.0 dB	query only	6.82
SAMPle:ARRay:MODulation:XPERror[:GMSK][:CURRent]?	–100.0 dB to +100.0 dB	query only	6.82
READ:SUBarrays:MODulation:XPERror[:GMSK][:CURRent]?	–100.0 dB to +20.0 dB	query only	6.83
FETCh:SUBarrays:MODulation:XPERror[:GMSK][:CURRent]?	–100.0 dB to +20.0 dB	query only	6.83
SAMPle:SUBarrays:MODulation:XPERror[:GMSK][:CURRent]?	–100.0 dB to +20.0 dB	query only	6.83
Modulation measurement: 8PSK Modulation, Phase Error			
INITiate:MODulation[:PERRor]:EPSK	–	no query	6.97
ABORt:MODulation[:PERRor]:EPSK	–	no query	6.97
STOP:MODulation[:PERRor]:EPSK	–	no query	6.97
CONTinue:MODulation[:PERRor]:EPSK	–	no query	6.97
CONFigure:SUBarrays:MODulation[:PERRor]:EPSK	ALL | ARIThmetical | MINimum | MAXimum | IVAL,<Start>,<Samples>{,<Start>,<Samples>}	with query	6.99
READ:ARRay:MODulation[:PERRor]:EPSK:AVERage?	–100.0 deg to +100.0 deg	query only	6.101
FETCh:ARRay:MODulation[:PERRor]:EPSK:AVERage?	–100.0 deg to +100.0 deg	query only	6.101
SAMPle:ARRay:MODulation[:PERRor]:EPSK:AVERage?	–100.0 deg to +100.0 deg	query only	6.101
READ:SUBarrays:MODulation[:PERRor]:EPSK:AVERage?	–100 deg to +100 deg	query only	6.101
FETCh:SUBarrays:MODulation[:PERRor]:EPSK:AVERage?	–100 deg to +100 deg	query only	6.101
SAMPle:SUBarrays:MODulation[:PERRor]:EPSK:AVERage?	–100 deg to +100 deg	query only	6.101
CONFigure:MODulation[:PERRor]:EPSK:CONTrol	SCALar | ARRay, 1 to 1000 | NONE	with query	6.98
CONFigure:MODulation[:PERRor]:EPSK:CONTrol:DEFault	ON | OFF	with query	6.99
CONFigure:MODulation[:PERRor]:EPSK:CONTrol:REPetition	CONTinuous | SINGleshot | 1 to 10000, SONerror | NONE, STEP | NONE	with query	6.98
CONFigure:MODulation[:PERRor]:EPSK:DBITs	ON | OFF	with query	6.95
CONFigure:MODulation[:PERRor]:EPSK:DBITs	ON | OFF	with query	6.102
READ[:SCALar]:MODulation[:PERRor]:EPSK:DBITS:PEAK?	0 to 7	query only	6.102
FETCh[:SCALar]:MODulation[:PERRor]:EPSK:DBITS:PEAK?	0 to 7	query only	6.102
SAMPle[:SCALar]:MODulation[:PERRor]:EPSK:DBITS:PEAK?	0 to 7	query only	6.102
READ[:SCALar]:MODulation[:PERRor]:EPSK:DBITS?	0 to 7	query only	6.102
FETCh[:SCALar]:MODulation[:PERRor]:EPSK:DBITS?	0 to 7	query only	6.102
SAMPle[:SCALar]:MODulation[:PERRor]:EPSK:DBITS?	0 to 7	query only	6.102
READ:ARRay:MODulation[:PERRor]:EPSK:DBITS?	0 to 7, …	query only	6.103
FETCh:ARRay:MODulation[:PERRor]:EPSK:DBITS?	0 to 7, …	query only	6.103
SAMPle:ARRay:MODulation[:PERRor]:EPSK:DBITS?	0 to 7, …	query only	6.103
CONFigure:MODulation[:PERRor]:EPSK:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.97
CALCulate:MODulation[:PERRor]:EPSK:LIMit:MATChing?	<Result>	query only	6.100
READ:ARRay:MODulation[:PERRor]:EPSK:MMAXimum?	–100.0 deg to +100.0 deg	query only	6.101
FETCh:ARRay:MODulation[:PERRor]:EPSK:MMAXimum?	–100.0 deg to +100.0 deg	query only	6.101
SAMPle:ARRay:MODulation[:PERRor]:EPSK:MMAXimum?	–100.0 deg to +100.0 deg	query only	6.101

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READ:SUBarrays:MODulation[:PERRor]:EPSK:MMAXimum?	–100 deg to +100 deg	query only	6.101
FETCh:SUBarrays:MODulation[:PERRor]:EPSK:MMAXimum?	–100 deg to +100 deg	query only	6.101
SAMPle:SUBarrays:MODulation[:PERRor]:EPSK:MMAXimum?	–100 deg to +100 deg	query only	6.101
FETCh:MODulation[:PERRor]:EPSK:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 1 to 10000 | NONE , 1 to 1000 | NONE	query only	6.97
READ[:SCALar]:MODulation[:PERRor]:EPSK?	<Result>	query only	6.100
FETCh[:SCALar]:MODulation[:PERRor]:EPSK?	<Result>	query only	6.100
SAMPle[:SCALar]:MODulation[:PERRor]:EPSK?	<Result>	query only	6.100
READ:ARRay:MODulation[:PERRor]:EPSK[:CURRent]?	–100.0 deg to +100.0 deg	query only	6.101
FETCh:ARRay:MODulation[:PERRor]:EPSK[:CURRent]?	–100.0 deg to +100.0 deg	query only	6.101
SAMPle:ARRay:MODulation[:PERRor]:EPSK[:CURRent]?	–100.0 deg to +100.0 deg	query only	6.101
READ:SUBarrays:MODulation[:PERRor]:EPSK[:CURRent]?	–100 deg to +100 deg	query only	6.101
FETCh:SUBarrays:MODulation[:PERRor]:EPSK[:CURRent]?	–100 deg to +100 deg	query only	6.101
SAMPle:SUBarrays:MODulation[:PERRor]:EPSK[:CURRent]?	–100 deg to +100 deg	query only	6.101
Modulation measurement: GMSK Modulation, Phase Error			
INITiate:MODulation[:PERRor][:GMSK]	–	no query	6.67
ABORt:MODulation[:PERRor][:GMSK]	–	no query	6.67
STOP:MODulation[:PERRor][:GMSK]	–	no query	6.67
CONTinue:MODulation[:PERRor][:GMSK]	–	no query	6.67
CONFigure:SUBarrays:MODulation[:PERRor][:GMSK]	ALL | ARIThmetical | MINimum | MAXimum | IVAL,<Start>,<Samples>{,<Start>,<Samples>}	with query	6.72
READ:ARRay:MODulation[:PERRor][:GMSK]:AVERage?	–100.0 dB to +100.0 dB	query only	6.74
FETCh:ARRay:MODulation[:PERRor][:GMSK]:AVERage?	–100.0 dB to +100.0 dB	query only	6.74
SAMPle:ARRay:MODulation[:PERRor][:GMSK]:AVERage?	–100.0 dB to +100.0 dB	query only	6.74
READ:SUBarrays:MODulation[:PERRor][:GMSK]:AVERage?	–100.0 dB to +20.0 dB	query only	6.75
FETCh:SUBarrays:MODulation[:PERRor][:GMSK]:AVERage?	–100.0 dB to +20.0 dB	query only	6.75
SAMPle:SUBarrays:MODulation[:PERRor][:GMSK]:AVERage?	–100.0 dB to +20.0 dB	query only	6.75
CONFigure:MODulation[:PERRor][:GMSK]:CONTrol	SCALar | ARRay, 1 to 1000 | NONE	with query	6.69
CONFigure:MODulation[:PERRor][:GMSK]:CONTrol:DEFault	ON | OFF	with query	6.69
CONFigure:MODulation[:PERRor][:GMSK]:CONTrol:REPetition	CONTinuous | SINGleshot | 1 to 10000, SONerror | NONE, STEP | NONE	with query	6.69
CONFigure:MODulation[:PERRor][:GMSK]:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.68
CONFigure:MODulation[:PERror][:GMSK]:FILTer	G500 | B600	with query	6.68
CONFigure:MODulation[:PERRor][:GMSK]:LIMit:AVERage	0.0 deg to 50.0 deg, 0.0 deg to 50.0 deg, 0 Hz to 999 Hz	with query	6.70
CONFigure:MODulation[:PERRor][:GMSK]:LIMit:DEFault	ON | OFF	with query	6.71
CONFigure:MODulation[:PERRor][:GMSK]:LIMit:LOWer:MODE	ON | OFF	with query	6.70
CALCulate:MODulation[:PERRor][:GMSK]:LIMit:MATChing?	<Result>	query only	6.74
CONFigure:MODulation[:PERRor][:GMSK]:LIMit:UPPer:MODE	ON | OFF	with query	6.70
CONFigure:MODulation[:PERRor][:GMSK]:LIMit[:CURRent]	0.0 deg to 50.0 deg, 0.0 deg to 50.0 deg, 0 Hz to 999 Hz	with query	6.70
READ:ARRay:MODulation[:PERRor][:GMSK]:MMAXimum?	–100.0 dB to +100.0 dB	query only	6.74
FETCh:ARRay:MODulation[:PERRor][:GMSK]:MMAXimum?	–100.0 dB to +100.0 dB	query only	6.74
SAMPle:ARRay:MODulation[:PERRor][:GMSK]:MMAXimum?	–100.0 dB to +100.0 dB	query only	6.74

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READ:SUBarrays:MODulation[:PERRor][:GMSK]:MMAXimum?	–100.0 dB to +20.0 dB	query only	6.75
FETCh:SUBarrays:MODulation[:PERRor][:GMSK]:MMAXimum?	–100.0 dB to +20.0 dB	query only	6.75
SAMPle:SUBarrays:MODulation[:PERRor][:GMSK]:MMAXimum?	–100.0 dB to +20.0 dB	query only	6.75
FETCh:MODulation[:PERRor][:GMSK]:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 1 to 10000 | NONE, 1 to 1000 | NONE	query only	6.68
CONFigure:MODulation[:PERRor][:GMSK]:TIME:DECode	STANdard | GTBits	with query	6.71
READ[:SCALar]:MODulation[:PERRor][:GMSK]?	<Result>	query only	6.73
FETCh[:SCALar]:MODulation[:PERRor][:GMSK]?	<Result>	query only	6.73
SAMPle[:SCALar]:MODulation[:PERRor][:GMSK]?	<Result>	query only	6.73
READ:ARRay:MODulation[:PERRor][:GMSK][:CURRent]?	–100.0 dB to +100.0 dB	query only	6.74
FETCh:ARRay:MODulation[:PERRor][:GMSK][:CURRent]?	–100.0 dB to +100.0 dB	query only	6.74
SAMPle:ARRay:MODulation[:PERRor][:GMSK][:CURRent]?	–100.0 dB to +100.0 dB	query only	6.74
READ:SUBarrays:MODulation[:PERRor][:GMSK][:CURRent]?	–100.0 dB to +20.0 dB	query only	6.75
FETCh:SUBarrays:MODulation[:PERRor][:GMSK][:CURRent]?	–100.0 dB to +20.0 dB	query only	6.75
SAMPle:SUBarrays:MODulation[:PERRor][:GMSK][:CURRent]?	–100.0 dB to +20.0 dB	query only	6.75
RF signal of the mobile phone			
CONFigure:MSSignal:CCH:PMAX	<Level>	with query	6.210
CONFigure:MSSignal:PDATa[:TCH]:MSLot:SCONfig	<Enable_0>,..., <Enable_7>, <Gamma_0>,... <Gamma_7>	with query	6.244
CONFigure:MSSignal[:CSWitched]:DTX	ON | OFF	with query	6.210
CONFigure:MSSignal[:CSWitched][:TCH]:MSLot:LOOP	<Loop>	with query	6.211
CONFigure:MSSignal[:CSWitched][:TCH]:MSLot:SCONfig	<Enable_0>,<Enable_1>, ..., <Enable_7>, <PCL_0>, ..., <PCL_7>	with query	6.211
CONFigure:MSSignal[:CSWitched][:TCH][:SSLot]:LOOP	<Loop>	with query	6.211
CONFigure:MSSignal[:CSWitched][:TCH][:SSLot]:MS:PCL	<Level>	with query	6.210
CONFigure:MSSignal[:TCH]:TADVance	0 bit to 63 bit	with query	6.210
Parameters of the mobile phone			
[SENSe:]MSSinfo:AMR:FRATe:DLCMode?	CM1 | CM2 | CM3 | CM4	with query	6.256
[SENSe:]MSSinfo:AMR:FRATe:ULCMode?	CM1 | CM2 | CM3 | CM4	with query	6.256
[SENSe:]MSSinfo:AMR:HRATe:DLCMode?	CM1 | CM2 | CM3 | CM4	with query	6.256
[SENSe:]MSSinfo:AMR:HRATe:ULCMode?	CM1 | CM2 | CM3 | CM4	with query	6.256
[SENSe:]MSSinfo:BANDs?	SUPP | NSUPP, 1 to 5, E1 | E2 | E3, …	query only	6.235
[SENSe:]MSSinfo:DNUMber?	Max. 20-digit	query only	6.234
[SENSe:]MSSinfo:IMEI:FAC?	2-digit | NAN	query only	6.233
[SENSe:]MSSinfo:IMEI:SNR?	6-digit | NAN	query only	6.233
[SENSe:]MSSinfo:IMEI:SVN?	1 | 2-digit | NAN	query only	6.233
[SENSe:]MSSinfo:IMEI:TAC?	6-digit | NAN	query only	6.233
[SENSe:]MSSinfo:IMSI:MCC?	0 to 999 | NAN	query only	6.233
[SENSe:]MSSinfo:IMSI:MNC?	0 to 99 | NAN	query only	6.233
[SENSe:]MSSinfo:IMSI:MSIN?	"0" to "9999999999" | NAN	query only	6.233
[SENSe:]MSSinfo:MSCLass:CSWitched?	CL1 to CL29	query only	6.234
[SENSe:]MSSinfo:MSCLass:DTM:EGPRs?	CL1 to CL29	query only	6.234
[SENSe:]MSSinfo:MSCLass:DTM[:GPRS]?	CL1 to CL29	query only	6.234
[SENSe:]MSSinfo:MSCLass:PDATa:EGPRs?	CL1 to CL29	query only	6.251

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[SENSe:]MSSinfo:MSCLass:PDATa[:GPRS]?	CL1 to CL29	query only	6.251
[SENSe:]MSSinfo:POWer:CLASs:EPSK?	1 to 5	query only	6.234
[SENSe:]MSSinfo:POWer:CLASs[:GMSK]?	1 to 5	query only	6.234
[SENSe:]MSSinfo:REVision?	PH1 | PH2 | PH2P	query only	6.233
[SENSe:]MSSinfo:SBANds?	SUPP | NSUPP, 1 to 5, E1 | E2 | E3, …	query only	6.235
Network parameters			
CONFigure:NETWork:B52Mode	SCOD | MSUP	with query	6.219
CONFigure:NETWork:BAList	<Channel> {,<Channel>}	with query	6.219
CONFigure:NETWork:IDENtity:BCC	0 to 7	with query	6.221
CONFigure:NETWork:IDENtity:LAC	1 to 65533 and 65535	with query	6.221
CONFigure:NETWork:IDENtity:MCC	0 to 999	with query	6.220
CONFigure:NETWork:IDENtity:MNC	0 to 99 | 0 to 999	with query	6.220
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[SENSe:]NETWork:MSERvice?	CSWitched | PDATa	query only	6.247
CONFigure:NETWork:NSUPport	GSM | GGPR | GEGP	with query	6.246
PROCedure:NETWork:PDATa:BITStream	PR9 | PR11 | PR15 | PR16	with query	6.251
CONFigure:NETWork:PDATa:BITStream	PR9 | PR11 | PR15 | PR16	with query	6.251
CONFigure:NETWork:PDATa:BPERiod	0 to 15	with query	6.250
CONFigure:NETWork:PDATa:CATYpe	NBUR | ABUR	with query	6.250
PROCedure:NETWork:PDATa:CATYpe	NBUR | ABUR	with query	6.250
CONFigure:NETWork:PDATa:CSCHeme	CS1 to CS4 | MCS1 ato MCS9	with query	6.247
PROCedure:NETWork:PDATa:CSCHeme	CS1 to CS4 | MCS1 to MCS9	with query	6.247
CONFigure:NETWork:PDATa:EDALlocation	ON | OFF | AUTO	with query	6.249
CONFigure:NETWork:PDATa:EGPRs:PSCHeme	<PS_1>, ... <PS_12>	with query	6.248
PROCedure:NETWork:PDATa:EGPRs:PSCHeme	<PS_1>, ... <PS_12>	with query	6.248
CONFigure:NETWork:PDATa:EGPRs:PSCHeme:IREDundancy	ON | OFF	with query	6.248
CONFigure:NETWork:PDATa:NOPDus	1 to 4095	with query	6.249
CONFigure:NETWork:PDATa:PCMChannel	BCCH | PDCH	with query	6.248
CONFigure:NETWork:PDATa:RLCMode	ACKN | UNAC	with query	6.250
CONFigure:NETWork:PDATa:RLCMode	ACKN | UNAC	with query	6.250
CONFigure:NETWork:PDATa:SOFFset	0 to 7	with query	6.249
CONFigure:NETWork:PDATa:TAVGt	0 to 31	with query	6.250
CONFigure:NETWork:PDATa:TRFL	ON | OFF	with query	6.251
CONFigure:NETWork:PDATa:TWACk	ON | OFF	with query	6.249
PROCedure:NETWork:PDATa:UDCYcle	A100 | A000 | A012	with query	6.249
CONFigure:NETWork:PDATa:USF	0 to 7	with query	6.248
CONFigure:NETWork:REQuest:IMSI	ON | OFF	with query	6.225
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CONFigure:NETWork:SI2Quater:NC3G:FDD:ARFCN	ON | OFF	with query	6.227
CONFigure:NETWork:SI2Quater:NC3G:FDD:PSCode	ON | OFF	with query	6.227
CONFigure:NETWork:SYSTem:ACLass	0 to 2^{16}–1	with query	6.222
CONFigure:NETWork:SYSTem:BINDicator	G18 | G19	with query	6.221
CONFigure:NETWork:SYSTem:BSAGblksres	0 to 7	with query	6.221

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CONFigure:NETWork:SYSTem:BSPamfrms	2 to 9	with query	6.222
CONFigure:NETWork:SYSTem:BSPReorganis	ON|OFF	with query	6.222
CONFigure:NETWork:SYSTem:CACCess	BARRed | NBARred	with query	6.221
CONFigure:NETWork:SYSTem:PLUPdate	OFF | 0 to 255	with query	6.222
CONFigure:NETWork[:CSWitched]:AMR:FRATe:DLCMode	ON | OFF	with query	6.252
PROCedure:NETWork[:CSWitched]:AMR:FRATe:DLCMode	ON | OFF	with query	6.252
CONFigure:NETWork[:CSWitched]:AMR:FRATe:RSETting	<CM4>, <CM3>, CM2>, <CM1>,<ThrDown4>, <ThrUp3>, <ThrDown3>, <ThrUp2>, <ThrDown2>, <ThrUp1>	with query	6.255
PROCedure:NETWork[:CSWitched]:AMR:FRATe:RSETting	<CM4>, <CM3>, CM2>, <CM1>,<ThrDown4>, <ThrUp3>, <ThrDown3>, <ThrUp2>, <ThrDown2>, <ThrUp1>	with query	6.255
CONFigure:NETWork[:CSWitched]:AMR:FRATe:ULCMode	ON | OFF	with query	6.253
PROCedure:NETWork[:CSWitched]:AMR:FRATe:ULCMode	ON | OFF	with query	6.253
CONFigure:NETWork[:CSWitched]:AMR:HRATe:DLCMode	ON | OFF	with query	6.252
PROCedure:NETWork[:CSWitched]:AMR:HRATe:DLCMode	ON | OFF	with query	6.252
CONFigure:NETWork[:CSWitched]:AMR:HRATe:RSETting	<CM4>, <CM3>, CM2>, <CM1>,<ThrDown4>, <ThrUp3>, <ThrDown3>, <ThrUp2>, <ThrDown2>, <ThrUp1>	with query	6.254
PROCedure:NETWork[:CSWitched]:AMR:HRATe:RSETting	<CM4>, <CM3>, CM2>, <CM1>,<ThrDown4>, <ThrUp3>, <ThrDown3>, <ThrUp2>, <ThrDown2>, <ThrUp1>	with query	6.254
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PROCedure:NETWork[:CSWitched]:AMR:HRATe:ULCMode	ON | OFF	with query	6.253
CONFigure:NETWork[:CSWitched]:AMR:NSUPpression	ON | OFF	with query	6.252
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CONFigure:NETWork[:CSWitched]:EMReports	ON | OFF	with query	6.220
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CONFigure:NETWork[:CSWitched]:REQuest:CTHRee	ON | OFF	with query	6.226
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CONFigure:NETWork[:CSWitched]:SMODe:IMSI:MSIN	"0" to "9999999999"	with query	6.225
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CONFigure:NETWork[:CSWitched]:SMODe:SCHannel	SDCCh | FACCh | NONE	with query	6.223

