ROHDE&SCHWARZ

Test and Measurement
Division

Operating Manual

Universal Radio Communication Tester

R&S CMU 200 / CMU 300

1100.0008.02/1100.0008.53/1100.0008.03

Printed in the Federal
Republic of Germany

Dear Customer,

throughout this manual, CMU200 and CMU300 is generally used as an abbreviation for the Universal Radio Communication Testers R&S CMU 200 and R&S CMU 300.

R&S CMU200/CMU300 – Equipment Supplied

The CMU is delivered with the following items:

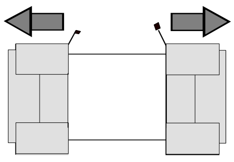
- Universal Radio Communication Tester R&S CMU 200 / R&S CMU 300.
- An AC power cable.
- The following documentation:
  - The present operating manual for R&S CMU 200 / R&S CMU 300.
  - Service manual instrument.
  - Operating manuals for software options and additional equipment purchased with the CMU. All available software manuals are listed before tabbed divider no. 1 of this manual. For a list of options available refer to the data sheet.

R&S CMU Models

The following models of the Universal Radio Communication Tester R&S CMU are deliverable:

- Universal Radio Communication Tester R&S CMU 200, stock no. 1100.0008.02, for all mobile station and user equipment tests including Bluetooth™ device tests.
- Universal Radio Communication Tester R&S CMU 200, stock no. 1100.0008.53, only for Bluetooth™ device tests.
- Universal Radio Communication Tester R&S CMU 300, stock no. 1100.0008.03, for base station tests.

Instructions for Unpacking the Instrument



remove protective cabs

➢ Take the instrument out of the shipping box and check whether the items listed in the packing list above are all included.

➢ Remove the two protective caps from the front and rear of the CMU and carefully check the instrument for damage.

Should the instrument be damaged, immediately notify the forwarder who shipped the instrument to you and keep the box and packing material.

Please observe all safety instructions given in this manual and follow the directions in chapter 1 to put the instrument into operation.

Tabbed Divider Overview

List of Figures and Tables

Data Sheet

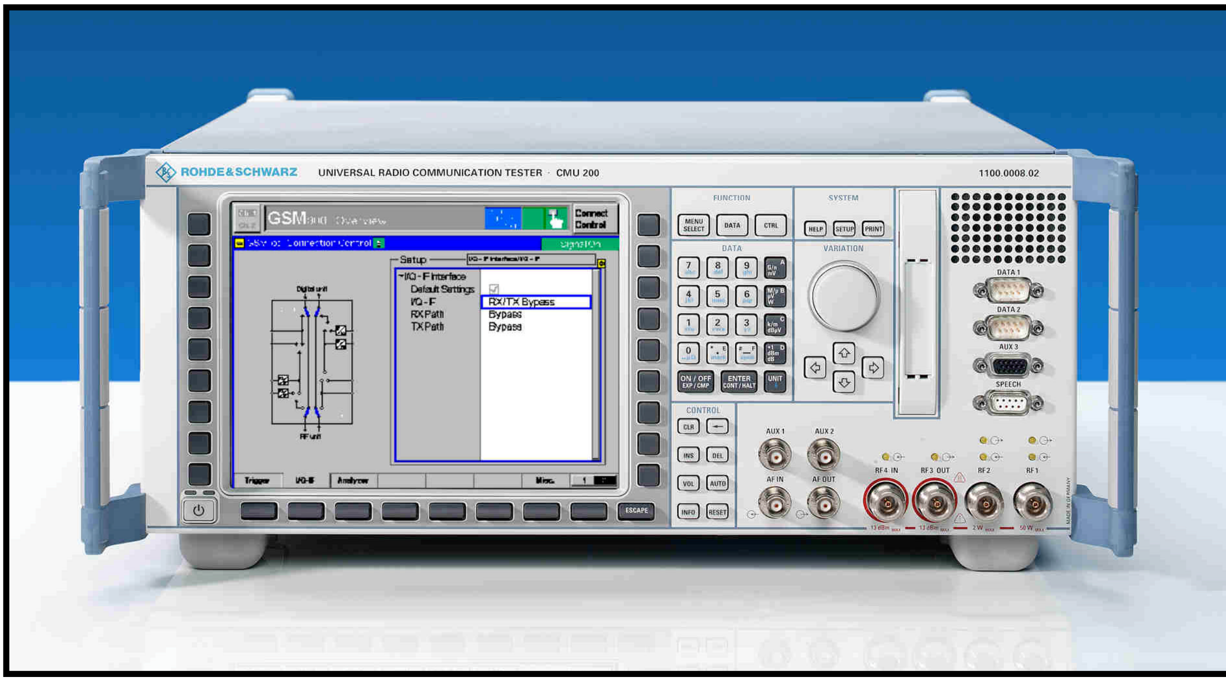
Safety Instructions
Certificate of Quality
EU Certificate of Conformity
List of R&S Representatives