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PROCedure:NETWork[:CSWitched]:SMODe:STIMe	0 to 600	with query	6.224
CONFigure:NETWork[:CSWitched]:SMODe:TRAFfic	FRV1 | FRV2 | HRV1 | FD24 | FD48 | FD96 | FD14 | HD24 | HD48 | C1TM |... | C4TM | MC1TM | ... | MC4TM | AMRH | AMRF	with query	6.223
PROCedure:NETWork[:CSWitched]:SMODe:TRAFfic	FRV1 | FRV2 | HRV1 | FD24 | FD48 | FD96 | FD14 | HD24 | HD48 | C1TM |... | C4TM | MC1TM | ... | MC4TM | AMRH | AMRF	with query	6.223
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PROCedure:NETWork[:CSWitched]:SMODe:TRAFfic:HRSubchanne l	SC0 | SC1	with query	6.224
CONFigure:NETWork[:CSWitched]:SOFFset	–7 to 7	with query	6.219
CONFigure:NETWork[:CSWitched]:TIMeout:MTC	0 s to 60 s | OFF	with query	6.227
CONFigure:NETWork[:CSWitched]:TIMeout:RLINk:TESTset	4 to 64 | OFF	with query	6.227
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NPOWer measurement			
INITiate:NPOWer	–	no query	6.41
ABORt:NPOWer	–	no query	6.41
STOP:NPOWer	–	no query	6.41
CONTinue:NPOWer	–	no query	6.41
CONFigure:NPOWer:CONTrol	1 to 1000 | NONE,CONTinuous | SINGleshot | 1 ... 10000, SONerror | NONE,STEP | NONE	with query	6.42
CONFigure:NPOWer:CONTrol:REPetition	CONTinuous | SINGleshot | 1 ... 10000, SONerror | NONE,STEP | NONE	with query	6.43
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FETCh:NPOWer:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 1 to 10000 | NONE, 1 to 1000 | NONE	query only	6.41
READ[:SCALar]:NPOWer?	–30 dBm to +30 dBm	query only	6.43
FETCh[:SCALar]:NPOWer?	–30 dBm to +30 dBm	query only	6.43
SAMPle[:SCALar]:NPOWer?	–30 dBm to +30 dBm	query only	6.43
Options			
SYSTem:OPTions:INFO:CURRent?		query only	6.35
Power vs. time, access burst			
INITiate:POWer:ABURst[:GMSK]	–	no query	6.157
ABORt:POWer:ABURst[:GMSK]	–	no query	6.157
STOP:POWer:ABURst[:GMSK]	–	no query	6.157
CONTinue:POWer:ABURst[:GMSK]	–	no query	6.157
CONFigure:SUBarrays:POWer:ABURst[:GMSK]	ALL | ARITHmetical | MINimum | MAXimum,<Start>,<Samples>{ ,<Start>,<Samples>}	with query	6.159
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?			
CONFigure:POWer:ABURst[:GMSK]:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.157
CALCulate:POWer:ABURst[:GMSK]:LIMit:MATChing?	AvgBurstPowerCurr, PeakBurstPowerCurr, BurstMatching, AvgBurstPowerAvg	query only	6.161
CALCulate:ARRay:POWer:ABURst[:GMSK]:LIMit:MATChing?	<Matching>	query only	6.162
FETCh:POWer:ABURst[:GMSK]:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 1 to 10000 | NONE , 1 to 1000 | NONE	query only	6.158
CONFigure:POWer:ABURst[:GMSK]:TOFFset	–4.00 to +4.00	with query	6.158
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FETCh[:SCALar]:POWer:ABURst[:GMSK]?	<Result>	query only	6.160
SAMPle[:SCALar]:POWer:ABURst[:GMSK]?	<Result>	query only	6.160
READ:ARRay:POWer:ABURst[:GMSK]?	–100.0 to +20.0	query only	6.161
FETCh:ARRay:POWer:ABURst[:GMSK]?	–100.0 to +20.0	query only	6.161
SAMPle:ARRay:POWer:ABURst[:GMSK]?	–100.0 to +20.0	query only	6.161
READ:SUBarrays:POWer:ABURst[:GMSK]?	–100.0 to +20.0	query only	6.162
FETCh:SUBarrays:POWer:ABURst[:GMSK]?	–100.0 to +20.0	query only	6.162
SAMPle:SUBarrays:POWer:ABURst[:GMSK]?	–100.0 to +20.0	query only	6.162
POWer:FRAMe measurement			
INITiate:POWer:FRAMe	–	no query	6.53
ABORt:POWer:FRAMe	–	no query	6.53
STOP:POWer:FRAMe	–	no query	6.53
CONTinue:POWer:FRAMe	–	no query	6.53
CONFigure:SUBarrays:POWer:FRAMe	ALL | ARIThmetical | MINimum | MAXimum | IVAL,<Start>,<Samples>{,<Start>,<Samples>}	with query	6.55
CONFigure:POWer:FRAMe:CONTrol:DEFault	ON | OFF	with query	6.54
CONFigure:POWer:FRAMe:CONTrol:REPetition	CONTinuous | SINGleshot | 1 to 10000, SONerror | NONE, STEP | NONE	with query	6.54
CONFigure:POWer:FRAMe:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.53
CONFigure:POWer:FRAMe:FCOunt	1 to 128	with query	6.53
READ[:SCALar]:POWer:FRAMe:FPOWer<nr>?	<Result>	query only	6.56
FETCh[:SCALar]:POWer:FRAMe:FPOWer<nr>?	<Result>	query only	6.56
SAMPle[:SCALar]:POWer:FRAMe:FPOWer<nr>?	<Result>	query only	6.56
FETCh:POWer:FRAMe:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 1 to 10000 | NONE	query only	6.53
READ:ARRay:POWer:FRAMe?	<Result>	query only	6.56
FETCh:ARRay:POWer:FRAMe?	<Result>	query only	6.56
SAMPle:ARRay:POWer:FRAMe?	<Result>	query only	6.56
READ:SUBarrays:POWer:FRAMe?	<Result>	query only	6.56
FETCh:SUBarrays:POWer:FRAMe?	<Result>	query only	6.56
SAMPle:SUBarrays:POWer:FRAMe?	<Result>	query only	6.56
POWer:MSLot measurement			
INITiate:POWer:MSLot	–	no query	6.57
ABORt:POWer:MSLot	–	no query	6.57

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STOP:POWer:MSLot	–	no query	6.57
CONTinue:POWer:MSLot	–	no query	6.57
CONFigure:SUBarrays:POWer:MSLot	ALL | ARITHmetical | MINimum | MAXimum,<Start>,<Samples>{,<Start>,<Samples>}	with query	6.61
[SENSe:]ARRay:POWer:MSLot:AREA:LIMit:INFO:STIMe?	<Start_Time>	query only	6.66
[SENSe:]ARRay:POWer:MSLot:AREA:LIMit:LOWer:INFO?	<Result>	query only	6.65
[SENSe:]ARRay:POWer:MSLot:AREA:LIMit:LOWer:LEVel?	<Result>	query only	6.65
[SENSe:]ARRay:POWer:MSLot:AREA:LIMit:LOWer:TIME?	<Result>	query only	6.65
CALCulate:ARRay:POWer:MSLot:AREA:LIMit:MATChing:MINimum?	<Matching>	query only	6.64
CALCulate:ARRay:POWer:MSLot:AREA:LIMit: MATChing[:CURRent]?	<Matching>	query only	6.64
[SENSe:]ARRay:POWer:MSLot:AREA:LIMit:UPPer:INFO?	<Result>	query only	6.65
[SENSe:]ARRay:POWer:MSLot:AREA:LIMit:UPPer:LEVel?	<Result>	query only	6.65
[SENSe:]ARRay:POWer:MSLot:AREA:LIMit:UPPer:TIME?	<Result>	query only	6.65
READ:ARRay:POWer:MSLot:AVERage?	–100.0 dB to +20.0 dB	query only	6.63
FETCh:ARRay:POWer:MSLot:AVERage?	–100.0 dB to +20.0 dB	query only	6.63
SAMPle:ARRay:POWer:MSLot:AVERage?	–100.0 dB to +20.0 dB	query only	6.63
READ:SUBarrays:POWer:MSLot:AVERage?	–100.0 dB to +20.0 dB	query only	6.64
FETCh:SUBarrays:POWer:MSLot:AVERage?	–100.0 dB to +20.0 dB	query only	6.64
SAMPle:SUBarrays:POWer:MSLot:AVERage?	–100.0 dB to +20.0 dB	query only	6.64
CONFigure:POWer:MSLot:CONTrol	SCALar | ARRay, 1 to 1000 | NONE	with query	6.58
CONFigure:POWer:MSLot:CONTrol:DEFault	ON | OFF	with query	6.59
DISPlay:POWer:MSLot:CONTrol:GRID	ON | OFF	with query	6.58
CONFigure:POWer:MSLot:CONTrol:REPetition	CONTinuous | SINGleshot | 1 to 10000, SONerror | NONE,STEP | NONE	with query	6.58
CONFigure:POWer:MSLot:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.57
CONFigure:POWer:MSLot:FILTer	G500 | B600	with query	6.60
CONFigure:POWer:MSLot:LIMit:LINE:GLEVel	0.00 dB to +10.00 dB	with query	6.60
CONFigure:POWer:MSLot:LIMit:LINE:OTEMPlate	RMAX | RSK	with query	6.60
CALCulate:ARRay:POWer:MSLot:LIMit:MATChing:MINimum?	<Matching>	query only	6.64
CALCulate:POWer:MSLot:LIMit:MATChing?	AvgBurstPowerCurr, PeakBurstPowerCurr, BurstMatching, AvgBurstPowerAvg	query only	6.62
CALCulate:ARRay:POWer:MSLot:LIMit:MATChing[:CURRent]?	<Matching>	query only	6.64
READ:ARRay:POWer:MSLot:MAXimum?	–100.0 dB to +20.0 dB	query only	6.63
FETCh:ARRay:POWer:MSLot:MAXimum?	–100.0 dB to +20.0 dB	query only	6.63
SAMPle:ARRay:POWer:MSLot:MAXimum?	–100.0 dB to +20.0 dB	query only	6.63
READ:SUBarrays:POWer:MSLot:MAXimum?	–100.0 dB to +20.0 dB	query only	6.64
FETCh:SUBarrays:POWer:MSLot:MAXimum?	–100.0 dB to +20.0 dB	query only	6.64
SAMPle:SUBarrays:POWer:MSLot:MAXimum?	–100.0 dB to +20.0 dB	query only	6.64
READ:ARRay:POWer:MSLot:MINimum?	–100.0 dB to +20.0 dB	query only	6.63
FETCh:ARRay:POWer:MSLot:MINimum?	–100.0 dB to +20.0 dB	query only	6.63
SAMPle:ARRay:POWer:MSLot:MINimum?	–100.0 dB to +20.0 dB	query only	6.63

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READ:SUBarrays:POWer:MSLot:MINimum?	–100.0 dB to +20.0 dB	query only	6.64
FETCh:SUBarrays:POWer:MSLot:MINimum?	–100.0 dB to +20.0 dB	query only	6.64
SAMPle:SUBarrays:POWer:MSLot:MINimum?	–100.0 dB to +20.0 dB	query only	6.64
CONFigure:POWer:MSLot:MVIew	<Mod_-1>,<Mod_0>, <Mod_1>, <Mod_2>	with query	6.59
CONFigure:POWer:MSLot:SCOunt	1 to 4	with query	6.59
FETCh:POWer:MSLot:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 1 to 10000 | NONE , 1 to 1000 | NONE	query only	6.57
CONFigure:POWer:MSLot:TOFFset	–4.00 to +4.00	with query	6.59
CONFigure:POWer:MSLot:TSALevel	–4.00 to +4.00	with query	6.60
READ[:SCALar]:POWer:MSLot?	<Result>	query only	6.62
FETCh[:SCALar]:POWer:MSLot?	<Result>	query only	6.62
SAMPle[:SCALar]:POWer:MSLot?	<Result>	query only	6.62
READ:ARRay:POWer:MSLot[:CURRent]?	–100.0 dB to +20.0 dB	query only	6.63
FETCh:ARRay:POWer:MSLot[:CURRent]?	–100.0 dB to +20.0 dB	query only	6.63
SAMPle:ARRay:POWer:MSLot[:CURRent]?	–100.0 dB to +20.0 dB	query only	6.63
READ:SUBarrays:POWer:MSLot[:CURRent]?	–100.0 dB to +20.0 dB	query only	6.64
FETCh:SUBarrays:POWer:MSLot[:CURRent]?	–100.0 dB to +20.0 dB	query only	6.64
SAMPle:SUBarrays:POWer:MSLot[:CURRent]?	–100.0 dB to +20.0 dB	query only	6.64
Power vs PCL			
INITiate:POWer:PCL	–	no query	6.163
ABORt:POWer:PCL	–	no query	6.163
STOP:POWer:PCL	–	no query	6.163
CONTinue:POWer:PCL	–	no query	6.163
CONFigure:POWer:PCL:CCOunt	C3 | C7	with query	6.164
CONFigure:POWer:PCL:CHANnel	<Channel1>, ... ,<Channeln>	with query	6.164
CONFigure:POWer:PCL:CONTrol:REPetition	CONTinuous | SINGleshot | 1 to 10000, SONerror | NONE, STEP | NONE	with query	6.164
CONFigure:POWer:PCL:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.163
READ[:SCALar]:POWer:PCL:PCLPower<PCL>?	<Result>	query only	6.166
FETCh[:SCALar]:POWer:PCL:PCLPower<PCL>?	<Result>	query only	6.166
SAMPle[:SCALar]:POWer:PCL:PCLPower<PCL>?	<Result>	query only	6.166
FETCh:POWer:PCL:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 1 to 10000 | NONE	query only	6.163
READ[:SCALar]:POWer:PCL?	<Result>	query only	6.165
FETCh[:SCALar]:POWer:PCL?	<Result>	query only	6.165
SAMPle[:SCALar]:POWer:PCL?	<Result>	query only	6.165
CALCulate:POWer:PCL[:CURRent]:LIMit:MATChing?	OK | NMAU | NMAL | INV	query only	6.166
CONFigure:POWer:PVT:IRDTimeout	NORMal | MEDium | SHORt	with query	6.44
POWer:SLOT measurement			
INITiate:POWer:SLOT	–	no query	6.44
ABORt:POWer:SLOT	–	no query	6.44
STOP:POWer:SLOT	–	no query	6.44
CONTinue:POWer:SLOT	–	no query	6.44
CONFigure:SUBarrays:POWer:SLOT	ALL | ARIThmetical | MINimum	with query	6.46

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	| MAXimum | IVAL,<Start>,<Samples>{,<Start>,<Samples>}		
CONFigure:POWer:SLOT:CONTrol:DEFault	ON | OFF	with query	6.45
CONFigure:POWer:SLOT:CONTrol:REPetition	CONTinuous | SINGleshot | 1 to 10000, SONerror | NONE, STEP | NONE	with query	6.45
CONFigure:POWer:SLOT:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.44
READ[:SCALar]:POWer:SLOT:SPOWer<nr>?	<Result>	query only	6.46
FETCh[:SCALar]:POWer:SLOT:SPOWer<nr>?	<Result>	query only	6.46
SAMPle[:SCALar]:POWer:SLOT:SPOWer<nr>?	<Result>	query only	6.46
FETCh:POWer:SLOT:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 1 to 10000 | NONE	query only	6.45
READ:ARRay:POWer:SLOT?	<Result>	query only	6.47
FETCh:ARRay:POWer:SLOT?	<Result>	query only	6.47
SAMPle:ARRay:POWer:SLOT?	<Result>	query only	6.47
READ:SUBarrays:POWer:SLOT?	<Result>	query only	6.47
FETCh:SUBarrays:POWer:SLOT?	<Result>	query only	6.47
SAMPle:SUBarrays:POWer:SLOT?	<Result>	query only	6.47
POWer:XSLOT measurement			
INITiate:POWer:XSLot	–	no query	6.48
ABORt:POWer:XSLot	–	no query	6.48
STOP:POWer:XSLot	–	no query	6.48
CONTinue:POWer:XSLot	–	no query	6.48
CONFigure:SUBarrays:POWer:XSLot	ALL | ARIThmetical | MINimum | MAXimum | IVAL,<Start>,<Samples>{,<Start>,<Samples>}	with query	6.51
CONFigure:POWer:XSLot:CONTrol:DEFault	ON | OFF	with query	6.49
CONFigure:POWer:XSLot:CONTrol:REPetition	CONTinuous | SINGleshot | 1 to 10000, SONerror | NONE, STEP | NONE	with query	6.49
CONFigure:POWer:XSLot:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.48
CONFigure:POWer:XSLot:SCOunt	S128 | S256 | S384 | S512[,1 to 512]	with query	6.50
READ[:SCALar]:POWer:XSLot:SPOWer<nr>?	<Result>	query only	6.52
FETCh[:SCALar]:POWer:XSLot:SPOWer<nr>?	<Result>	query only	6.52
SAMPle[:SCALar]:POWer:XSLot:SPOWer<nr>?	<Result>	query only	6.52
FETCh:POWer:XSLot:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 1 to 10000 | NONE	query only	6.48
READ:ARRay:POWer:XSLot?	<Result>	query only	6.52
FETCh:ARRay:POWer:XSLot?	<Result>	query only	6.52
SAMPle:ARRay:POWer:XSLot?	<Result>	query only	6.52
READ:SUBarrays:POWer:XSLot?	<Result>	query only	6.52
FETCh:SUBarrays:POWer:XSLot?	<Result>	query only	6.52
SAMPle:SUBarrays:POWer:XSLot?	<Result>	query only	6.52
Power vs. time (normal burst, 8PSK modulation)			
INITiate:POWer[:NORMal]:EPSK	–	no query	6.141

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ABORt:POWer[:NORMal]:EPSK	–	no query	6.141
STOP:POWer[:NORMal]:EPSK	–	no query	6.141
CONTinue:POWer[:NORMal]:EPSK	–	no query	6.141
CONFigure:SUBarrays:POWer[:NORMal]:EPSK	ALL | ARIThmetical | MINimum | MAXimum | IVAL,<Start>,<Samples>{,<Start>,<Samples>}	with query	6.151
CALCulate:ARRay:POWer[:NORMal]:EPSK:AREA:LIMit: MATChing:AVERage?	<Matching>	query only	6.156
CALCulate:ARRay:POWer[:NORMal]:EPSK:AREA:LIMit: MATChing:MAXimum?	<Matching>	query only	6.156
CALCulate:ARRay:POWer[:NORMal]:EPSK:AREA:LIMit: MATChing:MINimum?	<Matching>	query only	6.156
CALCulate:ARRay:POWer[:NORMal]:EPSK:AREA:LIMit: MATChing[:CURRent]?	<Matching>	query only	6.156
READ:ARRay:POWer[:NORMal]:EPSK:AVERage?	–100.0 dB to +20.0 dB	query only	6.154
FETCh:ARRay:POWer[:NORMal]:EPSK:AVERage?	–100.0 dB to +20.0 dB	query only	6.154
SAMPle:ARRay:POWer[:NORMal]:EPSK:AVERage?	–100.0 dB to +20.0 dB	query only	6.154
READ:SUBarrays:POWer[:NORMal]:EPSK:AVERage?	–100.0 dB to +20.0 dB	query only	6.155
FETCh:SUBarrays:POWer[:NORMal]:EPSK:AVERage?	–100.0 dB to +20.0 dB	query only	6.155
SAMPle:SUBarrays:POWer[:NORMal]:EPSK:AVERage?	–100.0 dB to +20.0 dB	query only	6.155
CONFigure:POWer[:NORMal]:EPSK:CONTrol	SCALar | ARRay, 1 to 1000 | NONE	with query	6.143
CONFigure:POWer[:NORMal]:EPSK:CONTrol:DEFault	ON | OFF	with query	6.144
DISPlay:POWer[:NORMal]:EPSK:CONTrol:GRID	ON | OFF	with query	6.144
CONFigure:POWer[:NORMal]:EPSK:CONTrol:REPetition	CONTinuous | SINGleshot | 1 to 10000, SONerror | NONE,STEP | NONE	with query	6.143
CONFigure:POWer[:NORMal]:EPSK:CONTrol:RPMode	CURRent | AVERage | DCOMpens	with query	6.144
CONFigure:POWer[:NORMal]:EPSK:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.142
CONFigure:POWer[:NORMal]:EPSK:FILTer	G500 | B600	with query	6.142
CONFigure:POWer[:NORMal]:EPSK:LIMit:LINE:DEFault	ON | OFF	with query	6.149
CONFigure:POWer[:NORMal]:EPSK:LIMit: LINE:LOWer:ALL:DYNamic:ENABle	ON | OFF	with query	6.149
CONFigure:POWer[:NORMal]:EPSK:LIMit: LINE:LOWer<AreaNr>:ALL:DYNamic:ENABle	ON | OFF	with query	6.149
CONFigure:POWer[:NORMal]:EPSK:LIMit: LINE:LOWer<nr>:DYNamic<RgNr>	<fromTPCL>, <toTPCL>, <Correction>, ON | OFF	with query	6.148
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FETCh:ARRay:POWer[:NORMal]:EPSK:MAXimum?	–100.0 dB to +20.0 dB	query only	6.154
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READ:ARRay:POWer[:NORMal]:EPSK:MINimum?	–100.0 dB to +20.0 dB	query only	6.154
FETCh:ARRay:POWer[:NORMal]:EPSK:MINimum?	–100.0 dB to +20.0 dB	query only	6.154
SAMPle:ARRay:POWer[:NORMal]:EPSK:MINimum?	–100.0 dB to +20.0 dB	query only	6.154
READ:SUBarrays:POWer[:NORMal]:EPSK:MINimum?	–100.0 dB to +20.0 dB	query only	6.155
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SAMPle:ARRay:POWer[:NORMal]:EPSK[:CURRent]?	–100.0 dB to +20.0 dB	query only	6.154
READ:SUBarrays:POWer[:NORMal]:EPSK[:CURRent]?	–100.0 dB to +20.0 dB	query only	6.155
FETCh:SUBarrays:POWer[:NORMal]:EPSK[:CURRent]?	–100.0 dB to +20.0 dB	query only	6.155
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CALCulate:ARRay:POWer[:NORMal][:GMSK]:AREA:LIMit: MATChing:MAXimum?	<Matching>	query only	6.156
CALCulate:ARRay:POWer[:NORMal][:GMSK]:AREA:LIMit: MATChing:MINimum?	<Matching>	query only	6.156
CALCulate:ARRay:POWer[:NORMal][:GMSK]:AREA:LIMit: MATChing[:CURRent]?	<Matching>	query only	6.156
READ:ARRay:POWer[:NORMal][:GMSK]:AVERage?	–100.0 dB to +20.0 dB	query only	6.154
FETCh:ARRay:POWer[:NORMal][:GMSK]:AVERage?	–100.0 dB to +20.0 dB	query only	6.154
SAMPle:ARRay:POWer[:NORMal][:GMSK]:AVERage?	–100.0 dB to +20.0 dB	query only	6.154
READ:SUBarrays:POWer[:NORMal][:GMSK]:AVERage?	–100.0 dB to +20.0 dB	query only	6.155
FETCh:SUBarrays:POWer[:NORMal][:GMSK]:AVERage?	–100.0 dB to +20.0 dB	query only	6.155
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CALCulate:ARRay:POWer[:NORMal][:GMSK]:LIMit: MATChing:MINimum?	MATC | NMAT | INV | NTSC | OUT	query only	6.156
CALCulate:POWer[:NORMal][:GMSK]:LIMit:MATChing?	AvgBurstPowerCurr, PeakBurstPowerCurr, BurstMatching, AvgBurstPowerAvg	query only	6.153
CALCulate:ARRay:POWer[:NORMal][:GMSK]:LIMit: MATChing[:CURRent]?	MATC | NMAT | INV | NTSC | OUT	query only	6.156
READ:ARRay:POWer[:NORMal][:GMSK]:MAXimum?	–100.0 dB to +20.0 dB	query only	6.154
FETCh:ARRay:POWer[:NORMal][:GMSK]:MAXimum?	–100.0 dB to +20.0 dB	query only	6.154
SAMPle:ARRay:POWer[:NORMal][:GMSK]:MAXimum?	–100.0 dB to +20.0 dB	query only	6.154
READ:SUBarrays:POWer[:NORMal][:GMSK]:MAXimum?	–100.0 dB to +20.0 dB	query only	6.155
FETCh:SUBarrays:POWer[:NORMal][:GMSK]:MAXimum?	–100.0 dB to +20.0 dB	query only	6.155
SAMPle:SUBarrays:POWer[:NORMal][:GMSK]:MAXimum?	–100.0 dB dB to +20.0 dB	query only	6.155
READ:ARRay:POWer[:NORMal][:GMSK]:MINimum?	–100.0 dB to +20.0 dB	query only	6.154
FETCh:ARRay:POWer[:NORMal][:GMSK]:MINimum?	–100.0 dB to +20.0 dB	query only	6.154
SAMPle:ARRay:POWer[:NORMal][:GMSK]:MINimum?	–100.0 dB to +20.0 dB	query only	6.154
READ:SUBarrays:POWer[:NORMal][:GMSK]:MINimum?	–100.0 dB to +20.0 dB	query only	6.155
FETCh:SUBarrays:POWer[:NORMal][:GMSK]:MINimum?	–100.0 dB to +20.0 dB	query only	6.155
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READ:ARRay:POWer[:NORMal][:GMSK]:MPR:MAXimum?	–100.0 to +20.0	query only	6.170
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READ:SUBarrays:POWer[:NORMal][:GMSK]:MPR:MAXimum?	–100.0 to +20.0	query only	6.171
FETCh:SUBarrays:POWer[:NORMal][:GMSK]:MPR:MAXimum?	–100.0 to +20.0	query only	6.171
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READ:ARRay:POWer[:NORMal][:GMSK]:MPR:MINimum?	–100.0 to +20.0	query only	6.170
FETCh:ARRay:POWer[:NORMal][:GMSK]:MPR:MINimum?	–100.0 to +20.0	query only	6.170
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READ:SUBarrays:POWer[:NORMal][:GMSK]:MPR:MINimum?	–100.0 to +20.0	query only	6.171
FETCh:SUBarrays:POWer[:NORMal][:GMSK]:MPR:MINimum?	–100.0 to +20.0	query only	6.171
SAMPle:SUBarrays:POWer[:NORMal][:GMSK]:MPR:MINimum?	–100.0 dB to +20.0 dB	query only	6.171
FETCh:POWer[:NORMal][:GMSK]:MPR:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 1 to 10000 | NONE , 1 to 1000 | NONE	query only	6.167
READ[:SCALar]:POWer[:NORMal][:GMSK]:MPR?	<Result>	query only	6.170
FETCh[:SCALar]:POWer[:NORMal][:GMSK]:MPR?	<Result>	query only	6.170
SAMPle[:SCALar]:POWer[:NORMal][:GMSK]:MPR?	<Result>	query only	6.170
READ:ARRay:POWer[:NORMal][:GMSK]:MPR[:CURRent]?	–100.0 to +20.0	query only	6.170
FETCh:ARRay:POWer[:NORMal][:GMSK]:MPR[:CURRent]?	–100.0 to +20.0	query only	6.170
SAMPle:ARRay:POWer[:NORMal][:GMSK]:MPR[:CURRent]?	–100.0 to +20.0	query only	6.170
READ:SUBarrays:POWer[:NORMal][:GMSK]:MPR[:CURRent]?	–100.0 to +20.0	query only	6.171
FETCh:SUBarrays:POWer[:NORMal][:GMSK]:MPR[:CURRent]?	–100.0 to +20.0	query only	6.171
SAMPle:SUBarrays:POWer[:NORMal][:GMSK]:MPR[:CURRent]?	–100.0 to +20.0	query only	6.171
FETCh:POWer[:NORMal][:GMSK]:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 1 to 10000 | NONE , 1 to 1000 | NONE	query only	6.142
CONFigure:POWer[:NORMal][:GMSK]:TOFFset	–4.00 to +4.00	with query	6.142
READ[:SCALar]:POWer[:NORMal][:GMSK]?	<Result>	query only	6.152
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SAMPle[:SCALar]:POWer[:NORMal][:GMSK]?	<Result>	query only	6.152
READ:ARRay:POWer[:NORMal][:GMSK][:CURRent]?	–100.0 dB to +20.0 dB	query only	6.154
FETCh:ARRay:POWer[:NORMal][:GMSK][:CURRent]?	–100.0 dB to +20.0 dB	query only	6.154
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READ:SUBarrays:POWer[:NORMal][:GMSK][:CURRent]?	–100.0 dB to +20.0 dB	query only	6.155
FETCh:SUBarrays:POWer[:NORMal][:GMSK][:CURRent]?	–100.0 dB to +20.0 dB	query only	6.155
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[SENSe:]RREPorts:CVALue?	0 to 63 | NAN	query only	6.231
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[SENSe:]RREPorts:ECBep?	0 to 7 | NAN	query only	6.231
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CONFigure:RXQuality:BAVerage:CONTrol[:CSWitched]	RFER | BER | BBB | BDBL | AIBF, 1 to 500 | OFF	with query	6.187
CONFigure:RXQuality:BAVerage:CONTrol[:CSWitched][:TCH]:MSLot:LEVel:INDividual	<Level_0>, ..., <Level_7>	with query	6.189
CONFigure:RXQuality:BAVerage:CONTrol[:CSWitched][:TCH]:MSLot:RLEVel	–127 dB to +127 dB	with query	6.188
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STOP:RXQuality:BER	–	no query	6.175

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CONFigure:RXQuality:BER<nr>:CONTrol:PDATa[:TCH]: MSLot:LEVel[:SLOT]:SEVen	<Level>	with query	6.181
CONFigure:RXQuality:BER<nr>:CONTrol:PDATa[:TCH]: MSLot:LEVel[:SLOT]:SIX	<Level>	with query	6.181
CONFigure:RXQuality:BER<nr>:CONTrol:PDATa[:TCH]: MSLot:LEVel[:SLOT]:THRee	<Level>	with query	6.181
CONFigure:RXQuality:BER<nr>:CONTrol:PDATa[:TCH]: MSLot:LEVel[:SLOT]:TWO	<Level>	with query	6.181
CONFigure:RXQuality:BER<nr>:CONTrol:PDATa[:TCH]: MSLot:LEVel[:SLOT]:ZERO	<Level>	with query	6.181
CONFigure:RXQuality:BER<nr>:CONTrol:PDATa[:TCH]: MSLot:RLEVel	–127 dB to +127 dB	with query	6.179
CONFigure:RXQuality:BER<nr>:CONTrol:REPetition	ALIMits | FLIMit | CLEVel | RFLS | NONE, STEP | NONE	with query	6.178
CONFigure:RXQuality:BER<nr>:CONTrol[:CSWitched]	RFER | BER | BBB | BDBL | AIBF, 1 to 200000 | OFF	with query	6.177
CONFigure:RXQuality:BER<nr>:CONTrol[:CSWitched][:TCH]: LEVel:UNTimeslot	–127 dB to +127 dB	with query	6.179
CONFigure:RXQuality:BER<nr>:CONTrol[:CSWitched][:TCH]: LEVel:UTIMeslot	<LEVel>	with query	6.178
CONFigure:RXQuality:BER<nr>:CONTrol[:CSWitched][:TCH]: LEVel[:SLOT]:FIVE	<LEVel>	with query	6.180
CONFigure:RXQuality:BER<nr>:CONTrol[:CSWitched][:TCH]: LEVel[:SLOT]:FOUR	<LEVel>	with query	6.180
CONFigure:RXQuality:BER<nr>:CONTrol[:CSWitched][:TCH]: LEVel[:SLOT]:ONE	<LEVel>	with query	6.180
CONFigure:RXQuality:BER<nr>:CONTrol[:CSWitched][:TCH]: LEVel[:SLOT]:SEVen	<LEVel>	with query	6.180
CONFigure:RXQuality:BER<nr>:CONTrol[:CSWitched][:TCH]: LEVel[:SLOT]:SIX	<LEVel>	with query	6.180
CONFigure:RXQuality:BER<nr>:CONTrol[:CSWitched][:TCH]: LEVel[:SLOT]:THRee	<LEVel>	with query	6.180

Command, Signalling	Parameter	Types	Page
CONFigure:RXQuality:BER<nr>:CONTrol[:CSWitched][:TCH]:LEVel[:SLOT]:TWO	<LEVel>	with query	6.180
CONFigure:RXQuality:BER<nr>:CONTrol[:CSWitched][:TCH]:LEVel[:SLOT]:ZERO	<LEVel>	with query	6.180
CONFigure:RXQuality:BER<nr>:CONTrol[:CSWitched][:TCH]:MSLot:LEVel:INDividual	<LEVel_0>, ..., <LEVel_7>	with query	6.180
CONFigure:RXQuality:BER<nr>:CONTrol[:CSWitched][:TCH]:MSLot:RLEVel	–127 dB to +127 dB	with query	6.179
CONFigure:RXQuality:BER<nr>:LIMit:CLIB	0 % to 100 %	with query	6.182
CONFigure:RXQuality:BER<nr>:LIMit:CLII	0 % to 100 %	with query	6.181
CONFigure:RXQuality:BER<nr>:LIMit:DBLer	0 % to 100 %	with query	6.182
CONFigure:RXQuality:BER<nr>:LIMit:DEFault	ON | OFF	with query	6.182
CONFigure:RXQuality:BER<nr>:LIMit:FERRors	0 % to 100 %	with query	6.182
CONFigure:RXQuality:BER<nr>:LIMit:USFBler	0 % to 100 %	with query	6.182
Receiver quality measurements, BLER			
INITiate:RXQuality:BLER	–	no query	6.194
ABORt:RXQuality:BLER	–	no query	6.194
STOP:RXQuality:BLER	–	no query	6.194
CONTinue:RXQuality:BLER	–	no query	6.194
CONFigure:RXQuality:BLER:CONTrol:DEFault	ON | OFF	with query	6.196
CONFigure:RXQuality:BLER:CONTrol:DLDCycle	RB1 | RB2 | … | RB12	with query	6.196
CONFigure:RXQuality:BLER:CONTrol:PDATa[:TCH]:MSLot:LEVel:INDividual	<Level_0>, ..., <Level_7>	with query	6.196
CONFigure:RXQuality:BLER:CONTrol:PDATa[:TCH]:MSLot:RLEVel	–127 dB to +127 dB	with query	6.195
CONFigure:RXQuality:BLER:CONTrol:REPetition	CONT | SING | 1 to 10000, STEP | NONE	with query	6.195
CONFigure:RXQuality:BLER:CONTrol:RLBCount	100 to 10 000 000	with query	6.195
CONFigure:RXQuality:BLER:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.194
FETCh:RXQuality:BLER:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 1 to 500 | NONE	query only	6.194
READ[:SCALar]:RXQuality:BLER?	<Result>	query only	6.197
FETCh[:SCALar]:RXQuality:BLER?	<Result>	query only	6.197
SAMPle[:SCALar]:RXQuality:BLER?	<Result>	query only	6.197
CONFigure:RXQuality:CONTrol:ACGTime	0 s to 100 s	with query	6.173
CONFigure:RXQuality:CONTrol:CONFidence:FAIL	C500 | C900 | C980 | C998	with query	6.174
CONFigure:RXQuality:CONTrol:CONFidence:MTTime	0.0 s to 100000.0 s	with query	6.174
CONFigure:RXQuality:CONTrol:CONFidence:PASS	C500 | C900 | C980 | C998	with query	6.174
CONFigure:RXQuality:CONTrol:CONFidence:RWINdow	OFF | P10 |P20 | P30	with query	6.174
CONFigure:RXQuality:CONTrol:DEFault	ON | OFF	with query	6.173
CONFigure:RXQuality:CONTrol:SEARch:LLIMit	0.0 dBm to –200.0 dBm	with query	6.175
CONFigure:RXQuality:CONTrol:SEARch:MCYCles	0 to 100	with query	6.174
CONFigure:RXQuality:CONTrol:SEARch:ULIMit	0.0 dBm to –200.0 dBm	with query	6.175
CONFigure:RXQuality:PDATa:BITStream	PR9 | PR11 | PR15 | PR16	with query	6.173
CONFigure:RXQuality[:CSWitched]:BITStream	PR9 | PR11 | PR15 | PR16	with query	6.173
Signalling			
PROCedure: SIGNalling:PDATa:ACTion	SOFF | SON | CTMA | CTMB | CLBS | CLBA | CRA | CRSignalling | CDLonly | CBLer	no query	6.240

Command, Signalling	Parameter	Types	Page
	| DISConnect | HANDover | CRES | CREA		
PROCedure:SIGNalling:PDATa:ASConfig:ENABle	ON | OFF	with query	6.244
[SENSe:]SIGNalling:PDATa:SERVice?	TMA | TMB | LBS | LBA | RSA | RSIG | RSCS | RSCA DLON | BLER	query only	6.242
[SENSe:]SIGNalling:PDATa:STATe?	IDLE | ATT | RAUP | AIPR | DIPR	query only	6.241
PROCedure:SIGNalling:PDATa[:TCH]:MSLot:CHANnel	<Number>	with query	6.242
PROCedure:SIGNalling:PDATa[:TCH]:MSLot:FHOPping:ENABle	ON | OFF	with query	6.244
PROCedure:SIGNalling:PDATa[:TCH]:MSLot:MS:SCONfig:GAMMa	<UL_Enable_0>,..., <UL_Enable_7>, <UL_Gamma_0>, ..., <UL_Gamma_7>	with query	6.243
PROCedure:SIGNalling:PDATa[:TCH]:MSLot:SCONfig	<Main_TS>,<DL_Enable_0>,..., <DL_Enable_7>, <DL_Power_0>, ..., <DL_Power_7> <UL_Enable_0>,..., <UL_Enable_7>, <UL_Gamma_0>, ..., <UL_Gamma_7>	with query	6.243
PROCedure:SIGNalling[:CSWitched]:ACTion	SOFF | SON | MTC | SMS | CRELease | HANDover	no query	6.202
PROCedure:SIGNalling[:CSWitched]:DAI	NORMal | DECoder | ENCoder | ADEVice	with query	6.204
CONFigure:SIGNalling[:CSWitched]:SMS	<Text>	with query	6.204
[SENSe:]SIGNalling[:CSWitched]:SMS?	<Text>	query only	6.204
[SENSe:]SIGNalling[:CSWitched]:STATe?	SOFF | SON | SYNC | CEST | CPEN | CED	query only	6.203
PROCedure:SIGNalling[:CSWitched][:TCH]:CHANnel	<Number>	with query	6.204
PROCedure:SIGNalling[:CSWitched][:TCH]:MSLot:LOOP	<Loop>	with query	6.207
PROCedure:SIGNalling[:CSWitched][:TCH]:MSLot:SCONfig	<Main_Slot>, <Enable_0>,<Enable_1>, ..., <Enable_7>, <PCL_0>, ..., <PCL_7>,<Main_TS>	with query	6.206
PROCedure:SIGNalling[:CSWitched][:TCH][:SSLot]:CHCCombined	<ChannelNumber>, <Timeslot>, <PCL>	with query	6.205
PROCedure:SIGNalling[:CSWitched][:TCH][:SSLot]:FHOPping:SEQuence	A | B | C | D | OFF	with query	6.205
PROCedure:SIGNalling[:CSWitched][:TCH][:SSLot]:LOOP	<Loop>	with query	6.207
PROCedure:SIGNalling[:CSWitched][:TCH][:SSLot]:MS:PCL	0 to 31	with query	6.206
PROCedure:SIGNalling[:CSWitched][:TCH][:SSLot]:TIMeslot	2 to 6 | 0 to 7	with query	6.205
PROCedure:SIGNalling[:TCH]:TADVance	0 bit to 63 bit	with query	6.204
Speech Codec			
ROUTe:SPDecoder:OUTPut	HANDset | ANALyzer | ANA2 | ABOTh	with query	6.229
ROUTe:SPENcoder[:INPut]	HANDset | GENerator	with query	6.229
Spectrum measurements: General commands			
CONFigure:SPECtrum:LIMit:LINE:SELect	GMSK | EPSK	with query	6.114
Spectrum due to modulation measurements			
INITiate:SPECtrum:MODulation	–	no query	6.115
ABORt:SPECtrum:MODulation	–	no query	6.115