Manuals for Universal Radio Communication Tester CMU

Tabbed Divider

Figures

Tables



Universal Radio Communication Tester R&S CMU200

Option R&S CMU-B17
IQ AND IF INTERFACE

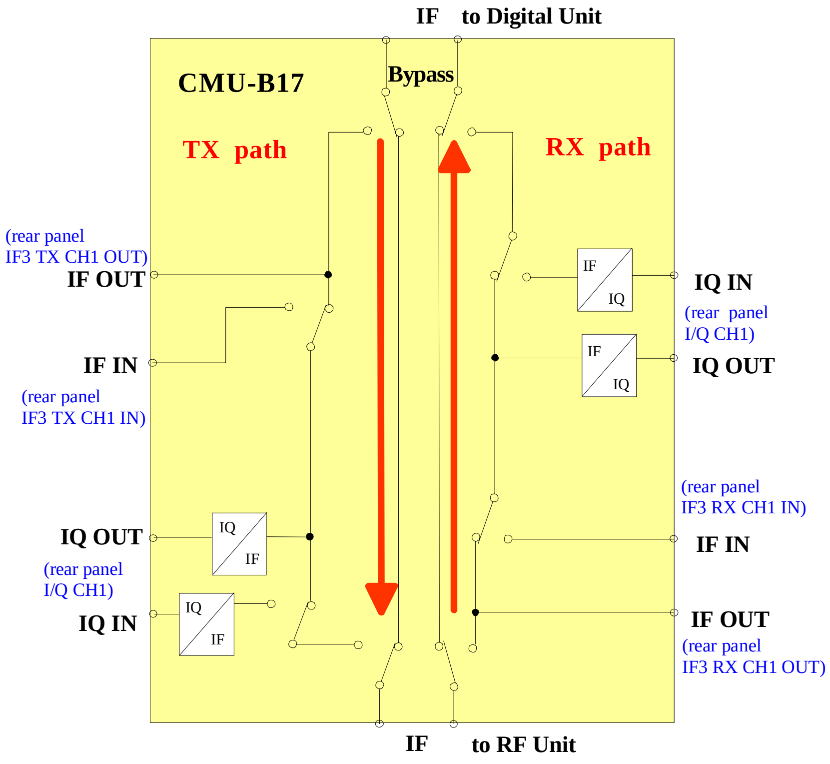
Technical Information

The R&S CMU200 in combination with the option R&S CMU-B17 represents an unique solution to get access to different IF- and IQ – signals on up- / down-link signal paths of mobile communication systems. The paper gives an overview about functionality, related applications and technical specifications.

ROHDE&SCHWARZ

Contents

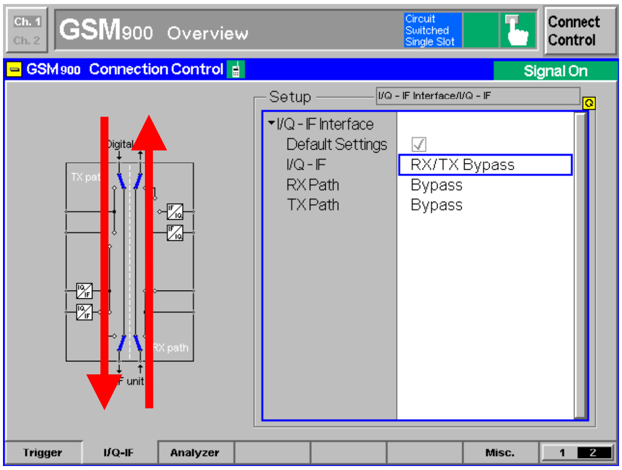
Block diagram



Option R&S CMU-B17 provides separate access to IF / IQ signals on R&S CMU200 receiver (RX) and transmitter (TX) paths (pls. see also annex 1). The functionality is applicable for Signalling and Non Signalling measurement modes. The insertion of option R&S CMU-B17 in bypass mode does not cause any influence to signals; i.e. the additional insertion loss of R&S CMU-B17 will be considered during mandatory calibration procedure after installation.

Functionality

Default: Bypass mode for highest measurement accuracy / RF tests

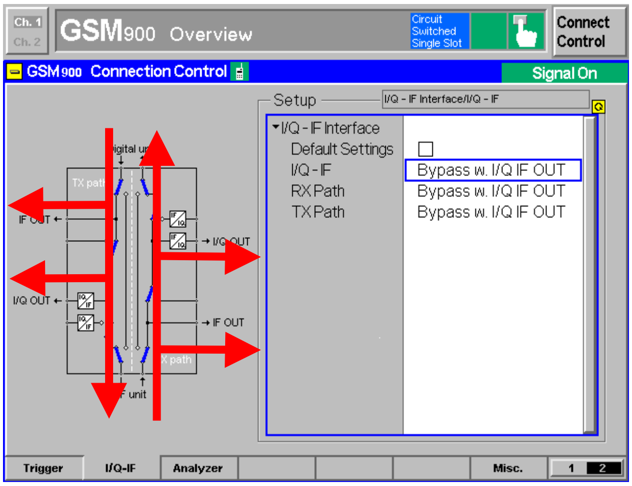


Setting: RX/TX Bypass

IEEE commands:
```
CONFigure:IQIF:RXTXcombined[?] BYP
CONFigure:IQIF:RXPath[?] BYP
CONFigure:IQIF:TXPath[?] BYP
```

Functionality:
- No influence to transmitted and received signals.
- The path loss due to the inserted R&S CMU-B17 board will be considered automatically during mandatory calibration procedure on R&S ACS calibration system after installation of the option.