Command, Signalling	Parameter	Types	Page
STOP:SPECtrum:MODulation	–	no query	6.115
CONTinue:SPECtrum:MODulation	–	no query	6.115
CONFigure:SPECtrum:MODulation:AVGareas	A | B | AB	with query	6.118
CONFigure:SPECtrum:MODulation:AVGareas	A | B | AB	with query	6.128
CONFigure:SPECtrum:MODulation:CONTrol	SCALar | ARRay, 1 to 1000 | NONE	with query	6.116
CONFigure:SPECtrum:MODulation:CONTrol:MPOint<nr>:ENABle	ON | OFF	with query	6.116
CONFigure:SPECtrum:MODulation:CONTrol:REPetition	CONTinuous | SINGleshot | 1 to 10000, SONerror | NONE, STEP | NONE	with query	6.116
CONFigure:SPECtrum:MODulation:CONTrol:VMPoint<nr>	0 MHz to 2.5 MHz | OFF	with query	6.117
CONFigure:SPECtrum:MODulation:EPSK:LIMit:LINE:MODE[:UPPer]	ON | OFF	with query	6.120
CONFigure:SPECtrum:MODulation:EPSK:LIMit:LINE:REFPower [:UPPer]	<Minimum>, <Maximum>	with query	6.119
CONFigure:SPECtrum:MODulation:EPSK:LIMit:LINE:UPPer<nr>	<MinLevel>,<MaxLevel>,<AbsLevel>,<Enable>	with query	6.118
CONFigure:SPECtrum:MODulation:EPSK:LIMit:LINE:UPPer<nr>: ENABle	ON | OFF	with query	6.118
CONFigure:SPECtrum:MODulation:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.115
[SENSe:]SPECtrum:MODulation:LIMit:LINE:USED?	GMSK | EPSK	query only	6.118
FETCh:SPECtrum:MODulation:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 1 to 10000 | NONE , 1 to 1000 | NONE	only query	6.115
CONFigure:SPECtrum:MODulation:TDFSelect	N180|N160|N140|N120|N100|N080|N060|N040|N025|N020|N010 | REF | P010|P020|P025|P040|P060|P080|P100|P120|P140|P160|P180|NV4|NV3|NV2|NV1|PV1|PV2|PV3|PV4|OFF|ON	with query	6.117
CONFigure:SUBarrays:SPECtrum:MODulation:TDOMain	ALL | ARIThmetical | MINimum | MAXimum | IVAL,<Start>,<Samples>{,<Start>,<Samples>}	with query	6.121
READ:ARRay:SPECtrum:MODulation:TDOMain?	–100.0 dB to +20.0 dB, ...	query only	6.123
FETCh:ARRay:SPECtrum:MODulation:TDOMain?	–100.0 dB to +20.0 dB, ...	query only	6.123
SAMPle:ARRay:SPECtrum:MODulation:TDOMain?	–100.0 dB to +20.0 dB, ...	query only	6.123
READ:SUBarrays:SPECtrum:MODulation:TDOMain?	–100.0 dB to +20.0 dB, ...	query only	6.124
FETCh:SUBarrays:SPECtrum:MODulation:TDOMain?	–100.0 dB to +20.0 dB, ...	query only	6.124
SAMPle:SUBarrays:SPECtrum:MODulation:TDOMain?	–100.0 dB to +20.0 dB, ...	query only	6.124
READ[:SCALar]:SPECtrum:MODulation?	<Result>	only query	6.121
FETCh[:SCALar]:SPECtrum:MODulation?	<Result>	only query	6.121
SAMPle[:SCALar]:SPECtrum:MODulation?	<Result>	only query	6.121
CONFigure:SUBarrays:SPECtrum:MODulation[:FDOMain]	ALL | ARIThmetical | MINimum | MAXimum | IVAL,<Start>,<Samples>{,<Start>,<Samples>}	with query	6.120
CALCulate:ARRay:SPECtrum:MODulation[:FDOMain]:AREA: LIMit:MATChing?	<Matching>	query only	6.123
READ:ARRay:SPECtrum:MODulation[:FDOMain]:VMPoint?	–100.0 dB to +20.0 dB, ...	query only	6.122
FETCh:ARRay:SPECtrum:MODulation[:FDOMain]:VMPoint?	–100.0 dB to +20.0 dB, ...	query only	6.122

Command, Signalling	Parameter	Types	Page
SAMPle:ARRay:SPECtrum:MODulation[:FDOMain]:VMPoint?	–100.0 dB to +20.0 dB, ...	query only	6.122
READ:ARRay:SPECtrum:MODulation[:FDOMain]?	–100.0 dB to +20.0 dB, ...	query only	6.122
FETCh:ARRay:SPECtrum:MODulation[:FDOMain]?	–100.0 dB to +20.0 dB, ...	query only	6.122
SAMPle:ARRay:SPECtrum:MODulation[:FDOMain]?	–100.0 dB to +20.0 dB, ...	query only	6.122
READ:SUBarrays:SPECtrum:MODulation[:FDOMain]?	–100.0 dB to +20.0 dB, ...	query only	6.123
FETCh:SUBarrays:SPECtrum:MODulation[:FDOMain]?	–100.0 dB to +20.0 dB, ...	query only	6.123
SAMPle:SUBarrays:SPECtrum:MODulation[:FDOMain]?	–100.0 dB to +20.0 dB, ...	query only	6.123
CONFigure:SPECtrum:MODulation[:GMSK]:LIMit:LINE:MODE [:UPPer]	ON | OFF	with query	6.120
CONFigure:SPECtrum:MODulation[:GMSK]:LIMit:LINE:REFPower [:UPPer]	<Minimum>, <Maximum>	with query	6.119
CONFigure:SPECtrum:MODulation[:GMSK]:LIMit:LINE:UPPer<nr>	<MinLevel>,<MaxLevel>,<AbsLevel>,<Enable>	with query	6.118
CONFigure:SPECtrum:MODulation[:GMSK]:LIMit:LINE:UPPer<nr>: ENABle	ON | OFF	with query	6.118
Spectrum due to modulation and switching measurements			
INITiate:SPECtrum:MSWitching	–	no query	6.136
ABORt:SPECtrum:MSWitching	–	no query	6.136
STOP:SPECtrum:MSWitching	–	no query	6.136
CONTinue:SPECtrum:MSWitching	–	no query	6.136
CALCulate:ARRay:SPECtrum:MSWitching:AREA:LIMit:MATChing?	<Matching>	query only	6.140
CONFigure:SPECtrum:MSWitching:CONTrol	SCALar | ARRay	with query	6.137
CONFigure:SPECtrum:MSWitching:CONTrol:REPetition	CONTinuous | SINGleshot | 1 to 10000, SONerror | NONE, STEP | NONE	with query	6.138
CONFigure:SPECtrum:MSWitching:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.136
[SENSe:]SPECtrum:MSWitching:LIMit:LINE:USED?	GMSK | EPSK	query only	6.138
FETCh:SPECtrum:MSWitching:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 1 to 1000 | NONE, 1 to 10000 | NONE, 1 to 10000 | NONE	only query	6.137
READ:ARRay:SPECtrum:MSWitching:VMPoint?	–100.0 dBm to +100.0 dBm, ...	query only	6.140
FETCh:ARRay:SPECtrum:MSWitching:VMPoint?	–100.0 dBm to +100.0 dBm, ...	query only	6.140
SAMPle:ARRay:SPECtrum:MSWitching:VMPoint?	–100.0 dBm to +100.0 dBm, ...	query only	6.140
READ[:SCALar]:SPECtrum:MSWitching?	<Result>	only query	6.139
FETCh[:SCALar]:SPECtrum:MSWitching?	<Result>	only query	6.139
SAMPle[:SCALar]:SPECtrum:MSWitching?	<Result>	only query	6.139
READ:ARRay:SPECtrum:MSWitching?	<32 results>dBm	only query	6.139
FETCh:ARRay:SPECtrum:MSWitching?	<32 results>	only query	6.139
SAMPle:ARRay:SPECtrum:MSWitching?	<32 results>	only query	6.139
Spectrum due to switching measurements			
INITiate:SPECtrum:SWITching	–	no query	6.125
ABORt:SPECtrum:SWITching	–	no query	6.125
STOP:SPECtrum:SWITching	–	no query	6.125
CONTinue:SPECtrum:SWITching	–	no query	6.125
CONFigure:SPECtrum:SWITching:CONTrol	SCALar | ARRay, 1 to 1000 | NONE	with query	6.126
CONFigure:SPECtrum:SWITching:CONTrol:MPOint<nr>:ENABle	ON | OFF	with query	6.127
CONFigure:SPECtrum:SWITching:CONTrol:REPetition	CONTinuous | SINGleshot | 1	with query	6.126

Command, Signalling	Parameter	Types	Page
	to 10000, SONerror | NONE, STEP | NONE		
CONFigure:SPECtrum:SWITching:CONTrol:VMPOint<nr>	0 MHz to 2.5 MHz | OFF	with query	6.127
CONFigure:SPECtrum:SWITching:CSMODE	PHOL | SCO	with query	6.126
CONFigure:SPECtrum:SWITching:EPSK:LIMit:LINE:DEFault	ON | OFF	with query	6.130
CONFigure:SPECtrum:SWITching:EPSK:LIMit:LINE:MODE[:UPPer]	ON | OFF	with query	6.130
CONFigure:SPECtrum:SWITching:EPSK:LIMit:LINE:UPPer<nr>	<Power level>, <Limit at 0.4 MHz>, <Limit at 0.6 MHz>, <Limit at 1.2 MHz>, <Limit at 1.8 MHz>,<Enable>	with query	6.129
CONFigure:SPECtrum:SWITching:EPSK:LIMit:LINE:UPPer<nr>: ENABle	ON | OFF	with query	6.129
CONFigure:SPECtrum:SWITching:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.125
[SENSe:]SPECtrum:SWITching:LIMit:LINE:USED?	GMSK | EPSK	query only	6.128
FETCh:SPECtrum:SWITching:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 1 to 10000 | NONE , 1 to 1000 | NONE	only query	6.125
CONFigure:SPECtrum:SWITching:TDFSelect	N180|N120|N060|N040|REF|P040|P060|P120|P180|NV4|NV3|NV2|NV1|PV1|PV2|PV3|PV4|OFF|ON	with query	6.128
CONFigure:SUBarrays:SPECtrum:SWITching:TDOMain	ALL | ARIThmetical | MINimum | MAXimum | IVAL,<Start>,<Samples>{,<Start>,<Samples>}	with query	6.132
READ:ARRay:SPECtrum:SWITching:TDOMain?	–100.0 dB to +100.0 dBm, ...	query only	6.135
FETCh:ARRay:SPECtrum:SWITching:TDOMain?	–100.0 dBm to +100.0 dBm, ...	query only	6.135
SAMPle:ARRay:SPECtrum:SWITching:TDOMain?	–100.0 dBm to +100.0 dBm, ...	query only	6.135
READ:SUBarrays:SPECtrum:SWITching:TDOMain?	–100.0 dBm to +100.0 dBm, ...	query only	6.135
FETCh:SUBarrays:SPECtrum:SWITching:TDOMain?	–100.0 dBm to +100.0 dBm, ...	query only	6.135
SAMPle:SUBarrays:SPECtrum:SWITching:TDOMain?	–100.0 dBm to +100.0 dBm, ...	query only	6.135
READ[:SCALar]:SPECtrum:SWITching?	<Result>	only query	6.133
FETCh[:SCALar]:SPECtrum:SWITching?	<Result>	only query	6.133
SAMPle[:SCALar]:SPECtrum:SWITching?	<Result>	only query	6.133
CONFigure:SUBarrays:SPECtrum:SWITching[:FDOMain]	ALL | ARIThmetical | MINimum | MAXimum | IVAL,<Start>,<Samples>{,<Start>,<Samples>}	with query	6.131
CALCulate:ARRay:SPECtrum:SWITching[:FDOMain]:AREA:LIMit: MATChing?	<Matching>	query only	6.134
READ:ARRay:SPECtrum:SWITching[:FDOMain]:VMPoint?	–100.0 dBm to +100.0 dBm, ...	query only	6.134
FETCh:ARRay:SPECtrum:SWITching[:FDOMain]:VMPoint?	–100.0 dBm to +100.0 dBm, ...	query only	6.134
SAMPle:ARRay:SPECtrum:SWITching[:FDOMain]:VMPoint?	–100.0 dBm to +100.0 dBm, ...	query only	6.134
READ:ARRay:SPECtrum:SWITching[:FDOMain]?	–100.0 dBm to +100.0 dBm	only query	6.133
FETCh:ARRay:SPECtrum:SWITching[:FDOMain]?	–100.0 dBm to +100.0 dBm	only query	6.133
SAMPle:ARRay:SPECtrum:SWITching[:FDOMain]?	–100.0 dBm to +100.0 dBm	only query	6.133
READ:SUBarrays:SPECtrum:SWITching[:FDOMain]?	–100.0 dBm to +100.0 dBm, ...	query only	6.134
FETCh:SUBarrays:SPECtrum:SWITching[:FDOMain]?	–100.0 dBm to +100.0 dBm, ...	query only	6.134
SAMPle:SUBarrays:SPECtrum:SWITching[:FDOMain]?	–100.0 dBm to +100.0 dBm, ...	query only	6.134
CONFigure:SPECtrum:SWITching[:GMSK]:LIMit:LINE:DEFault	ON | OFF	with query	6.130
CONFigure:SPECtrum:SWITching[:GMSK]:LIMit:LINE:MODE [:UPPer]	ON | OFF	with query	6.130

Command, Signalling	Parameter	Types	Page
CONFigure:SPECtrum:SWITching[:GMSK]:LIMit:LINE:UPPer<nr>	<Power level>, <Limit at 0.4 MHz>, <Limit at 0.6 MHz>, <Limit at 1.2 MHz>, <Limit at 1.8 MHz>,<Enable>	with query	6.129
CONFigure:SPECtrum:SWITching[:GMSK]:LIMit:LINE:UPPer<nr>: ENABle	ON | OFF	with query	6.129
CONFigure:SPECtrum:TMODe	NORM | CAMS | CAOS	with query Sign. only	6.114
Symbolic Status Register Evaluation			
STATus:OPERation:SYMBolic:ENABle	<Event>{,<Event>}	with query	6.38
STATus:OPERation:SYMBolic:ENABle	<Event>{,<Event>}	with query	6.198
STATus:OPERation:SYMBolic[:EVENt]?	NONE | <Event>{,<Event>}	query only	6.38
STATus:OPERation:SYMBolic[:EVENt]?	NONE | <Event>{,<Event>}	query only	6.198
Trigger			
TRIGger:OUTPut:DELay:VALue	0 to 7	with query	6.201
TRIGger:OUTPut:PIN<nr>:DELay:ENABle	ON | OFF	with query	6.201
TRIGger:OUTPut:PIN<nr>:SIGNal	NONE | FCL |	with query	6.201
TRIGger[:SEQuence]:DEFault	ON | OFF	with query	6.202
TRIGger[:SEQuence]:SLOPe	POSitive | NEGative	with query	6.201
TRIGger[:SEQuence]:SOURce	SIGNalling | FRUN | RFPower | IFPower	with query	6.200
TRIGger[:SEQuence]:THReshold:IFPower	<Threshold>	with query	6.201
TRIGger[:SEQuence]:THReshold:RFPower	LOW | MEDium | HIGH	with query	6.200
Wideband Power			
INITiate:WPOWer	–	no query	6.39
ABORt:WPOWer	–	no query	6.39
STOP:WPOWer	–	no query	6.39
CONTinue:WPOWer	–	no query	6.39
CONFigure:WPOWer:CONTrol:REPetition	CONTinuous | SINGleshot | 1 ... 10000, SONerror | NONE,STEP | NONE	with query	6.40
CONFigure:WPOWer:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.39
FETCh:WPOWer:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 1 ... 10000 | NONE	query only	6.39
READ[:SCALar]:WPOWer?	–30 dBm to +30 dBm	query only	6.40
FETCh[:SCALar]:WPOWer?	–30 dBm to +30 dBm	query only	6.40
SAMPle[:SCALar]:WPOWer?	–30 dBm to +30 dBm	query only	6.40

Alphabetical Command Lists

Table 6-3 Remote control commands: *Non Signalling* mode

Command (Non Signalling, alphabetical)	Page
ABORt:MODulation:EVMagnitude:EPSK	*6.128*
ABORt:MODulation:IQANalyzer:EPSK	*6.149*
ABORt:MODulation:MERRor:EPSK	*6.142*
ABORt:MODulation:OVERview:EPSK	*6.122*
ABORt:MODulation:XPERror[:GMSK]	*6.114*
ABORt:MODulation[:PERRor]:EPSK	*6.135*
ABORt:MODulation[:PERRor][:GMSK]	*6.105*
ABORt:NPOWer	*6.79*
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Table 6-4 Remote control commands: Signalling mode

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7 Remote Control – Program Examples

The following program examples illustrate how to solve typical measurement tasks in the *Non Signalling* and in the *Signalling* mode. To keep the syntax as short and simple as possible, the programs were written with the aid of *Winbatch*, a batch job tool organizing and simplifying the transfer of commands and data between the controller and the instrument.

Winbatch uses device names such as *CMUBASE, CMUGSMNS, CMUGSMSIG* which are previously defined and assigned to the primary address, secondary address, and some general device settings. With these device names, a complete command line reads:

`CMUBASE: <CMU_Command>`

where `<CMU_Command>` may be any of the commands (setting commands or queries) specified within the function group and mode identified by the device name *CMUBASE.* Program sequences consisting of commands that are defined in several function groups and modes can be re-used with an exchanged device name.

In addition to these data transfer commands, *Winbatch* provides *WHILE, GOTO*, and *IF* statements to express conditions and define loops. With the statement

`WHILE CMUGSM: SENS:SIGN:STAT? <> SYNC`

the instrument waits until it has reached the signalling state *Synchronized* before it executes the following commands.

For a C program assigning secondary addresses refer to chapter 7 of the CMU200 manual.

GSM-MS Non Signalling Measurements

The CMU generates a GSM signal which is configured, output via RF 3, fed in via RF 4, and measured with the appropriate analyzer settings. To see which analyzer settings are necessary, it is recommended to carry out the measurement manually first. Before doing so and running the program, connect RF 1 to RF 2 using a coax cable, in analogy to the test setup suggested in chapter 2. Also, configure your *Winbatch* settings such that *CMUBASE* is the device name for the CMU *BASE* system and *CMUGSMNS* denotes function group *GSM900-MS Non Signalling*.

```
ECHO ON

FPRINT ........................................................................
FPRINT    INITIALISATION ROUTINE:
FPRINT    ASK FOR THE IDENTIFIER OF THE CMU, RESET THE INSTRUMENT,
FPRINT    DEFINE THE SECONDARY ADDRESSES FOR ALL AVAILABLE FUNCTION GROUPS
FPRINT ........................................................................

CMUBASE: *IDN?                                  Identification query
CMUBASE: *RST;*OPC?                             Reset the instrument; prevent the following
                                                  command to be executed before *RST is
                                                  complete
CMUBASE: *CLS                                   Clear output buffer, set status byte
CMUBASE: SYST:REM:ADDR:SEC 1,"RF_NSig"          Define all function groups
CMUBASE: SYST:REM:ADDR:SEC 2,"GSM900MS_Sig"
CMUBASE: SYST:REM:ADDR:SEC 3,"GSM900MS_NSig"
CMUBASE: SYST:REM:ADDR:SEC 4,"GSM1800MS_Sig"
CMUBASE: SYST:REM:ADDR:SEC 5,"GSM1800MS_NSig"
CMUBASE: SYST:REM:ADDR:SEC 6,"GSM1900MS_Sig"
CMUBASE: SYST:REM:ADDR:SEC 7,"GSM1900MS_NSig"

FPRINT .........................................................................
FPRINT   CONNECTORS + ATTENUATION
```

```
FPRINT ...........................................................................

CMUGSMNS: INP:STAT RF4                           Define input connector RF4
CMUGSMNS: OUTP:STAT RF3                          Define output connector RF3
CMUGSMNS: SENS:CORR:LOSS:INP2 0.0                Make sure that external attenuations are set
CMUGSMNS: SENS:CORR:LOSS:OUTP2 0.0                  to zero

FPRINT ...........................................................................
FPRINT    GENERATOR SETTINGS
FPRINT ...........................................................................

CMUGSMNS: CONF:RFG:MOD:BIT:SEL DUMM              Select GSM dummy burst to be generated
CMUGSMNS: CONF:RFG:MOD:TSEQ:SEL GSM0             Select training sequence
CMUGSMNS: CONF:RFG:MOD:TRAN BURS                 Select signal shape (burst signal)
CMUGSMNS: SOUR:RFG:FREQ:CHAN 900 MHZ             SetRF carrier frequency
CMUGSMNS: SOUR:RFG:LEV:UTIM –5                   Set RF level in used timeslot
CMUGSMNS: INIT:RFG;*OPC?                         Switch on RF generator

FPRINT ...........................................................................
FPRINT    ANALYZER SETTINGS
FPRINT ...........................................................................

CMUGSMNS: RFAN:CHAN 900 MHZ                      Adjust analyzer frequency to generator freq.
CMUGSMNS: RFAN:TSEQ GSM0                         Adjust training sequence analyzed
CMUGSMNS: SYST:ERR?                              Read error queue

FPRINT ...........................................................................
FPRINT    CONFIGURE THE POWER MEASUREMENT
FPRINT ...........................................................................

CMUGSMNS: CONF:POW:CONT SCAL,1                   Scalar results, one burst per statistics cycle
CMUGSMNS: CONF:POW:CONT:REP SING,NONE,NONE       Single shot measurement, no stop on error
CMUGSMNS: CONF:POW:MPR:CONT SCAL,1               Same settings as before, but for  combined
CMUGSMNS: CONF:POW:MPR:CONT:REP SING,NONE,NONE      power and modulation measurement

FPRINT ...........................................................................
FPRINT    SETTLE THE EXPECTED POWER (+OVERSHOOT MARGIN) AND MEASURE THE POWER
FPRINT    REMEMBER: RFG POWER -5 dBm
FPRINT ...........................................................................

CMUGSMNS: LEV:MAX 0                              Adjust expected maximum level
CMUGSMNS: READ:POW:MPR?                          Start single shot measurement, wait until it is
                                                    terminated, and return scalar power and
                                                    modulation results

FPRINT ...........................................................................
FPRINT    FREE TX MEASUREMENT DSP RESOURCES
FPRINT ...........................................................................

CMUGSMNS: ABOR:POW:MPR                           Abort combined power/mod measurement,
                                                    free resources

FPRINT ...........................................................................
FPRINT    RFG POWER -10 dBm, USING FASTER WIDEBAND PEAK POWER METER
FPRINT ...........................................................................

CMUGSMNS: SOUR:RFG:LEV:UTIM -10;*OPC?            Select RF level in used timeslot
CMUGSMNS: LEV:MAX –5                             Adjust expected maximum level
CMUGSMNS: READ:SPOW?                             Start single shot wide band peak power
                                                    measurement, wait until it is terminated,
                                                    and return result
```

The measurement can be easily repeated at other RF levels or with different configurations.