IQ / IF signal monitoring



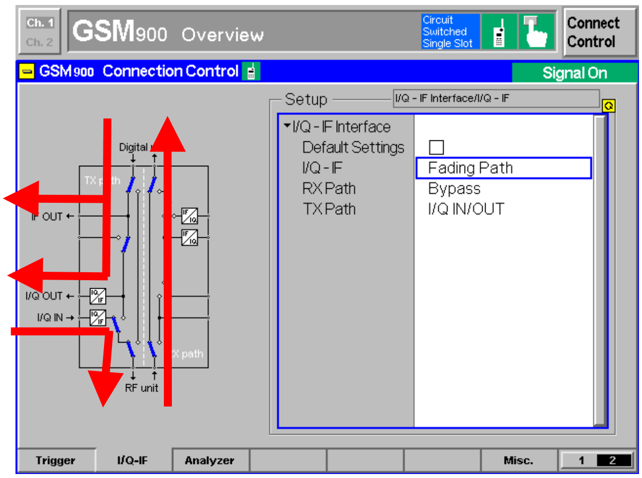
Setting: Bypass w. I/Q IF OUT

IEEE commands:
```
CONFigure:IQIF:RXTXcombined[?]
BYIQ
CONFigure:IQIF:RXPath[?] BYIQ
CONFigure:IQIF:TXPath[?] BYIQ
```

Functionality:
- Monitoring of up-link and downlink signals via IF or IQ outputs possible.
- The insertion loss of option R&S CMU-B17 will be considered during calibration procedure (pls. see Annex 4, Specification, Influence on RF interface).
- This mode can also be used for fading applications (pls. refer to chapter Applications, R&S CMU in combination with R&S SMIQ, SMIQ provides the faded RF signal).

Interruption of IQ / IF signal paths for external signal processing

Predefined paths

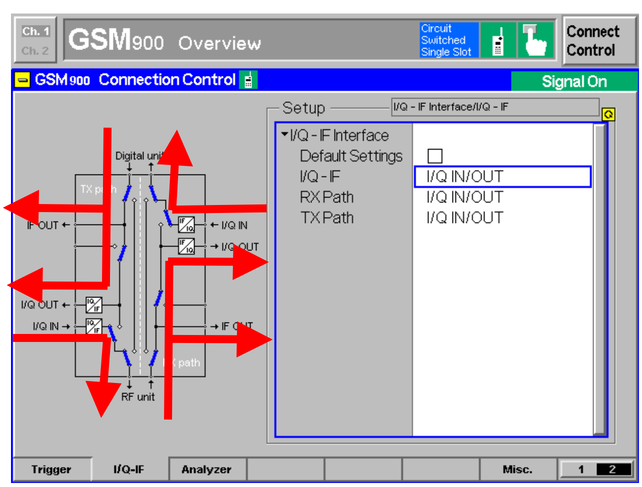


Setting: Fading Path

IEEE commands:
```
CONFigure:IQIF:RXTXcombined[?]
 FPAT
CONFigure:IQIF:RXPath[?] BYP
CONFigure:IQIF:TXPath[?] XOIO
```

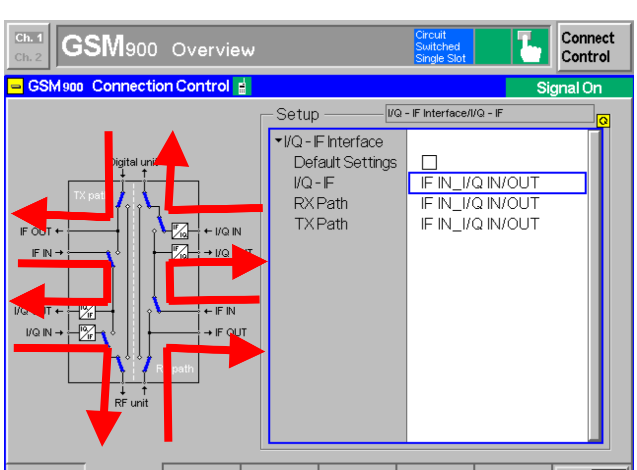
Functionality:

- The setting "Fading Path" can be used for connecting an external baseband fading simulator (pls. refer to chapter Applications, R&S CMU in combination with fading simulator R&S ABFS or R&S SMIQ/SMIQB14, CMU provides the faded RF signal).
- The transmitted signal can be routed to the fading simulator via IF or IQ outputs.
- Additionally it is possible to return the faded signal via IQ input.



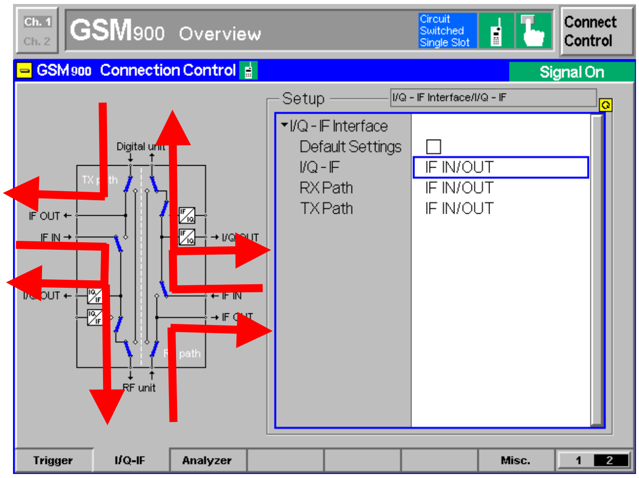
Setting: I/Q IN/OUT

IEEE commands:
```
CONFigure:IQIF:RXTXcombined[?]
 XOIO
CONFigure:IQIF:RXPath[?] XOIO
CONFigure:IQIF:TXPath[?] XOIO
```