GSM Signalling Measurements

A GSM mobile phone is connected to the bidirectional connector RF2 as described in chapter 2 and tested. We assume that the mobile phone is capable of operating in the GSM900 band; in the example involving a GSM900/1800 handover, an appropriate dual-band mobile must be used. Moreover, a test SIM card for the mobile phone is required.

Call Setup to the Mobile Phone, Simple RX/TX Measurements

Preliminary configurations for a power and receiver quality measurement are defined, and the network parameters are set for maximum speed of the call procedure. The IMSI of the mobile phone must be known to set up a call; it can be either reported to the tester or will be determined during the location update. The first alternative will speed up the call procedure.

Next, the CMU generates a BCCH (C0 carrier) signal for synchronization. The mobile phone searches the whole channel range for this BCCH and camps on it for some mobile-specific time until it reaches the *Synchronized* state. In this state, configuration settings made at the beginning are checked, and the CMU sets up a call to the mobile phone. Parameters such as the PCL and channel should be defined before the call is setup to reduce signalling time (no PCL/channel change). As soon as the call is established, power and receiver quality measurements are performed.

Before running the program, configure your *Winbatch* settings such that *CMUBASE* is the device name for the CMU *BASE* system and *CMUGSM* denotes function group *GSM900-MS Signalling*.

```
ECHO ON

FPRINT ............................................................................
FPRINT    INITIALISATION ROUTINE:
FPRINT    ASK FOR THE IDENTIFIER OF THE CMU, RESET THE INSTRUMENT,
FPRINT    DEFINE THE SECONDARY ADDRESSES FOR ALL AVAILABLE FUNCTION GROUPS
FPRINT ............................................................................

CMUBASE: *IDN?                                   Identification query
CMUBASE: *RST;*OPC?                              Reset the instrument; prevent the following
                                                   command to be executed before *RST is
                                                   complete
CMUBASE: *CLS                                    Clear output buffer, set status byte
CMUBASE: SYST:REM:ADDR:SEC 1,"RF_NSig"           Define all function groups
CMUBASE: SYST:REM:ADDR:SEC 2,"GSM900MS_Sig"
CMUBASE: SYST:REM:ADDR:SEC 3,"GSM900MS_NSig"
CMUBASE: SYST:REM:ADDR:SEC 4,"GSM1800MS_Sig"
CMUBASE: SYST:REM:ADDR:SEC 5,"GSM1800MS_NSig"
CMUBASE: SYST:REM:ADDR:SEC 6,"GSM1900MS_Sig"
CMUBASE: SYST:REM:ADDR:SEC 7,"GSM1900MS_NSig"

FPRINT .............................................................................
FPRINT   CONNECTORS + ATTENUATION
FPRINT .............................................................................

CMUGSM: INP:STAT RF2                             Define input connector RF2
CMUGSM: OUTP:STAT RF2                            Define output connector RF2
CMUGSM: SENS:CORR:LOSS:INP2 1.0                  Define external attenuation to compensate
CMUGSM: SENS:CORR:LOSS:OUTP2 1.0                   for known cable losses

FPRINT .............................................................................
FPRINT   NETWORK PARAMETERS, SELECTED FOR MAXIMUM SPEED OF THE CALL PROCEDURE
FPRINT   THE IMSI REQUIRED MAY DIFFER FROM THE EXAMPLE (=DEFAULT) SETTINGS
FPRINT .............................................................................

CMUGSM: CONF:NETW:SMOD:IMSI:MNC 001;MCC 01;MSIN '1000000095'      Set IMSI
CMUGSM: CONF:NETW:REQ:IMSI OFF                   Switch IMSI request off
```

```
CMUGSM: CONF:NETW:REQ:IMEI OFF                  Switch IMEI request off
CMUGSM: CONF:NETW:REQ:AUTH OFF                  Switch authentication request off
CMUGSM: CONF:NETW:REQ:HAND OFF                  Switch handover request off
CMUGSM: CONF:NETW:SMOD:SCH FACC                 Signalling via FACCH
CMUGSM: CONF:NETW:SMOD:PCH FAST                 Fast power change (over FACCH)

FPRINT ............................................................................
FPRINT   CONFIGURATION OF A SINGLE SHOT BER MEASUREMENT
FPRINT ............................................................................

CMUGSM: CONF:RXQ:CONT:HTIM 0.2,0.0              Reduce holdoff times for AGC and
                                                  bit stream synchronization
CMUGSM: CONF:RXQ:BER1:CONT:LEV:UTIM -102.0      Absolute level in used timeslot
CMUGSM: CONF:RXQ:BER1:CONT:LEV:UNT -20.0        Relative level in unused timeslot
CMUGSM: CONF:RXQ:BER1:CONT:REP NONE,NONE        No stop on error
CMUGSM: CONF:RXQ:BER1:CONT BER,129              Bit error rate measurement over 129 frames
CMUGSM: CONF:RXQ:BER:TSET T1                    Store configuration in test setup 1


FPRINT ............................................................................
FPRINT   CONFIGURATION OF A SINGLE SHOT POWER MEASUREMENT
FPRINT ............................................................................

CMUGSM: CONF:POW:MPR:CONT SCAL,10               Scalar results, 10 bursts per statistics cycle
CMUGSM: CONF:POW:MPR:CONT:REP SING,NONE,NONE    Single shot measurement, no stop on error


FPRINT ............................................................................
FPRINT   DEFINITION FOR BCCH BS POW: -85 dBm / Channel 5
FPRINT ............................................................................

CMUGSM: CONF:BSS:CCH:LEV -85.0;*OPC?            Absolute power of BCCH BS signal
CMUGSM: CONF:BSS:CCH:CHAN 30;*OPC?              Channel number of BCCH BS signal

FPRINT ............................................................................
FPRINT   DEFINITION FOR TESTSET BS POW: -85 dBm (-102 dBm) / Channel 1 / PCL 5
FPRINT ............................................................................

CMUGSM: CONF:BSS:TCH:LEV:UTIM -85.0;*OPC?       Absolute power of TCH BS signal, used TS
CMUGSM: CONF:BSS:CHAN 1;*OPC?                   Channel number of TCH BS signal
CMUGSM: CONF:NETW:POW 5;*OPC?                   Power control level of the mobile
                                                  setting up a call

FPRINT ............................................................................
FPRINT   GENERATING THE BCCH
FPRINT ............................................................................

CMUGSM: PROC:SIGN:ACT SON;*OPC?                 Switch on BCCH signal

FPRINT ............................................................................
FPRINT   WAIT FOR LOCATION UPDATE
FPRINT ............................................................................

REPORT OFF
WHILE CMUGSM: SENS:SIGN:STAT? <> SYNC           Wait until signalling state Synchronized is
                                                  reached, then go to next command
REPORT ON

FPRINT ............................................................................
FPRINT   CALL PROCEDURE (CHECK IMSI IF THIS PROCEDURE FAILS)
FPRINT ............................................................................

CMUGSM: PROC:SIGN:ACT MTC;*OPC?                 Initiate a mobile terminating call

FPRINT ............................................................................
FPRINT   REDUCE THE BS POWER. THIS AFFECTS THE BER BUT NOT THE TX MEASUREMENTS
FPRINT ............................................................................
```

```
CMUGSM: PROC:BSS:LEV:UTIM -102;*OPC?            Absolute power of TCH BS signal, used TS

FPRINT ....................................................................
FPRINT   START THE SINGLE SHOT BER (RXQ:BER) AND THE POWER/MODULATION MEASUREMENT
FPRINT   THE TX MEASUREMENTS ARE FASTER AND WILL BE FINISHED FIRST
FPRINT   WHILE THE RXQ:BER MEAS. IS RUNNING THE RXLEV AND RXQUAL CAN BE QUERIED
FPRINT ....................................................................

CMUGSM: INIT:RXQ:BER;*OPC?                      Initiate single shot BER measurement
CMUGSM: INIT:POW:MPR;*OPC?                      Initiate combined power/mod. measurement

WHILE CMUGSM: FETC:POW:MPR:STAT? !{} RDY        Wait until power/mod. measurement is in the
                                                RDY (ready) state, then go to next command
CMUGSM: FETC:POW:MPR?                           Return scalar power/mod. results

[MEAS1_1]
IF CMUGSM: FETC:RXQ:BER:STAT? {} RDY GOTO MEAS1_2 Check whether BER measurement is ready
CMUGSM: RREP:RXL?                               Return RXLev reported by the mobile
CMUGSM: RREP:RXQ?                               Return RXQual reported by the mobile
GOTO MEAS1_1
[MEAS1_2]
CMUGSM: FETC:RXQ:BER?                           Read out BER measurement results
```

To change the traffic channel without dropping the call, use the `PROC:SIGN:CHAN` command. To change the PCL of the mobile, use `PROC:SIGN:MS:PCL`. To change both parameters simultaneously, use `PROC:SIGN:CHCC`.

Handover

The example of the last section is repeated for a GSM900/1800 dual-band mobile phone. To this end, extend your *Winbatch* settings such that *CMUDCS* denotes function group *GSM1800-MS Signalling*. Repeat and modify the program of the last section in the following way:

- Before the BCCH signal is generated, set the parameters for call setup and for the measurements in function group *GSM1800-MS Signalling:*

```
CMUDCS: INP:STAT RF2                            Define input connector RF2
CMUDCS: OUTP:STAT RF2                           Define output connector RF2
CMUDCS: SENS:CORR:LOSS:INP2 2.0                 Define external attenuation to compensate
CMUDCS: SENS:CORR:LOSS:OUTP2 2.0                   for known cable losses

CMUDCS: CONF:NETW:SMOD:PCH FAST                 Fast power change (over FACCH)

CMUDCS: CONF:RXQ:CONT:HTIM 0.2,0.0              Reduce holdoff times for AGC and
                                                   bit stream synchronization
CMUDCS: CONF:RXQ:BER1:CONT:LEV:UTIM -102.0      Absolute level in used timeslot
CMUDCS: CONF:RXQ:BER1:CONT:LEV:UNT -20.0        Relative level in unused timeslot
CMUDCS: CONF:RXQ:BER1:CONT:REP NONE,NONE        No stop on error
CMUDCS: CONF:RXQ:BER1:CONT BER,129              Bit error rate measurement over 129 frames
CMUDCS: CONF:RXQ:BER:TSET T1                    Store configuration in test setup 1

CMUDCS: CONF:POW:MPR:CONT SCAL,10               Scalar results, 10 bursts per statistics cycle
CMUDCS: CONF:POW:MPR:CONT:REP SING,NONE,NONE    Single shot measurement, no stop on error

CMUDCS: CONF:BSS:CHAN 512                       Channel number of TCH BS signal
CMUDCS: CONF:NETW:POW 5                         Power control level of the mobile
                                                   setting up a call
```

- Generate the BCCH signal and set up the call as shown in the previous section. This means that the mobile operates on the GSM900 band while the signalling procedures are carried out.

➢ As soon as the call is established RXQuality and other measurements can be performed in the GSM900 band. Instead initiate a dual-band handover to GSM1800:

```
FPRINT ..............................................................................
FPRINT   DUALBAND HANDOVER
FPRINT ..............................................................................
```

CMUGSM: CONF:HAND:TARG 'GSM1800MsDualBand'	Define target band for handover
CMUGSM: PROC:SIGN:ACT HAND;*OPC?	Initiate handover procedure
REPORT OFF	
WHILE CMUDCS: SENS:SIGN:STAT? <> CED	Wait until signalling state *Call Established Dualband* is reached, then continue
REPORT ON	
CMUDCS: SENS:SIGN:STAT?	Query signalling state (printout)

```
FPRINT ..............................................................................
FPRINT   CHANNEL 512, PCL 0
FPRINT ..............................................................................
```

CMUDCS: INIT:RXQ:BER	Initiate single shot BER measurement
CMUDCS: INIT:POW:MPR	Initiate combined power/mod. measurement
WHILE CMUDCS: FETC:POW:MPR:STAT? !{} RDY	Wait until power/mod. measurement is in the *RDY* (ready) state, then go to next command
CMUDCS: FETC:POW:MPR?	Return scalar power/mod. results

```
FPRINT ..............................................................................
FPRINT   CALL RELEASE
FPRINT ..............................................................................
```

```
CMUDCS: PROC:SIGN:ACT CREL;*OPC?
```

Contents

8 Smart Alignment

Smart Alignment @ GSM-MS (option R&S CMU-K47) is a supplementary software option extending the GSM-MS network test options R&S® CMU-K20…-K26. The option has been designed for fast transmitter and receiver adjustments over a wide range of channels and output powers including VCO calibration. The power can be varied after each timeslot so that the speed of transmitter and receiver tests is considerably improved.

The TX and RX adjustments are both integrated in the GSM-MS network test user interface but accessible from different menus:

- The *TX Calibration* is an application of the Power menu. All test settings are configured in the *Power Configuration* menu.
- The *RX Calibration* is performed with a special RF test signal, to be configured in the *Generator* tab of the *Connection Control* menu.

Both calibrations can be performed in *Non Signalling* mode. If they are run in parallel the entire test procedure for the transmit and receive power adjustment can be completed in approx. ¼ s.

TX Calibration

The *TX Calibration* measurement provides the average burst power in up to 50 consecutive frames where the DUT may transmit at different frequencies. The R&S CMU measures the burst power in 7 slots per channel so that in total up to 350 burst power results can be acquired over a measurement time of 50 frame periods (50 x 4.6 ms = 230 ms). The gain in speed is due to the dense alignment of measured slots with different frequencies and powers; see Fig. 8-2 on p. 8.3. The measurement time decreases with the number of frames measured.

The *TX Calibration* application is complemented by a *RX Calibration* measurement which is configured in the *Generator* tab of the *Connection Control* menu (see section RX Calibration on p. 8.5 ff.). An application example for TX calibration is reported below.

TX Calibration Test Procedure

The *Power* menu provides all test settings for the *TX Calibration* and displays the results.

Measurement task Verify the transmitter output power of a GSM900 mobile phone in the PCL range between 5 (33 dBm) and 11 (21 dBm) and over the entire GSM channel range 1 (890.2 MHz) to 124 (914.8 MHz).

Mobile Configuration

1. Stimulate the mobile transmitter to change its power from PCL 5 in slot 0 down to PCL 11 in slot 6 of each TDMA frame.
2. Define a hopping sequence so that the mobile changes its frequency after each TDMA frame, using the channels 1, 4, 7, …, 121, 124 (42 different channels). The mobile output power level is according to Fig. 8-2 on p. 8.3.

CMU Settings

3. In the *Menu Select* menu, select the GSM900 band and the measurement menu *Non Signalling – Power – TX Calibration*. Press *RESET* to set the instrument to a defined state. Press *ENTER CONT/HALT* to set the measurement to the *HLT* state and eliminate the *Trigger not found !* message.

4. Press the measurement control softkey *TX Calibration* twice to open the *Power Configuration* menu. In the *Control* tab, expand the *TX Calibration* section and define the *Frequency List: 890.2 MHz, 890.8 MHz, 891.4 MHz,…, 914.8 MHz.* Switch *Off* the remaining frequencies no. 43 to 50.
5. Press *TX Calibration* again to close the *Power Configuration* menu.
6. Press *Analyzer Level – RF Max. Level* and increase the maximum allowed input level to 36 dB (the maximum expected power plus an appropriate margin).
7. Press *Analyzer Level – Trigger Source* and make sure that an *IF Level* trigger is set.
8. Start the *TX Calibration* measurement *(TX Calibration – ENTER CONT/HALT)*, connect the mobile to the RF2 connector of the CMU and switch on.

A single shot measurement starts as soon as the R&S CMU receives the first burst from the mobile. The results for all PCLs and channels are displayed in the output table.

TX Calibration Results

If the *TX Calibration* application is active, the *Power* menu shows the following information:

- Essential tests settings
- Measurement results, i.e. the average burst power in up to 350 TDMA timeslots.

The information is displayed in a parameter line and a slot table:

Parameter line

Max. Level: - 2.0 dBm Low Noise Freq. Offset: + 0.000 kHz Chan./Freq.: 65 / 903.0 MHz

Slot table

Frequency/Slot	0	1	2	3	4	5	6
877.0 MHz	-10.3	-10.0	-10.0	-10.0	-10.0	-10.0	-10.0
878.0 MHz	-10.1	-14.0	-17.9	-21.9	-25.9	-30.0	-34.1
879.0 MHz	-10.1	-14.0	-17.9	-21.9	-25.9	-30.0	-34.1
880.0 MHz	-10.1	-14.0	-17.9	-21.9	-25.9	-30.0	-34.1
881.0 MHz	-10.1	-14.0	-17.9	-21.9	-25.9	-29.9	-34.1
882.0 MHz	-10.1	-14.0	-17.9	-21.9	-25.9	-30.0	-34.1
883.0 MHz	-10.1	-14.0	-17.9	-21.9	-25.9	-30.0	-34.1
884.0 MHz	-10.1	-14.0	-17.9	-21.9	-25.9	-29.9	-34.1
885.0 MHz	-10.1	-14.0	-17.9	-21.9	-25.9	-30.0	-34.1
886.0 MHz	-10.1	-14.0	-17.9	-21.9	-25.9	-29.9	-34.1
887.0 MHz	-10.1	-14.0	-17.9	-21.9	-25.9	-29.9	-34.1
888.0 MHz	-10.1	-14.0	-17.9	-21.9	-25.9	-30.0	-34.1
889.0 MHz	-10.1	-14.0	-17.9	-21.9	-25.9	-30.0	-34.1
890.0 MHz	-10.1	-14.0	-17.9	-21.9	-25.8	-30.0	-34.1
891.0 MHz	-10.1	-14.0	-17.9	-21.9	-25.8	-29.9	-34.1
892.0 MHz	-10.1	-14.0	-17.9	-21.9	-25.8	-29.9	-34.1

all results in dBm

Fig. 8-1 Display of results (Power – TX Calibration)

Settings

The essential test settings are indicated in a parameter line above the test diagram:

Max. Level Maximum expected input level, set in the *Analyzer* tab of the *Connection Control* menu

Attenuation Input path attenuation *(Normal, Low Noise, Low Distortion),* set in the *Analyzer* tab of the *Connection Control* menu

Results

The *TX Calibration* application measures the average burst power in 7 consecutive slots (slots no. 0 to 6) per TDMA frame and in up to 50 consecutive frames, so that up to 350 results are obtained in each measurement cycle. The average is taken over a section of the useful part of the burst; it is not correlated to the training sequence. The last slot in each frame (slot no. 7) is not displayed; it provides the necessary settling time after the MS transmitter hops to the next frequency.

The frequencies in the measured frames can all be different; they must be set in the *Control* tab of the *Power Configuration* menu *(Frequency List;* see p. 8.4 ff), together with the *Repetition Mode* of the measurement. Moreover, the power can vary from one slot to another. A typical MS output power ramp is shown in Fig. 8-2 below.