Setting: IF IN_I/Q IN/OUT

IEEE commands:
```
CONFigure:IQIF:RXTXcombined[?]
 IOIO
CONFigure:IQIF:RXPath[?] IOIO
CONFigure:IQIF:TXPath[?] IOIO
```

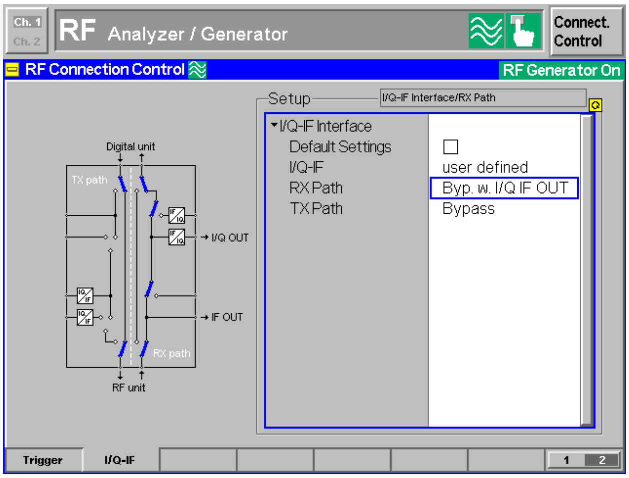


Setting: IF IN/OUT

IEEE commands:

```
CONFigure:IQIF:RXTXcombined[?]
 IOXO
CONFigure:IQIF:RXPath[?] IOXO
CONFigure:IQIF:TXPath[?] IOXO
```

User definable signal paths



Setting: user defined

IEEE commands:

```
CONFigure:IQIF:RXPath[?] BYIQ
CONFigure:IQIF:TXPath[?] BYP
```

Functionality:

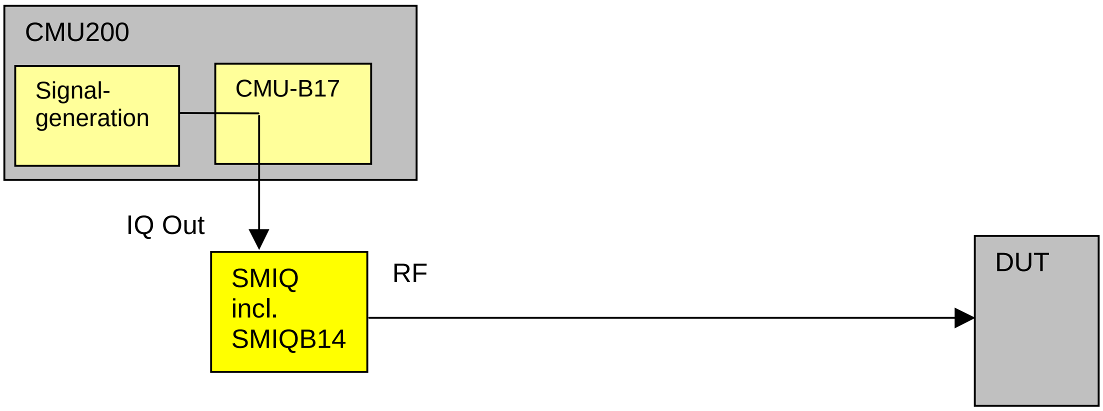
It is possible to select different user specific IQ / IF paths depending on application.

<u>Applications</u>

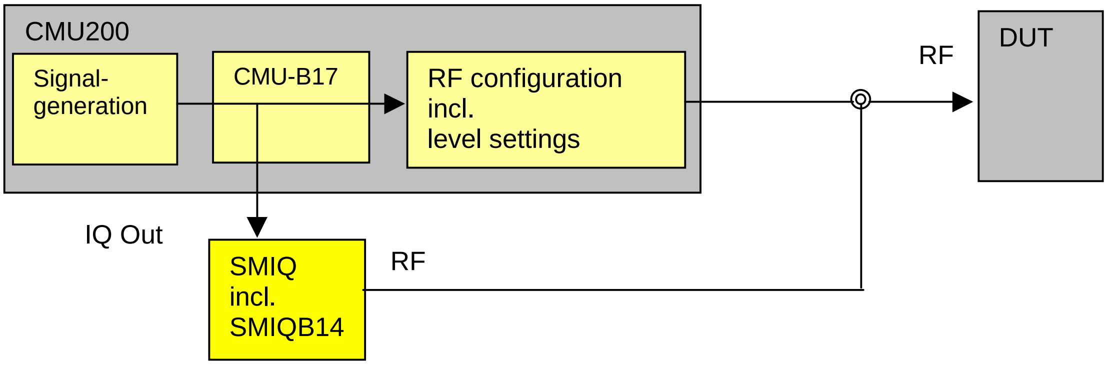
Bit Error Rate measurements on digital receivers under fading conditions

R&S CMU in combination with R&S SMIQ (R&S SMIQ provides the faded RF signal)