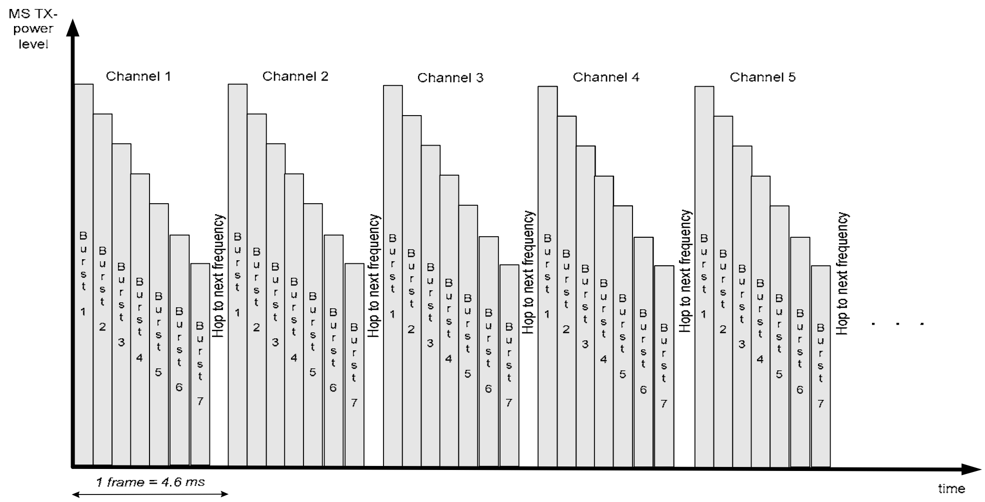


Fig. 8-2 Alignment of measured slots in the TX Calibration measurement

The measurement must be triggered. In the example of Fig. 8-2 above a power trigger (trigger source *RF Power* or – preferably – *IF Power)* can be used. As an alternative, provide an appropriate external trigger signal.

For more than 16 measured frames, the table can be scrolled using the cursor keys. Red output fields indicate an RF analyzer overflow, which can be avoided by adjusting the maximum expected input level *(Analyzer Level – RF Max. Level).* No limit check is performed.

Remote control
```
READ[:SCALar]:POWer:TXCal<nr>?
FETCh[:SCALar]:POWer:TXCal<nr>?
SAMPle[:SCALar]:POWer:TXCal<nr>?
READ:ARRay:POWer:TXCal?
FETCh:ARRay:POWer:TXCal?
SAMPle:ARRay:POWer:TXCal?
```

TX Calibration Configuration

The frequency list for the TX calibration must be set in the *Control* tab of the *Connection Control* menu to be in accordance with the MS transmitter settings. In addition the *Repetition* parameter defines the scope of the measurement. No other specific test settings are required.

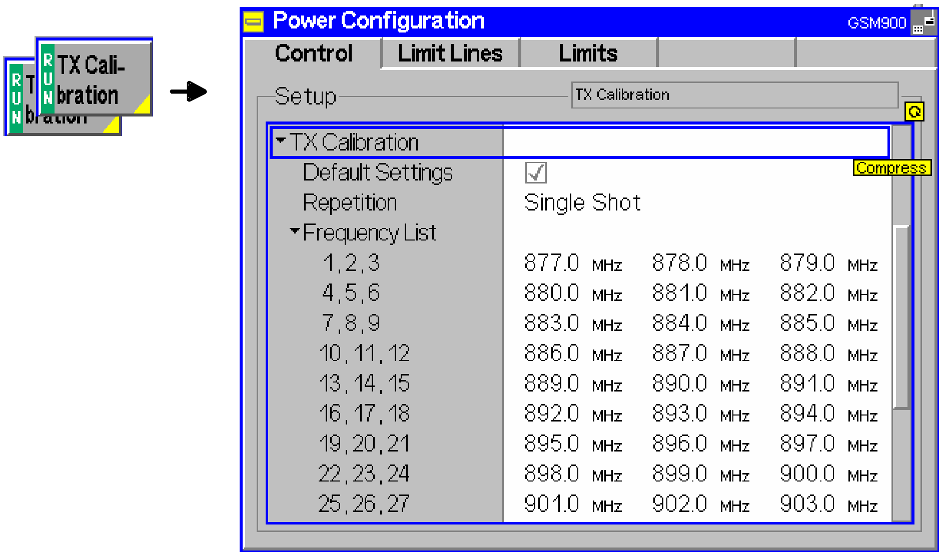


Fig. 8-3 Power Configuration – Control

TX Calibration – Repetition

The *Repetition* parameter defines how often the measurement is repeated:

Single Shot The measurement is stopped *(HLT)* after the entire frequency list has been measured. This is the default settings corresponding to the ordinary application case for the *TX Calibration* measurement.

Continuous The measurement is repeated until it is terminated explicitly using the *ON/OFF* key. This mode requires a time delay between consecutive measurement cycles. If the mobile repeats its slot sequence without delay, the *IF Power* trigger is likely to miss the first frame of the second cycle and cause invalid results.

Remote control
```
CONFigure:POWer:TXCal:CONTrol:REPetition
   CONTinuous | SINGleshot | 1 ... 10000, NONE, <Stepmode>
```

TX Calibration – Frequency List

The *Frequency List* selects up to 50 carrier frequencies to be measured in the *TX Calibration* application. The frequencies can be set in multiples of 100 kHz; they do not have to coincide with GSM channel frequencies.

The analyzer frequency changes after each TDMA frame (see Fig. 8-2 on p. 8.3); the output transmitter frequency of the mobile under test must be set accordingly. To measure a sequence of less than 50 frames, any of the frequencies in the list can be set to *Off*. The R&S CMU always measures in consecutive frames; the total measurement time is n times 4.6 ms where n is the number of frequencies that are not switched *Off* and 4.6 ms is the TDMA frame duration.

Remote control
```
CONFigure:POWer:TXCal:FREQuency<nr>
CONFigure:POWer:TXCal:FREQuency:ALL
```

RX Calibration

Fast mobile receiver adjustments are performed by means of an *RX Calibration* test signal that the R&S CMU transmits with a periodicity of up to 50 TDMA frames. The frequency of the test signal may change after each frame. Moreover, the signal levels in slots 0 to 6 of each frame can be configured independently. This means that, over a measurement time of 50 frame periods (50 x 4.6 ms = 230 ms), the mobile can receive up to 350 bursts with a different level/frequency combination. The gain in speed is due to the dense alignment of slots in the test signal with different frequencies and powers; see Fig. 8-5 on p. 8.8.

Different burst types *(Frequency Correction Burst, Synchronization Burst)* may be used in each frame. With an FCH transmitted in the first slot of the test signal, the mobile can adjust its Voltage Controlled Oscillator (VCO).

The *RX Calibration* signal is complemented by a *TX Calibration* application in the *Power* menu (see section TX Calibration on p. 8.1 ff.). An application example for RX calibration is reported below.

RX Calibration Test Procedure

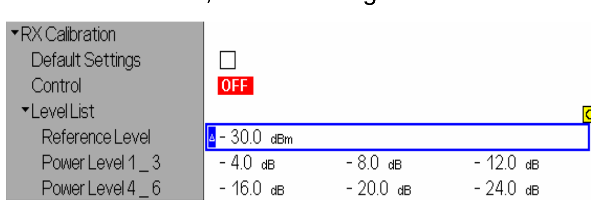
The *Generator* tab of the *Connection Control* menu controls the *RX Calibration* test signal and configures all signal parameters.

Measurement task

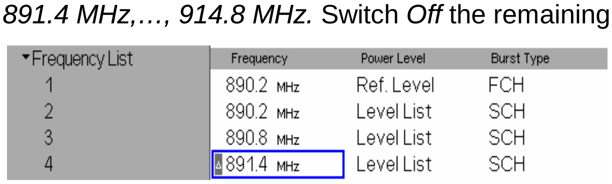
Verify the receiver power adjustment of a GSM900 mobile phone in the power range between –30 dBm and –54 dBm and over the entire GSM channel range 1 (890.2 MHz) to 124 (914.8 MHz).

Test signal configuration

1. Connect the mobile to the RF2 connector of the CMU and switch on.
2. In the *Menu Select* menu, select the GSM900 band and the *Non Signalling* test mode. Press *RESET* to set the instrument to a defined state.
3. Open the *Generator* tab of the *Connection Control* menu. In the *RX Calibration – Level List* section, define the signal levels as follows:



4. In the *RX Calibration – Frequency List* section, define the *Frequency (890.2 MHz), Level (Reference Level)* and *Burst Type (FCH)* of the first frame that the mobile can use to adjust its VCO.
5. Set the frequencies in the following frames as follows*: 890.2 MHz, 890.8 MHz, 891.4 MHz,…, 914.8 MHz.* Switch *Off* the remaining frequencies no. 44 to 50.



6. Select *RX Calibration – Control* and switch the RF generator on.

After the entire slot sequence has been received you can perform the receiver calibration by comparing the transmitted signal power to the receiver reports provided by the mobile phone.

Test Signal Configuration

The *RX Calibration* test signal is configured in the *Generator* tab of the *Connection Control* menu.

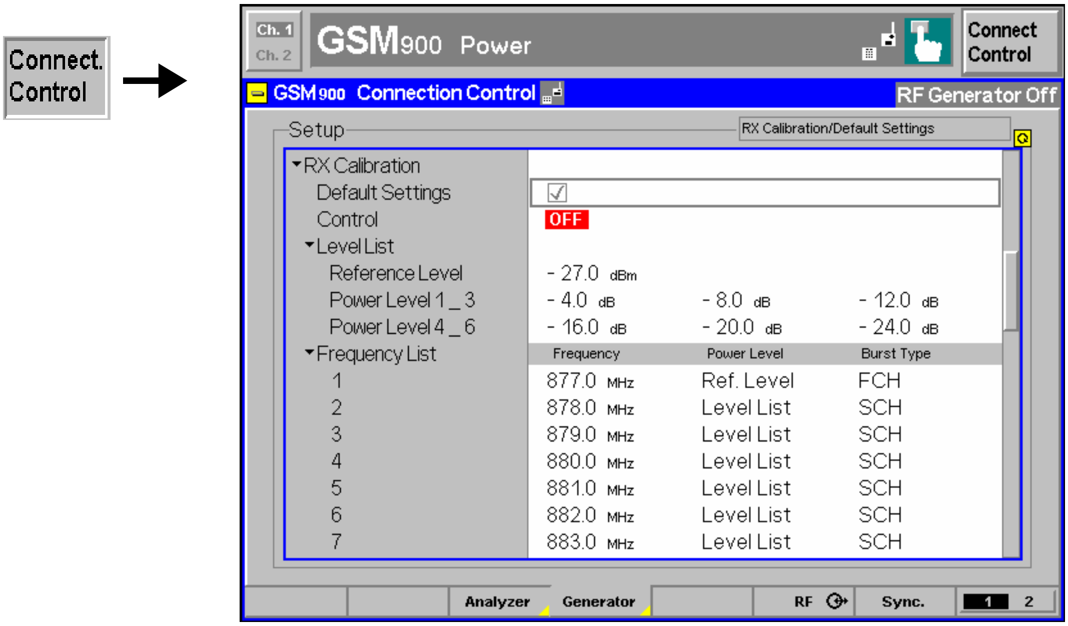


Fig. 8-4 RX Calibration settings

The following settings determine the properties of the test signal:

Default Settings The *Default Settings* switches assign default values to all *RX Calibration* parameters. The default configuration corresponds to Fig. 8-5 on p. 8.8; all default values are quoted in the command description in section *RX Calibration (RFGenerator:RXCal)* on p. 8.14 ff.

Remote control
–

Control Controls the *RX Calibration* signal and indicates whether it is switched *ON* or *OFF*. While it switched on, the *RX Calibration* signal replaces the ordinary *Generator TX* signal.

The *RX Calibration* signal can be switched on or off irrespective of the *Generator TX* state. The signal is repeated cyclically and without delay as long as it is switched on.

Remote control
```
INITiate:RFGenerator:RXCal
ABORt:RFGenerator:RXCal
FETCh:RFGenerator:RXCal:STATus?
SOURce:RFGenerator:RXCal:LEVel
```

Level List

Defines the *RX Calibration* signal levels in timeslots 0 to 6 of each TDMA frame. The levels in slots 0 to 6 may be equal or different from each other; see *Frequency List* settings below. In the last slot in each frame (slot no. 7), no signal is transmitted. Slot 7 provides the necessary settling time after the RF generator hops to the next frequency.

Reference Level Absolute signal level (in dBm) in timeslot no. 0. The levels in the remaining timeslots (1 to 6) are defined relative to the reference level.

Power Level 1_3 Level in timeslots 1, 2, and 3 relative to the reference level.

Power Level 4_6 Level in timeslots 4, 5, and 6 relative to the reference level.

The relative level settings are used if *Level List* is selected in the frequency list.

Remote control
```
SOURce:RFGenerator:RXCal:RLEVel
SOURce:RFGenerator:RXCal:PLEVel<nr>
SOURce:RFGenerator:RXCal:PLEVel:ALL
```

Frequency List

Defines the *RX Calibration* frequencies, signal levels and burst types in timeslots 0 to 6 of TDMA frames no 1 to 50.

Frequency Frequency in all timeslots of the frame. To shorten the frame sequence, any of the frequencies in the list can be set to *Off*. The R&S CMU always transmits in consecutive frames; the total duration of the frame sequence is n times 4.6 ms where n is the number of frequencies that are not switched *Off* and 4.6 ms is the TDMA frame duration. The frame sequence is repeated without delay.

Power Level Level in timeslots 0 to 6 of the frame. The levels can be equal in all slots (they can be set to the *Ref. Level, Power Level 1, …, Power Level 6;* see *Level List* settings above). If *Level List* is selected, the levels are set according to the *Level List settings.*

Burst Type The R&S CMU can transmit either 1 Frequency Correction Bursts (FCHs) followed by 6 dummy bursts (setting *FCH)* or 7 Synchronization Bursts (SCHs) in each frame (see standard GSM 05.01). The FCH corresponds to an unmodulated carrier, shifted in frequency, and is used for frequency synchronization of the mobile. The SCH contains a long training sequence and is used for time synchronization.

An FCH transmitted in the first slot will adjust the VCO oscillator of the mobile. Selecting SCHs for the following frames will improve the stability of the mobile's time synchronization.

The default configuration with a series of FCHs at constant level in the first frame and SCHs with descending levels in the following frames is shown below.

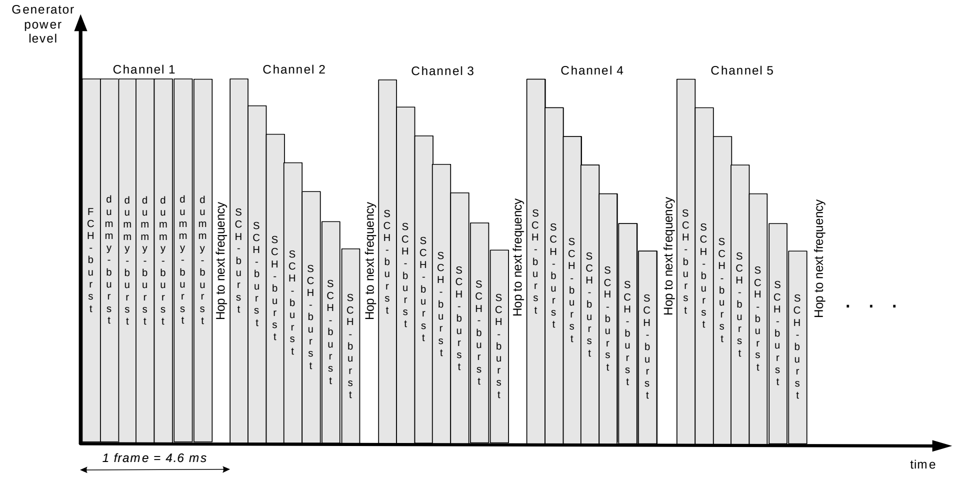


Fig. 8-5 Alignment of measured slots in the RX Calibration test signal

Remote control

```
SOURce:RFGenerator:RXCal:FREQuency:PLEVel
SOURce:RFGenerator:RXCal:FREQuency:BTYPe<nr>
SOURce:RFGenerator:RXCal:FREQuency:XALL
```

Remote Control Commands

The following sections describe the remote control commands related to TX and RX Calibration. All commands are only available with option R&S CMU-K47; *Smart Alignment @ GSM-MS*.

TX Calibration (POWer:TXCal)

The subsystem *POWer:TXCal* controls the *TX Calibration* measurement. It corresponds to the measurement menu *Power* with the application *TX Calibration.*

Note: *The `POWer:TXCal` measurement can not be carried out with a Free Run trigger (`TRIGger[:SEQuence]:SOURce FRUN`).*

INITiate:POWer:TXCal	Start new measurement	⇒ *RUN*
ABORt:POWer:TXCal	Abort running measurement and switch off	⇒ *OFF*
STOP:POWer:TXCal	Stop measurement after current stat. cycle	⇒ *STOP*
CONTinue:POWer:TXCal	Next measurement step (only *stepping mode*)	⇒ *RUN*
Description of command		FW vers.
These commands have no query form. They start or stop the measurement, setting it to the status indicated in the top right column.		V3.60

CONFigure:POWer:TXCal:EREPorting <*Mode*>				Event Reporting
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
SRQ | SOPC | SRSQ | OFF	Service request Single operation complete SRQ and SOPC No reporting	OFF	–	V3.60
Description of command				
This command defines the events generated when the measurement is terminated or stopped *(event reporting,* see chapter 5 of CMU operating manual).				

FETCh[:SCALar]:POWer:TXCal:STATus?				Measurement Status
Return	Description of parameters	Def. value	Def. unit	FW vers.
OFF | RUN | STOP | ERR | STEP | RDY,	Measurement in the *OFF* state (`*RST` or `ABORt`) Running (after `INITiate, CONTinue` or `READ`) Stopped (`STOP`) *OFF* (could not be started) Stepping mode *(<stepmode>=STEP)* Stopped according to repetition mode and stop condition	OFF	–	V3.60
1 to 10000 | NONE	Counter for current statistics cycle No counting mode set	NONE	–	
Description of command				
This command is always a query. It returns the status of the measurement (see chapters 3 and 5 of CMU manual).				

Subsystem POWer:TXCal:CONTrol

The subsystem *POWer:TXCal:FREQuency* defines the scope of the measurement. The settings are located in the *Control* tab of the *Power Configuration* menu.

CONFigure:POWer:TXCal:CONTrol:REPetition <*Repetition*>,<*StopCondition*>,<*Stepmode*>				Test Cycle
<Repetition>	Description of parameters	Def. value	Def. unit	
CONTinuous |	Continuous measurement (continuous, until STOP or ABORT)	SING	–	
SINGleshot |	Single measurement (single shot, until Status = RDY)			
1 to 10000	Multiple measurement (counting, until Status = STEP | RDY)			
<StopCond>	Description of parameters	Def. value	Def. unit	
SONerror | NONE	Stop measurement in case of error *(stop on error)* No limit check, no stop condition available	NONE	–	
<Stepmode>	Description of parameters	Def. value	Def. unit	FW vers.
STEP | NONE	Interrupt measurement after each statistics cycle Continue measurement according to its rep. mode	NONE	–	V3.60
Description of command				
This command determines the number of statistics cycles and the stepping mode for the measurement. **Note:** In the case of READ commands (`READ:`...), the <Repetition> parameter has no effect; the measurement is always stopped after a single shot.				

CONFigure:POWer:TXCal:CONTrol:DEFault <Enable>				Default Settings
<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | OFF	The parameters are set to their default values Some or all parameters are not set to default	ON	–	V3.60
Description of command				
If used as a setting command with the parameter *ON* this command sets all parameters of the subsystem to their default values (the setting *OFF* causes an error message). If used as a query the command returns whether all parameters are set to their default values *(ON)* or not *(OFF)*.				

Subsystem POWer:TXCal:FREQuency

The subsystem *POWer:TXCal:FREQuency* defines the measured frequencies for the TX calibration. It corresponds to the *Frequency List* in the *Control* tab of the *Power Configuration* menu.

CONFigure:POWer:TXCal:FREQuency<nr> *<Frequency>* Frequency List

<Frequency>	Description of parameters	Def. value	Def. unit	FW vers.
10 MHz to 2700 MHz | OFF	Frequency <nr> where <nr> = 1 to 50 No frequency <nr> defined	See below	MHz	V3.60

Description of command

This command defines a single measured frequency numbered by the numeric suffix. Alternatively, `CONFigure:POWer:TXCal:FREQuency:ALL` defines all frequencies. An *OFF* setting for any frame <nr> shortens the total measurement cycle.

The frequencies are defined in multiples of 100 kHz. The default frequencies are equal for all GSM bands; they read:

f_{def}<nr> = (876 + <nr>) MHz (<nr> = 1, … 38); f_{def}<nr> = OFF (<nr> = 39, … 50)

CONFigure:POWer:TXCal:FREQuency:ALL *<Frequency>* Frequency List

<Frequency>	Description of parameters	Def. value	Def. unit	FW vers.
10 MHz to 2700 MHz | OFF,	Frequency no. 1 Frame no. 1 not measured,	See below	MHz	V3.60
…	…			
10 MHz to 2700 MHz | OFF	Frequency no. 1 Frame no. 1 not measured			

Description of command

This command defines a all measured frequencies. Alternatively, `CONFigure:POWer:TXCal:FREQuency<nr>` defines a single frequency. An *OFF* setting for any frame <nr> shortens the total measurement cycle.