R&S CMU200 setting: **Fading Path** or **Bypass w. I/Q IF OUT^**



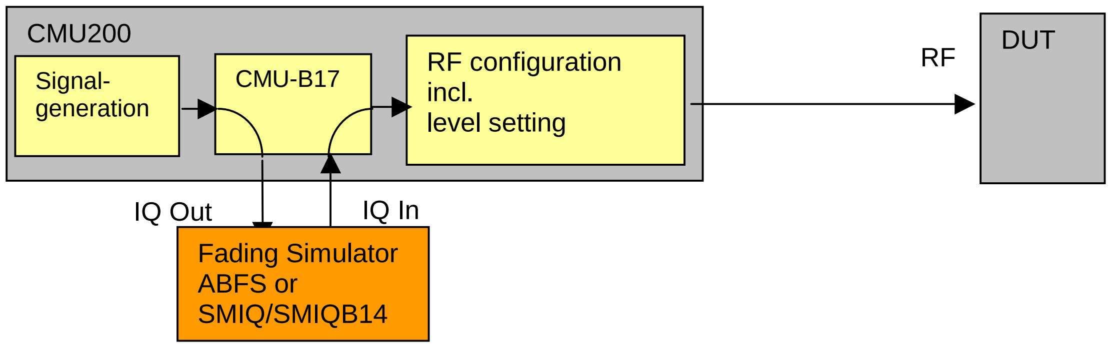
R&S CMU200 setting: **Bypass w. I/Q IF OUT**



The R&S CMU incl. option R&S CMU-B17 in combination with signal generator R&S SMIQ incl. IQ fading simulator option R&S SMIQB14 can be used for receiver (RX) Bit Error Rate (BER) tests under fading conditions. The IQ output of R&S CMU-B17 transmitter (TX) path feeds the signal into R&S SMIQ's IQ input. The R&S SMIQ forwards the faded RF signal directly to the receiver (RX) of the Device Under Test (DUT). The illustrated test set-ups are depending on selected mode of option R&S CMU-B17. In Bypass w. I/Q IF OUT mode it is recommended to reduce to minimum the RF level of non faded traffic channel.
For more information please refer to R&S application note 1MA07_0E „SMIQ as Fading Simulator for External Signals“.

R&S CMU in combination with fading simulator R&S ABFS or R&S SMIQ/SMIQB14 (R&S CMU provides the faded RF signal)

R&S CMU200 setting: **Fading Path**



The R&S CMU200 incl. option R&S CMU-B17 in combination with IQ fading simulator R&S ABFS or R&S SMIQ/SMIQB14 can be used for receiver tests under fading conditions. In this case the signal is forwarded to the device under test (DUT) via CMU RF interface.

Additional information for GSM:

To avoid influences on the fading profile it is highly recommended:

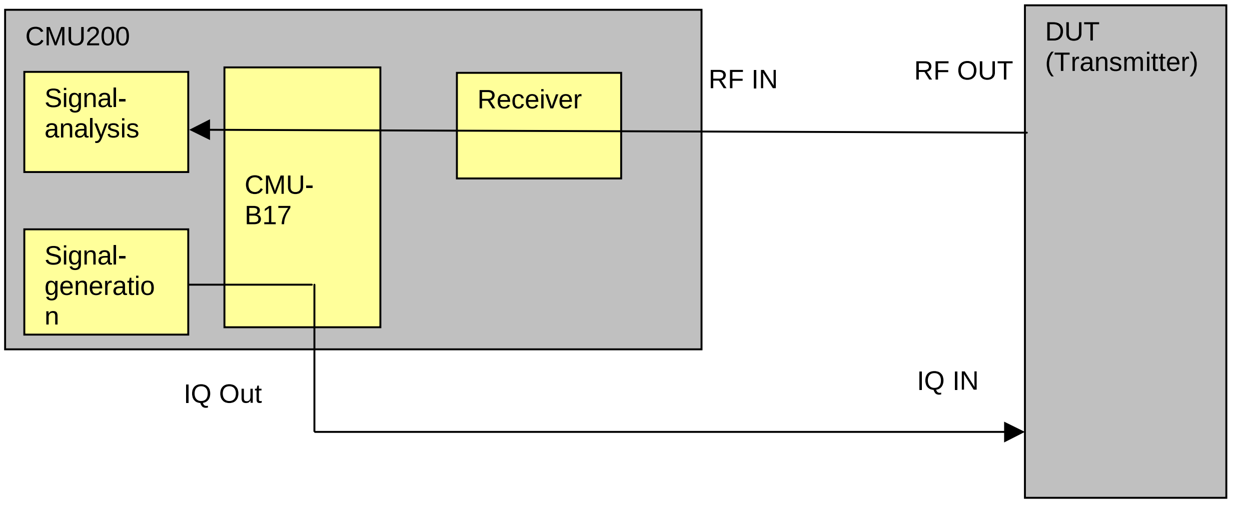
- To set all timeslots to the same level.
- To use for the TX signal of the R&S CMU the same RF frequencies and RF levels for both TCH and BCCH.
- To switch hopping off.

Based on external PC it is possible to perform an automated signal path calibration procedure. Both instruments will be controlled via IEEE interface. An application note incl. software is available on R&S WWW.

R&S CMU200 as IQ generator / RF analyzer

Another important application is the generation of IQ signals meeting the relevant standards. The user can generate complex signals that may even originate from a real signalling sequence. Most mobile radio chipsets comprise a RF chip and a baseband chip that communicate with each other via an analog IQ interface. The R&S CMU-B17 IQ-interface can be used to access the two chips. In mobile radio development, different teams are often required for this purpose. The IQ interface allows development work to be divided in space and time.

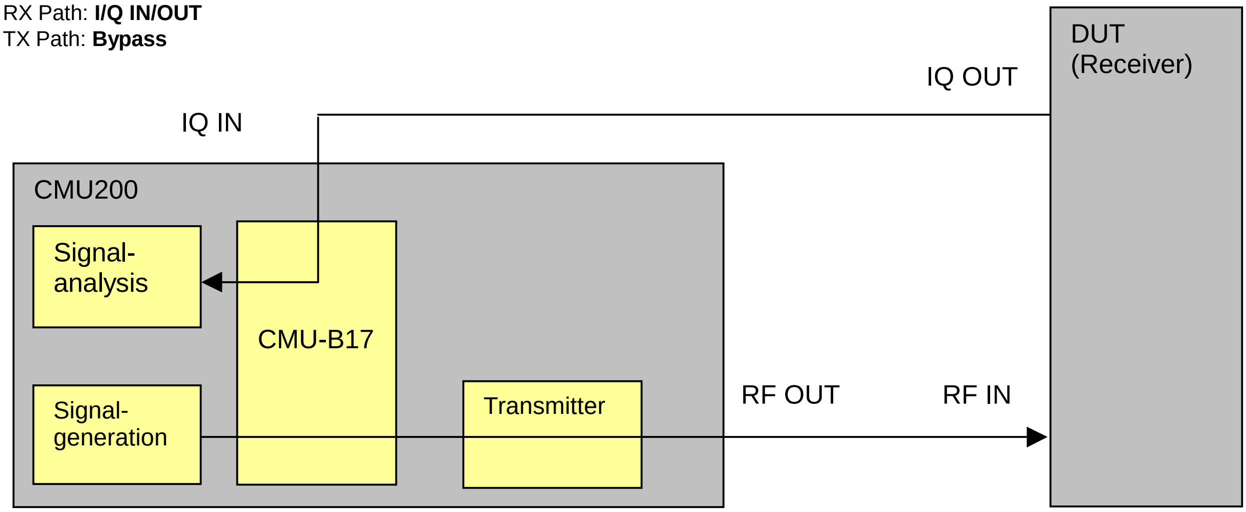
R&S CMU200 setting: **Bypass w. I/Q IF OUT**



R&S CMU200 as RF generator / IQ analyzer

If IQ signals are applied to the receive section of the tester, signal analysis can be performed in the same manner as when feeding a RF signal. In this connection, modulation analysis, for example, is useful since it evaluates the quality of an IQ signal. Modulation analysis yields analysis results such as IQ offset and IQ imbalance, which directly affect IQ signals, or even more complex evaluations such as error vector magnitude (EVM).