The frequencies are defined in multiples of 100 kHz. The default frequencies are equal for all GSM bands; they read:

f_{def}<nr> = (876 + <nr>) MHz (<nr> = 1, … 38); f_{def}<nr> = OFF (<nr> = 39, … 50)

Subsystem SUBarrays:POWer:TXCal

The subsystem *SUBarrays:POWer:TXCal* defines the measurement range and the type of output values.

CONFigure:SUBarrays:POWer:TXCal <Mode>,<Start>,<Samples>{,<Start>,<Samples>}

Definition of Subarrays

<Mode>	Description of parameters	Def. value	Def. unit	
ALL | ARIThmetical | MINimum | MAXimum | IVAL,	Return all measurement values Return arithm. mean value in every range Return minimum value in every range Return maximum value in every range Return single value at <Start>	ALL	–	
<Start>	Description of parameters	Def. value	Def. unit	
0 to 349	First slot in current range	0	–	
<Samples>	Description of parameters	Def. value	Def. unit	FW vers.
1 to 350	Number of slots in current range	350	–	V3.60

Description of command

This command configures the `READ:SUBarrays...`, `FETCh:SUBarrays...,`, and `SAMPle:SUBarrays:POWer:TXCal` commands. It restricts the measurement to up to 32 subranges where either all measurement results (the number of which is given by the second numerical parameter) or a single statistical value is returned. The subranges are defined by the current number of the first slot and the number of slots within a subrange.

For <Mode> = IVAL, the <Samples> parameter is ignored and the CMU returns a single measurement value corresponding to the <Start> slot.

The subranges may overlap but must be within the total range of the *P/Slot Table* measurement. Test points outside this range are not measured (result *NAN)* and do not enter into the ARIThmetical, MINimum and MAXimum values. By default, only one range corresponding to the total measurement range is used and all measurement values are returned.

Subsystem POWer:TXCal?

The subsystem *POWer:TXCal* measures power versus slot and returns the results. The subsystem corresponds to the output table in the *TX Calibration* measurement menu*.*

Single Result

READ[:SCALar]:POWer:TXCal:POWer<nr>? Start single shot measurement and return results
FETCh[:SCALar]:POWer:TXCal:POWer<nr>? Read out measurement results (unsynchronized)
SAMPle[:SCALar]:POWer:TXCal:POWer<nr>? Read out measurement results (synchronized)

Returned Values	Description of parameters	Def. value	Def. unit	FW vers.
–100 dBm to 100 dBm	Avg. power in slot <nr>	NAN	dBm	V3.60

Description of command

These commands are always queries. They start a measurement (READ...) and/or return the average power in a particular timeslot (numbered by <nr> = 1 to 350).

All Results

READ:ARRay:POWer:TXCal? Start single shot measurement and return results
FETCh:ARRay:POWer:TXCal? Read out measurement results (unsynchronized)
SAMPle:ARRay:POWer:TXCal? Read out measurement results (synchronized)

Returned Values	Description of parameters	Def. value	Def. unit	FW vers.
–100 dBm to 100 dBm, ... –100 dBm to 100 dBm	Avg. power in slot 1, ..., Avg. power in slot 350	NAN, ..., NAN	dBm, ..., dBm	V3.60

Description of command

These commands are always queries. They start a measurement (READ…) and/or return all measurement results. The returned list contains the average burst power in 350 timeslots.

Subarray Results

READ:SUBarrays:POWer:TXCal? Start single shot measurement and return results
FETCh:SUBarrays:POWer:TXCal? Read out measurement results (unsynchronized)
SAMPle:SUBarrays:POWer:TXCal? Read out measurement results (synchronized)

Ret. values per subrange	Description of parameters	Def. value	Def. unit	FW vers.
–100 dBm to 100 dBm, ... –100 dBm to 100 dBm	Avg. power in first slot, ..., Avg. power in last slot	NAN ... NAN	dB ... dB	V3.60

Description of command

These commands are always queries. They return the average burst power in the subranges defined by means of the `CONFigure:SUBarrays:POWer:TXCal` command. In the default setting of the configuration command the `READ:SUBarrays..., FETCh:SUBarrays..., and SAMPle:SUBarrays...` command group is equivalent to the `READ:ARRay..., FETCh:ARRay..., and SAMPle:ARRay...` command group described above.

The `CONFigure:SUBarrays:POWer[:NORMal][:GMSK]:MPR` command defines a maximum of 32 subranges. If one of the statistical modes (`ARIThmetical, MINimum, MAXimum`) is set, only one value is returned per subrange.

RX Calibration (RFGenerator:RXCal)

The subsystem *RFGenerator:RXCal* configures the test signal for *RX Calibration*. It corresponds to the *RX Calibration* section in the *Generator* tab of the *Connection Control* menu.

INITiate:RFGenerator:RXCal **ABORt:RFGenerator:RXCal**	Start test signal, reserve resources Switch off generator, release resources	⇒ *RUN* ⇒ *OFF*
Command description		FW vers.
These commands have no query form. They start or stop the RF generator for the `RXCal` test signal signal, setting it to the status indicated in the top right column.		V3.60

FETCh:RFGenerator:RXCal:STATus?				Generator status
Returned value	Parameter description	Def. value	Def. unit	FW vers.
OFF | RUN | ERR	Generator switched off (`ABORt or *RST`) Running (`INITiate`) Switched off (could not be started)	OFF	–	V3.60
Command description				
This command is always a query. It returns the current `RXCal` test signal generator status.				

SOURce:RFGenerator:RXCal:RLEVel <*Level*>				Reference Level
<Level>	Parameter description	Def. value	Def. unit	FW vers.
–137.0 dBm to –27.0 dBm **–137.0 dBm to –10.0 dBm** **–90.0 dBm to +13.0 dBm**	RF1 level in used timeslot RF2 level in used timeslot RF 3 OUT level in used timeslot	–27.0 –27.0 –27.0	dBm dBm dBm	V3.60
Command description				
This command defines the reference level for the `RXCal` test signal. The value range depends on the RF output of the CMU used and on the external attenuation set (see `[SENSe:]CORRection:LOSS:OUTPut<nr> [:MAGNitude]` command).				

SOURce:RFGenerator:RXCal:PLEVel<nr> <*Level*>				Power Level 1_3, Power Level 4_6
<Level>	Parameter description	Def. value	Def. unit	FW vers.
See below*)	Relative output level in slot <nr>	<nr> * (–4 dB)	dB	V3.60
Command description				
This command defines the output level for the `RXCal` test signal in slot no. <nr> where <nr> = 1 to 6. The levels are defined in dB relative to the reference level (`SOURce:RFGenerator:RXCal:RLEVel`, used in slot 0). The relative levels can be defined with a single command `SOURce:RFGenerator:RXCal:PLEVel:ALL`. *) The absolute output levels in all slots must not exceed the output level range for the different output connectors; see `SOURce:RFGenerator:RXCal:RLEVel`. For RF2 and a reference level of –27 dBm, the relative output powers can vary between –110 dB and +17 dB.				

SOURce:RFGenerator:RXCal:PLEVel:ALL <Level>		Power Level 1_3, Power Level 4_6		
<Level>	Parameter description	Def. value	Def. unit	FW vers.
See below*) **See below*)**	Relative output level in slot no. 1 Relative output level in slot no. 6	–4 dB, … –24 dB	dB dB	V3.60

Command description

This command defines the output level for the `RXCal` test signal in slots no. 1 to 6. The levels are defined in dB relative to the reference level (`SOURce:RFGenerator:RXCal:RLEVel`, used in slot 0).

The relative levels in a single slot <nr> can be defined with the command `SOURce:RFGenerator:RXCal:PLEVel<nr>`.

*) The absolute output levels in all slots must not exceed the output level range for the different output connectors; see `SOURce:RFGenerator:RXCal:RLEVel`. For RF2 and a reference level of –27 dBm, the relative output powers can vary between –110 dB and +17 dB.

SOURce:RFGenerator:RXCal:FREQuency:FREQuency<nr> *<Frequency>*				Frequency
<Frequency>	Parameter description	Def. value	Def. unit	FW vers.
10 MHz to 2700 MHz | **OFF**	Frequency <nr> where <nr> = 1 to 50 No signal in frame no. <nr>	See below	MHz	V3.60

Command description

This command defines the frequency for the `RXCal` test signal in frame no. <nr>. The frequencies are defined in multiples of 100 kHz. An OFF setting for any frame <nr> shortens the measurement cycle. The default frequencies are equal for all GSM bands; they read:

f_{def}<nr> = (876 + <nr>) MHz (<nr> = 1, … 38); f_{def}<nr> = OFF (<nr> = 39, … 50)

SOURce:RFGenerator:RXCal:FREQuency:PLEVel<nr> *<Level>*				Power Level
<Level>	Parameter description	Def. value	Def. unit	FW vers.
LLISt | **RLEV |** **PLEV1 | PLEV2 | PLEV3 |** **PLEV4 | PLEV5 | PLEV6**	Level list (levels for slots no. 0 to 6) Reference level Level of slots no. 1, 2, 3, 4, 5, or 6	<nr> = 1: RLEV <nr> > 1: LLISt	–	V3.60

Command description

This command defines the slot levels for the `RXCal` test signal in frame no. <nr>. The reference level (slot 0) is defined via `SOURce:RFGenerator:RXCal:RLEVel`. The remaining slot levels are defined via `SOURce:RFGenerator:RXCal:PLEVel<nr>`.

SOURce:RFGenerator:RXCal:FREQuency:BTYPe<nr> *<Burst>*				Burst Type
<Burst>	Parameter description	Def. value	Def. unit	FW vers.
SCH | **FCH**	Synchronization burst Frequency correction burst	<nr> = 1: FCH <nr> > 1: SCH	–	V3.60

Command description

This command defines the burst type for the `RXCal` test signal in frame no. <nr>.

Contents

9 Dual Transfer Mode (Option R&S CMU-K44)

Dual Transfer Mode (DTM) is a special operating mode for mobile stations that support GPRS (see standard 3GPP TS 43.055). A mobile station in dual transfer mode has resources for a circuit switched (CS) RR connection and for a packet data connection (TBF), provided that the base station co-ordinates its allocation of radio resources. DTM is optional both for the mobile station and the network.

Multislot configurations

A mobile station in dual transfer mode has one timeslot allocated for the CS services. In DTM multislot configurations, additional timeslots are allocated for packet channel combinations (see standard 3GPP TS 45.001). The total number of downlink (DL) and uplink (UL) timeslots is defined in terms of the DTM multislot classes 5, 6, 9, 10, or 11. Any DTM-capable mobile phone must, as a minimum, support DTM multislot class 5, which uses a single full-rate TCH (CS connection) plus a single full rate PDTCH.

Table 9-1 DTM multislot classes

Multislot class	**Maximum number of slots**		
	Downlink (MS RX)	**Uplink (MS TX)**	**Sum**
5	2	2	4
6	3	2	4
9	3	2	5
10	4	2	5
11	4	3	5

DTM Features in R&S CMU

The R&S CMU 200 is capable of setting up a DTM call and assess the mobile phone's DTM capabilities, in particular using the following measurements:

- BLER measurement: Block Error Ratio for the timeslots allocated for packet data channels.
- BER measurement: Bit Error Rate for packet data and circuit switched timeslots.
- P/t Multislot measurement: Simultaneous analysis of UL bursts in several adjacent timeslots.

Note: *All circuit switched and packet data signalling features of the R&S CMU 200 are also available for DTM connections. In particular, it is possible to use all packet data Service Selections (test modes, reduced signalling, …).*

Required equipment

DTM measurements can be performed with the following R&S CMU hardware and software configuration:

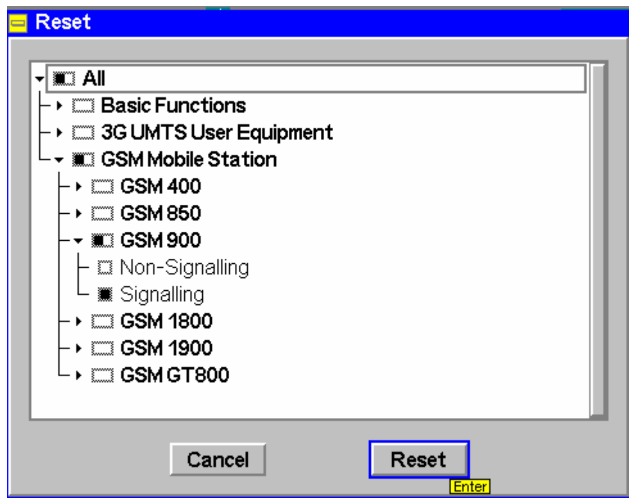
- Universal Signalling Unit R&S CMU-B21 var. 14 (or 54).
- Either option R&S CMU-B95 or option R&S CMU-B96, Additional RF Generator, providing the BCCH for the CS connection.
- One of the options R&S CMU-K20/…/-K26 plus the GPRS/EGPRS software extension R&S CMU-K42/-K43.
- Option R&S CMU-K44, Dual Transfer Mode.

. Measurement Example

In the following application example, a DTM connection is set up in order to perform receiver quality and power vs. time multislot measurements.

Preparations In order to avoid inconsistent settings, it is recommended to reset the *GSM Signalling* function group before attempting a DTM call.

1. Press *MENU SELECT* and access one of the *GSM Signalling* function groups.
2. Press the *RESET* key at the front panel and reset the current function group.

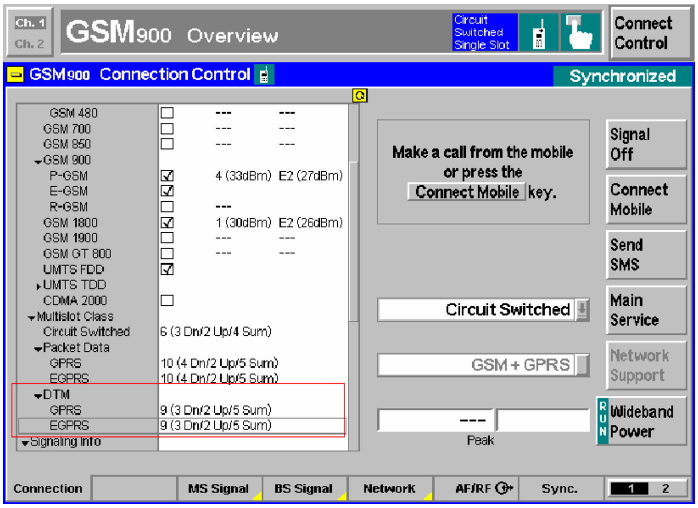


Setting up a DTM connection A DTM connection is first set up in circuit switched mode. The packet data connection is activated after the R&S CMU has entered the *Call Established* signalling state:

3. Open the *BS Signal* tab of the *Connection Control* menu and select *Aux Tx – Channel Type: BCCH.*
4. Open the *Connection* tab of the *Connection Control* menu and select *Network Support – GSM + GPRS* or *GSM + EGPRS,* depending on your mobile capabilities and R&S CMU software configuration. Leave the *Circuit Switched* main service unchanged.
5. Switch on your mobile phone which will automatically synchronize to the R&S CMU's BS signal and perform an (E)GPRS attach.

DTM multislot class

After the attach the DTM multislot class is displayed in the list of MS capabilities.



6. Press *Connect Mobile* and wait until the R&S CMU has entered the *Call Established* state (if the *Connection Control* menu is closed automatically, press the *Connect Control* softkey to re-open it).

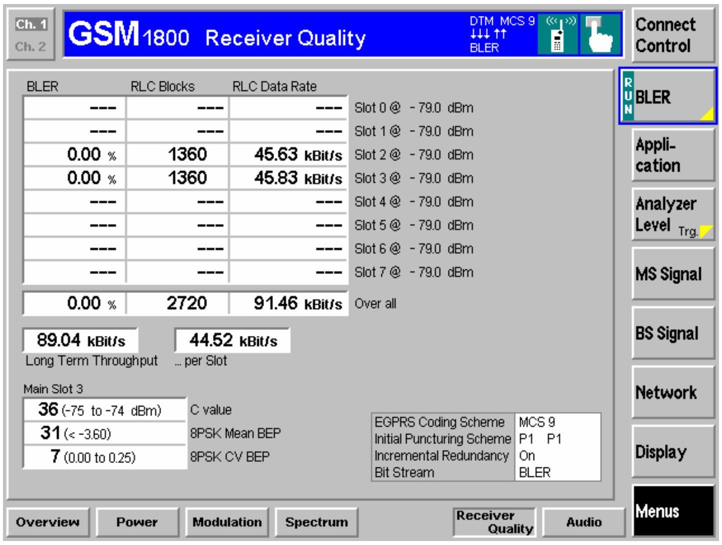
7. Select *Main Service: Packet Data, Service Selection: BLER* for BLER tests on packet data channels.

8. Press *Connect DTM* to change to establish a TBF.

BLER measurement

9. Close the *Connection Control* menu (if this is not done automatically) and open the *Receiver Quality – BLER* menu.

The *Receiver Quality* menu shows the BLER results in the timeslot(s) allocated for packet data channels. The number of uplink and downlink packet data timeslots is indicated in the menu's title bar:

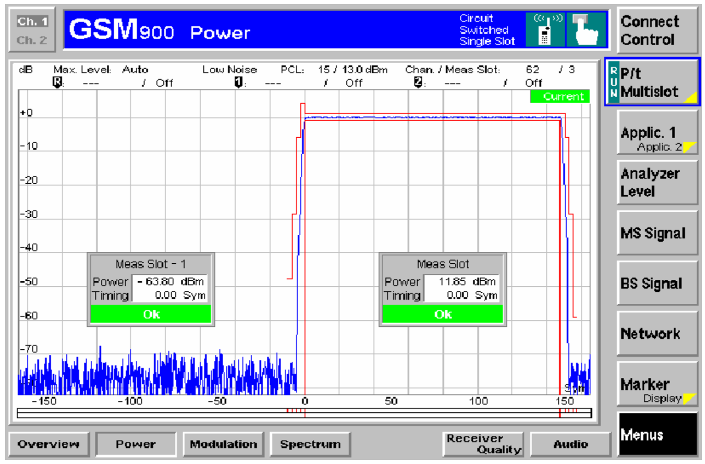


The timeslot allocated for the circuit switched (CS) service is not shown in the BLER menu. To measure this timeslot re-open the Connection Control menu and switch back to Circuit Switched main service. You can then evaluate the BER in the CS channel using the applications BER or BER Average.

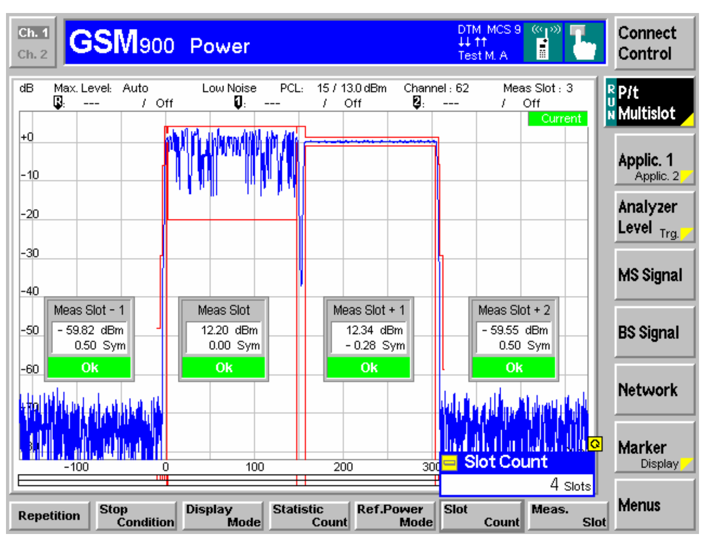
10. Open the *Power – P/t Multislot* menu and analyze the burst power vs. time in the CS timeslot and the adjacent timeslots.

Power vs. time measurements

The *P/t Multislot* menu shows the permanent, GMSK-modulated, uplink CS timeslot and a sporadic burst in the UL timeslots allocated for the packet data channels.



To measure the circuit switched and the packet data channels on a continuous basis, you have to change the *Service Selection.* In *Test Mode A* (for transmitter tests), EGPRS mode (8PSK modulation and coding scheme MCS5 to MCS9), and with the default slot configuration (slot 3 for the packet data service, slot 4 for circuit switched connection) the following result can be obtained:



. Connection Setup for DTM Tests

A DTM test requires both a circuit switched and a packet data connection between the R&S CMU 200 and the mobile under test. An operating sequence for establishing this double connection is described above. **Fig. 9-1** below shows the simplified signalling state machine for DTM tests.