R&S CMU200 setting: **user defined**
RX Path: **I/Q IN/OUT**
TX Path: **Bypass**



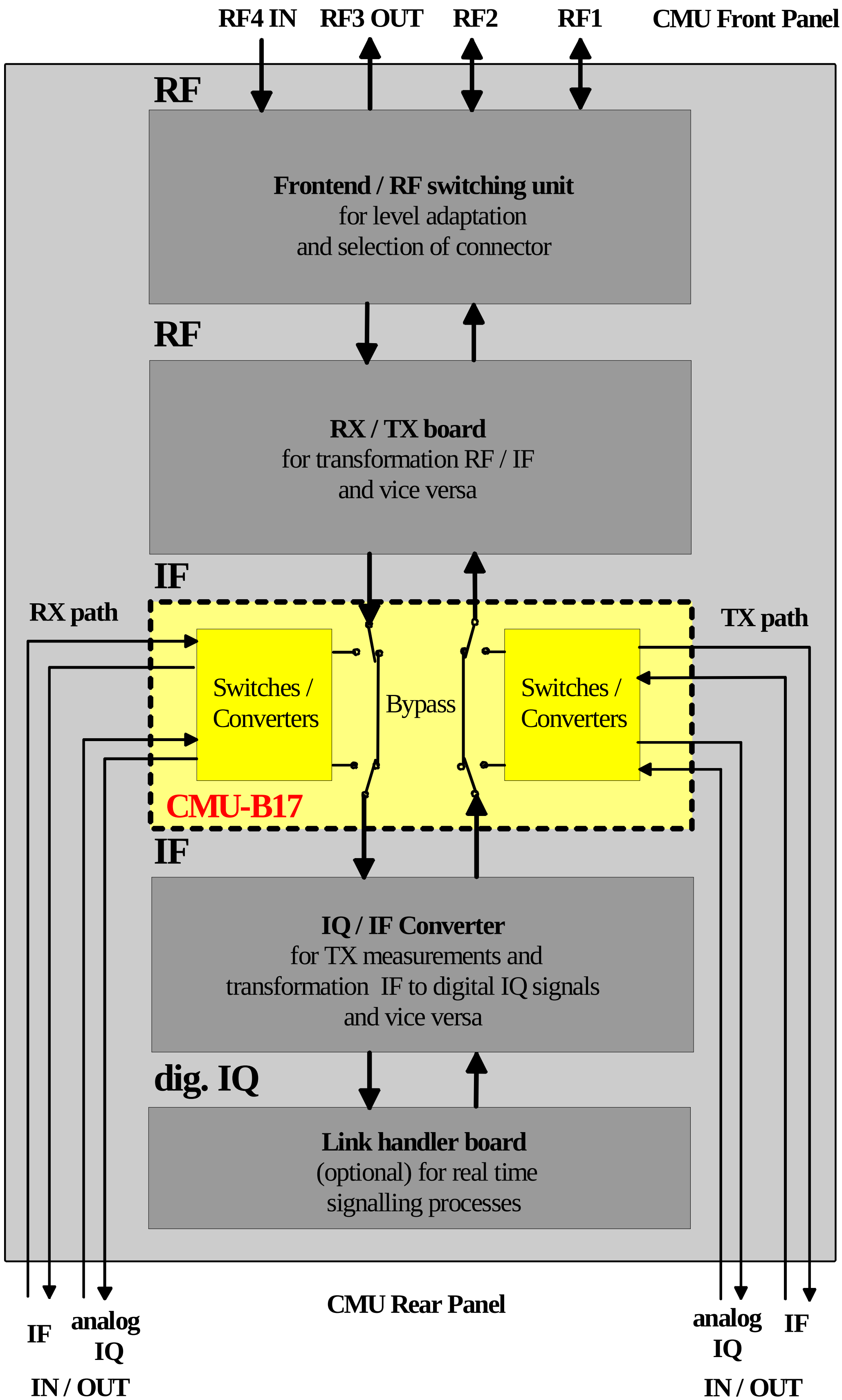
Ordering information

Type Stock.-No	Designation
CMU-B17 1100.6906.02	IQ AND IF INTERFACES FOR CMU200/300, ANALOG, SINGLE CHAN

Remarks:

- The listed R&S CMU200 function groups support the option R&S CMU-B17 from SW version V3.10 on:
  RF
  GSM (GPRS, EGPRS)
  IS136
  CDMA2000 (IS95)
  WCDMA (3GPP FDD)
- Due to used modulation schemes Bluetooth and AMPS standards will not be supported.
- The upgrade of existing units can be performed at R&S Service Center Munich. Installation and calibration costs must be considered in addition to the price of option R&S CMU-B17. Later on it will be possible to perform R&S CMU-B17 upgrades at local R&S Service Centers.
- The options R&S CMU-B17 and R&S CMU-B73 use the same mainboard connector of R&S CMU. Therefore either the R&S CMU-B17 or the R&S CMU-B73 can be ordered for a single instrument.

Annex 1: Signal paths R&S CMU200 incl. R&S CMU-B17



Annex 2: Assignment of IQ / IF connectors on R&S CMU rear panel

Sub-D connector I/Q CH1:

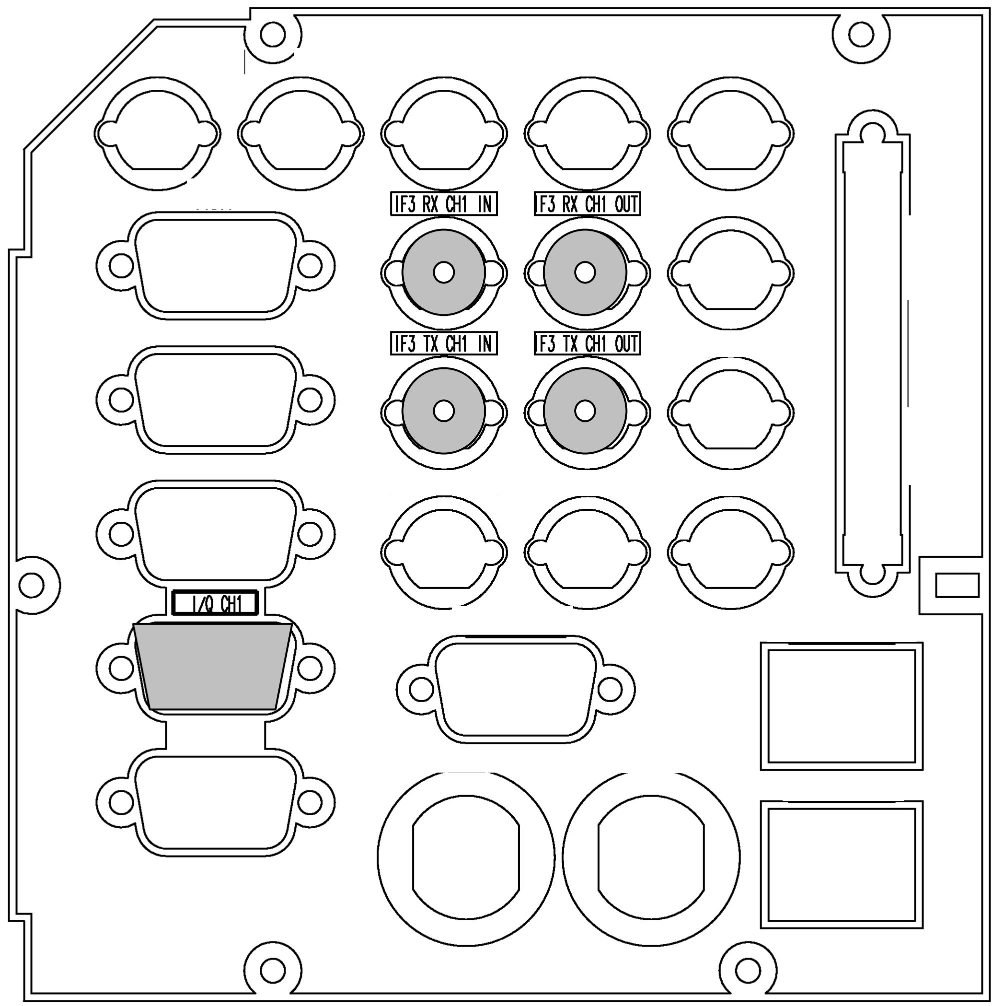
Pin	Signal designation	Function
1	GND	
2	MOD_ I_ IN	I input, TX path, max ±0.5 V, impedance 50 Ohm
3	MOD_Q_IN	Q input, TX path, max ±0.5 V, impedance 50 Ohm
4	GND	
5	MOD_I_OUT	I output, TX path, max ±0.5 V, impedance 50 Ohm
6	MOD_Q_OUT	Q output, TX path, max ±0.5 V, impedance 50 Ohm
7	GND	
8	DEMOD_I_IN	I input, RX path, max ±0.5 V, impedance 50 Ohm
9	DEMOD_Q_IN	Q input, RX path, max ±0.5 V, impedance 50 Ohm
10	GND	
11	DEMOD_I_OUT	I output, RX path, max ±0.5 V, impedance 50 Ohm
12	DEMOD_Q_OUT	Q output, RX path, max ±0.5 V, impedance 50 Ohm
13	GND	
14		
15		