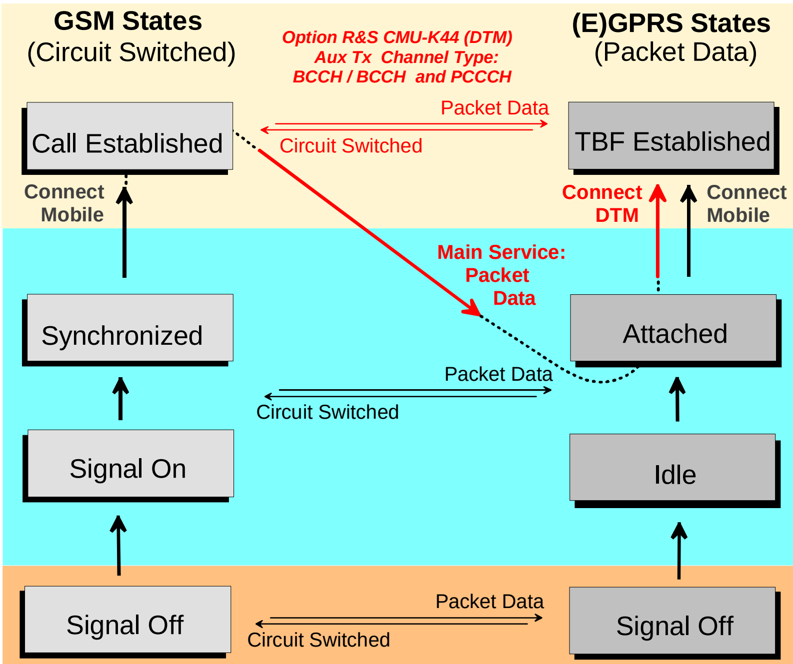


Fig. 9-1 Signalling states for DTM tests

Connection Setup

According to **Fig. 9-1** a DTM connection is set up as follows:

➢ Set up a circuit switched connection *(Call Established),* change to *Main Service: Packet Data,* finally press *Connect DTM* until you have reached the *TBF Established* state.

The DTM connection requires the additional RF generator signal (Aux TX signal): In the *BS Signal* tab, the *Aux TX Channel Type* must be set to *BCCH* or *BCCH + PBCCH.*

In the title bar of the *Connection Control* menu, the signalling state message *DTM* indicates that the R&S CMU 200 has reached both the *Call Established* and the *TBF Established* signalling states. Besides an icon in the title bar of the measurement menus shows the DTM multislot configuration.

Reduced Signalling

DTM connections can be set up in reduced signalling mode where the mobile is controlled externally so that the signalling procedures for the connection setup can be skipped. To establish a DTM connection in reduced signalling mode perform the following configurations in the *Connection Control* menu:

- For the circuit switched part, select *Network – Circuit Switched – Signalling Mode – Signalling Channel: None* and *Network – Circuit Switched – Timeouts – Radio Link Timeout Testset: Off*.
- For the packet data part, press *Connection – Service Selection* and select one of the reduced signalling services.

The R&S CMU 200 generates an error message unless both parts of the connection are configured for reduced signalling.

Connection Release

The release of a DTM connection is the inverse of the setup procedure shown in **Fig. 9-1**. If the packet data connection is released *(Disconnect DTM),* the circuit switched connection is still maintained *(Call Established).* If the circuit switched connection is released, the packet data connection is dropped as well.

Remote Control

Set up circuit switched connection:
`PROCedure:SIGNalling[:CSWitched]:ACTion …`
Set up packet data connection:
`PROCedure:SIGNalling:PDATa:ACTion …`
Query signalling state after a DTM connection has been established:
`[SENSe:]SIGNalling[:CSWitched]:STATe?` Response: `CEST`
`[SENSe:]SIGNalling:PDATa:STATe?` Response: `TEST`

. DTM Multislot Configurations

The *Slot Configuration Editor* provides the parameters for the downlink **and** the uplink DTM slot configuration. It is accessible from the *MS Signal* and from the *BS Signal* tabs of the *Connection Control* menu.

Note 1: DTM and (E)GPRS parameters

The parameters in the Slot Configuration Editor are used for both packet data connection schemes (simple (E)GPRS and DTM). During a (E)GPRS connection, the DTM CS Timeslot is ignored.

Note 2: RF Channel and Hopping List for DTM

DTM measurements are performed on the circuit switched RF Channel (BS Signal – Circuit Switched – Traffic Channel – RF Channel) and with the circuit switched hopping sequence (BS Signal – Circuit Switched – Traffic Channel – Hopping Sequence List …). The hopping sequence lists A to D are truncated after the first seven entries.

Note 3: Auto Slot Config. for DTM

In the Auto Slot Config. mode (Connection tab), the R&S CMU 200 automatically enables the uplink and downlink timeslots according to the DTM multislot class of the connected mobile; see ***Table 9-1*** *on p. 9.1 .*

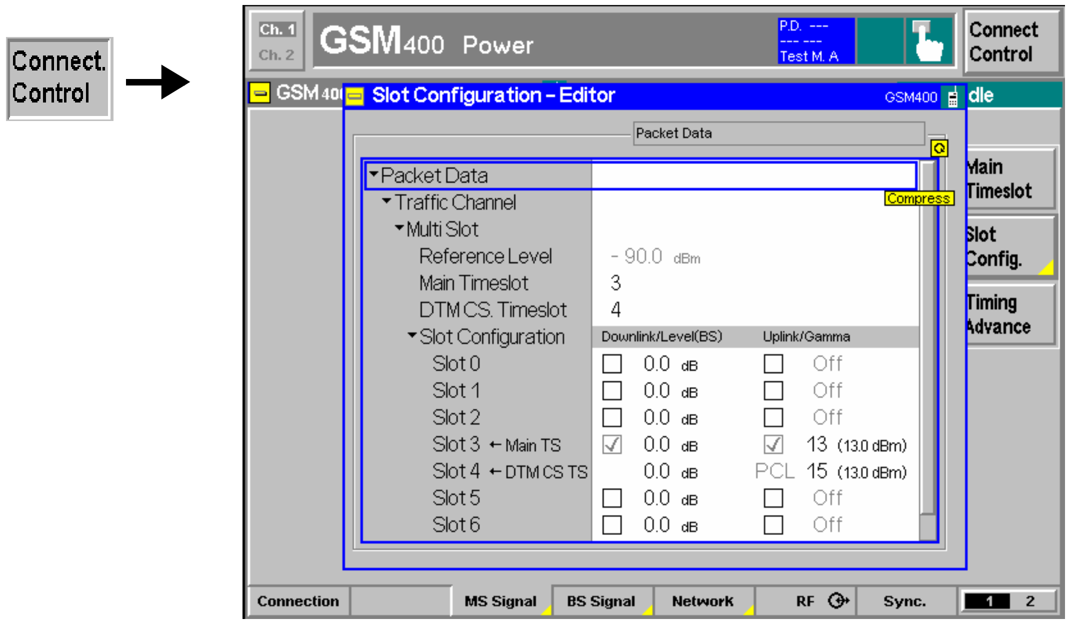


Fig. 9-2 Slot Configuration Editor

The editor provides the following DTM-specific settings:

DTM CS Timeslot Timeslot that the R&S CMU 200 uses for the circuit switched part of the DTM connection. While a DTM connection is active, the *DTM CS Timeslot* is also indicated in the *Slot Configuration* table.

The *DTM CS Timeslot* must not coincide with the *Main Timeslot* because the latter is used for packet data services by definition. However, in a DTM connection, the *Main Timeslot* and all other allocated packet data channels play the same role.

The *DTM CS Timeslot* is configured with its downlink level and uplink PCL. All other (packet data) timeslots are configured with their downlink level and uplink power control parameter Γ_{Ch}; see description in section *GPRS Signalling and EGPRS – RF Signals of the MS* in the operating manual.

Remote Control

```
CONFigure:BSSignal:DTMode:CSTimeslot
PROCedure:SIGNalling:DTMode[:TCH]:MSLot:SCONfig
PROCedure:SIGNalling:DTMode[:TCH]:MSLot:BS:SCONfig:POWer
CONFigure:BSSignal:DTMode[:TCH]:MSLot:SCONfig
CONFigure:MSSignal:DTMode[:TCH]:MSLot:SCONfig
```

. DTM Receiver Quality Tests

The R&S CMU 200 provides the following DTM receiver quality results:

- The Bit Error Rate (BER) in the circuit-switched timeslot
- The Bit Error Rate (BER) in the packet data timeslots
- The Block Error Ratio (BLER) and the data rates in all packet data timeslots (Main Service: Packet Data and Receiver Quality Application: BLER). The R&S CMU 200 can measure up to 4 timeslots in parallel.

The different measurements require the settings listed below.

Table 9-2 Receiver quality test settings

Measurement	Main Service (Connection)	Service Selection (Connection)	Meas. Timeslot (MS Signal)
Circuit Switched, BER	Circuit Switched	Test Mode B or A BLER	DTM CS Timeslot
Packet Data, BER	Packet Data	Test Mode B or A	Main Timeslot (+ Slot Offset) (Network – Packet Data – Slot Offset)
BLER	Packet Data	BLER	All packet data timeslots

With *Service Selection: BLER*, both the BLER and the circuit switched BER can be measured. BLER and BER results are displayed in different applications of the *Receiver Quality* menu (the BER is obtained in the *BER* and in the *BER Average* applications):

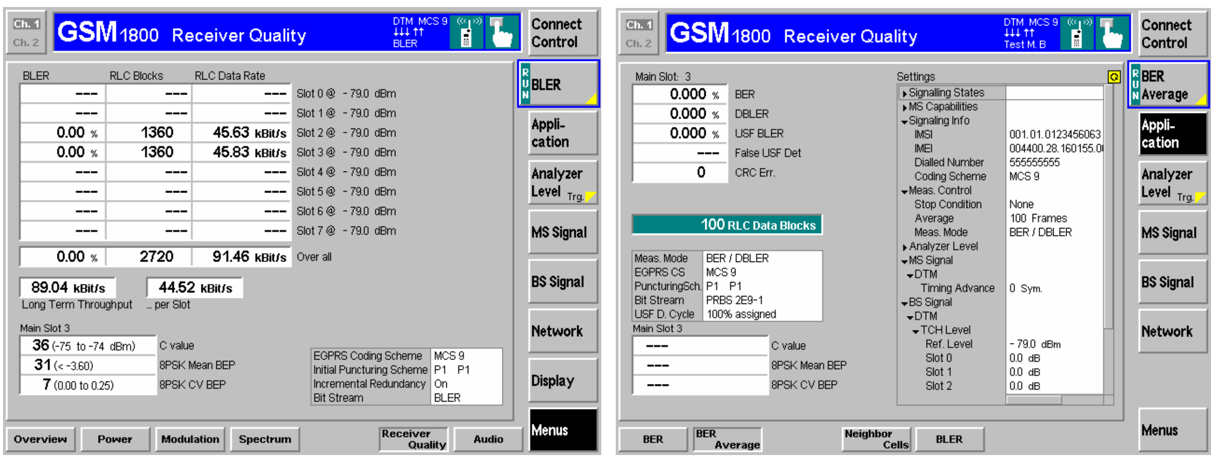


Fig. 9-3 DTM receiver quality results

Note: Level settings for DTM receiver quality tests

> *The R&S CMU 200 uses the current BS Signal levels (see **Fig. 9-2** on p. 9.7) to perform DTM receiver quality tests. The measurement-specific TCH Level BER is never used for DTM tests.*

Remote Control In remote control, the BLER results for the packet data channels and the BER results for the circuit switched timeslot can be obtained simultaneously. Use the following configuration:

Packet data connection, service selection:

```
PROCedure:SIGNalling:PDATa:ACTion CBL
```

Start BLER measurement:

```
[CONFigure:NETWork:MSERvice PDATa]
INITiate:RXQuality:BLER
```

Select circuit switched main service and start BER measurement:

```
CONFigure:NETWork:MSERvice CSWitched
INITiate:RXQuality:BER
```

. Remote Control Commands

The commands in this section are related to the configuration of DTM measurements.

Note: Disabled commands in DTM

To avoid settings conflicts, a number of circuit switched and packet data `PROCedure:…` commands are disabled while the R&S CMU 200 operates in DTM. In particular the commands for changing the multislot configuration are replaced by the commands listed below. In contrast, all `PROCedure:NETwork…` commands are still available.

CONFigure:NETWork:MSERvice		Main Service Selection (for DTM)		
Return	Description of parameters	Def. value	Def. unit	FW vers.
CSWitched | PDATa	Circuit switched GSM (E)GPRS packet data service	CSW	–	V3.80
Description of command				Sig. State
This command selects the main service for DTM measurements (with option R&S CMU-K44). To query the main service while no DTM functionality is available use `[SENSe:]NETWork:MSERvice?`				all

[SENSe:]MSSinfo:MSCLass:DTMode[:GPRS]? **[SENSe:]MSSinfo:MSCLass:DTMode:EGPRs?**		Multislot Class		
Returned values	Description of parameters	Def. value	Def. unit	FW vers.
CL5 | CL6 | CL9 | CL10 | CL11	DTM multislot class of the mobile	NAN	–	V3.80
Description of command				Sig. State
This command is always a query and returns the DTM multislot class of a GPRS or EGPRS mobile. The DTM multislot class is communicated during the attach procedure. According to the standard, DTM multislot classes 5, 6, 9, 10, or 11 are used.				ATT TEST

PROCedure:SIGNalling:DTMode[:TCH]:MSLot:SCONfig *<Main_TS>,<DL_Enable_0>,..., <DL_Enable_7>, <DL_Power_0>, ..., <DL_Power_7> <UL_Enable_0>,..., <UL_Enable_7>, <UL_Gamma_0>, ..., <UL_Gamma_7>, <CS_Slot>, <CS_PCL>*		Slot Configuration: Uplink/Downlink		
<Main_TS>	Description of parameters	Def. value	Def. unit	FW vers.
0 to 7	Main timeslot used for signalling	3	–	V3.80
<DL_Enable_n>	Description of parameters	Def. value	Def. unit	
ON | OFF	Enable or disable timeslot no. n	ON (slots 3 and 4) OFF (other slots)	–	
<DL_Power_n>	Description of parameters	Def. value	Def. unit	
–127.0 dB to +127.0 dB	Individual BS level in timeslot no. n:	0.0 (all DL slots)	dB	
<UL_Enable_n>	Description of parameters	Def. value	Def. unit	
ON | OFF	Enable or disable timeslot no. n	ON (slots 3 and 4) OFF (other slots)	–	
<UL_Gamma_n>	Description of parameters	Def. value	Def. unit	
0 to 31	Power control parameter Γ_{CH} in timeslot no. n	13 (all UL slots)	–	
<CS_Slot>	Description of parameters	Def. value	Def. unit	
0 to 7	Number of DTM CS timeslot	4	–	
<CS_PCL>	Description of parameters	Def. value	Def. unit	Sig. State
 0 to 19 **0 to 31** **0 to 31**	PCL in DTM CS timeslot GSM400/GT800/850/900 GSM1800 GSM1900	 15 10 10	 (PCL) (PCL) (PCL)	CEST + TEST[1]

Description of command

This command changes the main timeslot, the levels in all active and inactive timeslots of the BS signal, and the channel-specific power control parameters Γ_{CH} for the MS (current values, see *Slot Configuration Editor* in manual control) while a DTM connection is active. `PROCedure:SIGNalling:PDATa[:TCH]:MSLot:SCONfig` is disabled for DTM; see note at the beginning of this section.

The DL levels are relative to the *Reference Level* queried via *`[SENSe:]BSSignal:PDATa[:TCH]:MSLot:RLEVel?`*. The DL level range quoted above is restricted by the condition that the absolute level (calculated from the reference level and the relative individual levels) must not exceed the level ranges of the RF connectors.

Example: With output connector RF2 and a reference level of –85 dBm, the individual DL timeslot levels can be set in the range –52 dB to +75 dB, corresponding to an absolute level of –137 dBm to –10 dBm.

The UL signal settings must be compatible with the capabilities of the MS under test (DTM multislot class, power class). The DTM CS timeslot is reserved for the circuit switched connection and must not coincide with the main timeslot.

The parameters <*DL_Enable_n*>, <*UL_Enable_n*>, and <*UL_Gamma_n*> for the DTM CS timeslot are ignored. The <*DL_Power_n*> for the DTM CS timeslot is used for the circuit switched connection.

[1] This command is available after a DTM connection is established; see section *Connection Setup for DTM Tests* on p. 9.5 ff.

PROCedure:SIGNalling:DTMode[:TCH]:MSLot:BS:SCONfig:POWer ***<DL_Power_0>, ..., <DL_Power_7>***					BS Level
<DL_Power_n>	Description of parameters	Def. value	Def. unit	FW vers.	Sig. State
–127.0 dB to +127.0 dB	Individual BS level in timeslot no. n	0.0 (all DL slots)	dB	V3.80	CEST + TEST[1]

Description of command

This command changes the levels in all active and inactive timeslots slots of the BS signal. `PROCedure :SIGNalling:PDATa[:TCH]:MSLot:SCONfig` is disabled for DTM; see note at the beginning of this section.

The levels are relative to the *Reference Level* queried via *`[SENSe:]BSSignal:PDATa[:TCH]:MSLot :RLEVel?`*. The DL level range quoted above is restricted by the condition that the absolute level (calculated from the reference level and the relative individual levels) must not exceed the level ranges of the RF connectors.

Example: With output connector RF2 and a reference level of –85 dBm, the individual DL timeslot levels can be set in the range –52 dB to +75 dB, corresponding to an absolute level of –137 dBm to –10 dBm.

CONFigure:BSSignal:DTMode[:TCH]:MSLot:SCONfig ***<Enable_0>,..., <Enable_7>, <Level_0>,... <Level_7>***				Downlink Slot Configuration
<Enable_n>	Description of parameters	Def. value	Def. unit	FW vers.
ON | OFF	Enable or disable downlink timeslot no. n (the MS is instructed to listen to this TS)	ON (slots 3 and 4) OFF (other slots)	–	V3.80
<Power_n>	Description of parameters	Def. value	Def. unit	Sig. State
–127 dB to +127 dB	Power of CMU in timeslot no. n (the CMU actually transmits a signal in this TS)	0.0 (all DL slots)	dB	≠ CEST + TEST[2], Q: all

Description of command

This command configures the downlink slot configuration and the RF levels that the CMU uses in DTM test mode (default parameters). The values defined via `CONFigure:BSSignal:PDATa[:TCH]:MSLot:SCONfig` are overwritten.

The levels are relative to the *Reference Level* queried via *`[SENSe:]BSSignal:PDATa[:TCH]:MSLot :RLEVel?`*. The level range quoted above is restricted by the condition that the absolute level (calculated from the reference level and the relative individual levels) must not exceed the level ranges of the RF connectors.

Example: With output connector RF2 and a reference level of –90 dBm, the individual timeslot levels can be set in the range –47 dB to +80 dB, corresponding to an absolute level of –137 dBm to –10 dBm.

The parameter *<Enable_n>* for the DTM CS timeslot is ignored. The *<Power_n>* for the DTM CS timeslot is used for the circuit switched connection.

[2] This command is available before a DTM connection is established; see section *Connection Setup for DTM Tests* on p. 9.5 ff..

CONFigure:MSSignal:DTMode[:TCH]:MSLot:SCONfig *<Enable_0>,..., <Enable_7>, <Gamma_0>,... <Gamma_7>, <CS_Slot>, <CS_PCL>*			Uplink Slot Configuration	
<Enable_n>	Description of parameters	Def. value	Def. unit	
ON | OFF	Enable or disable uplink timeslot no. n	ON (slots 3 and 4) OFF (other slots)	–	
<Gamma_n>	Description of parameters	Def. value	Def. unit	FW vers.
0 to 31	Power control parameter Γ_{CH} in timeslot no. n	13 (all UL slots)	–	V3.80
<CS_Slot>	Description of parameters	Def. value	Def. unit	
0 to 7	Number of DTM CS timeslot	4	–	
<CS_PCL>	Description of parameters	Def. value	Def. unit	Sig. State
 0 to 19 **0 to 31** **0 to 31**	PCL in DTM CS timeslot GSM400/GT800/850/900 GSM1800 GSM1900	 15 10 10	 (PCL) (PCL) (PCL)	≠ CEST + TEST[2], Q: all
Description of command				

This command defines the slot configuration and the channel-specific power control parameters Γ_{CH} that the MS is to use for DTM tests (default parameters). In the default setting, slot no. 3 is also the main timeslot; see `PROCedure:SIGNalling:DTMode[:TCH]:MSLot:SCONfig` on p. 9.10. The values defined via `CONFigure:MSSignal:PDATa[:TCH]:MSLot:SCONfig` are overwritten.

The parameters *<Enable_n>* and *<Gamma_n>* for the DTM CS timeslot are ignored. The DTM CS timeslot must not coincide with the main timeslot.

CONFigure:BSSignal:DTMode:CSTimeslot ***<Slot_No>***				DTM CS Timeslot
<Slot_No>	Description of parameters	Def. value	Def. unit	FW vers.
0 to 7	Timeslot used for DTM, circuit switched connection	4	–	V3.80
Description of command				Sig. State
This command defines the timeslot allocated for the CS services while the mobile operates in DTM. The DTM CS timeslot must not coincide with the main timeslot set via `CONFigure:BSSignal:PDATa[:TCH]:MSLot:MTIMeslot` (see p. 9.10).				≠ CEST + TEST[2], Q: all

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