BNC sockets:

Socket designation	PIN*	Function
IF3 RX CH1 IN	BNC	IF input, RX path, f= 7,68 MHZ or 10,7 MHz; max level +2 dBm PEP; impedance 50 Ohm
IF3 RX CH1 OUT	BNC	IF output, RX path, f= 7,68 MHZ or 10,7 MHz; max level +4 dBm PEP; impedance 50 Ohm
IF3 TX CH1 IN	BNC	IF input, TX path, f= 15,36 MHz or 13,85 MHz; max level +3 dBm PEP for WCDMA, max level –5 dBm for GSM; impedance 50 Ohm
IF3 TX CH1 OUT	BNC	IF output, TX path, f= 15,36 MHz or 13,85 MHz; max level +3 dBm PEP for WCDMA, max level –5 dBm for GSM; impedance 50 Ohm

*) The BNC shield is GND.

Annex 3: Location of R&S CMU-B17 connectors on rear panel



Annex 4: Specification

IQ Interface

Analogue IQ Outputs (IF->IQ; TX- and RX-Paths, analogue I/Q Output)

(Connector I/Q CH1)

IQ Bandwidth		0 to 2.5 MHz
Max output voltage range	EMF	-1 V to +1 V, peak $\sqrt{I^2+Q^2}$ =1V, peak
Output impedance		50 Ω
I- and Q-Amplitude Imbalance	 For WCDMA function group	< +/- 2 % < +/- 2,5 %
Offset voltage	+20 °C to +35 °C +20 °C to +35 °C for WCDMA function group +5 °C to +45 °C	<4 mV <5 mV <8 mV

Analogue IQ Inputs (IQ->IF; TX-path, analogue I/Q Input)

(Connector I/Q CH1)

IQ Bandwidth		0 to 2.5 MHz
Max input voltage range		-0.5 V to +0.5 V, peak $\sqrt{I^2+Q^2}$ = 0,5V, peak
Input impedance		50 Ω
Carrier suppression	+20 °C to +35 °C +5 °C to +45 °C	>40 dB >35 dB
Side band suppression	f_{iq} < 1 MHz 1 MHz < f_{iq} < 2.5 MHz	>45 dB >40 dB

Analogue IQ Inputs (IQ->IF; RX-path, analogue I/Q Input)

(Connector I/Q CH1)

IQ Bandwidth		0 to 2.5 MHz
Max input voltage range		-0.5 V to +0.5 V, peak $\sqrt{I^2+Q^2}$ = 0,5V, peak
Input impedance		50 Ω
Carrier suppression	+20 °C to +35 °C +5 °C to +45 °C	>35 dB[1] >35 dB[1]
Side band suppression	f_{iq} < 1 MHz 1 MHz < f_{iq} < 2.5 MHz	>45 dB >40 dB

[1] For GSMK modulation and max input voltage at IQ inputs

Influence on RF interface

WCDMA Measurements (3GPP FDD, UE test)

Additional influence on signal quality	analogue I/Q Input and Output considered; for TX- and RX-Paths	
EVM		<5 %, rms

GSM / EDGE Measurements

Additional influence on signal quality, EVM	Analogue I/Q Input and Output considered; for TX- and RX-Paths;	
Phase error	GMSK	<3°, peak <1°, rms
EVM	8PSK	<5 %, rms

RF Level uncertainty (Bypass with IQ/IF OUT, IQ IN/OUT, IF IN/OUT)

Additional output level uncertainty, related to CMU data sheet	At RF1, RF2, RF3 OUT	<0.3 dB
Additional input level uncertainty, related to CMU data sheet	At RF1, RF2, RF4 IN (frequency-selective)	<0.3 dB

IF Interface

IF Inputs, TX Path
(Connector IF3 TX CH1 IN)

IF level range		up to -5 dBm, PEP
Standard IF frequencies	RF/GSM/IS136/AMPS/IS95/CDMA2000 WCDMA	13.85 MHz 15.36 MHz

IF Inputs, RX Path
(Connector IF3 RX CH1 IN)

IF level range		up to +2 dBm, PEP
Standard IF frequencies	RF/GSM/IS136/AMPS/IS95/CDMA2000 WCDMA	10.7 MHz 7.68 MHz

IF Outputs, TX Path
(Connector IF3 TX CH1 OUT)

IF level range		up to -5 dBm, PEP
Standard IF frequencies	RF/GSM/IS136/AMPS/IS95/CDMA2000 WCDMA	13.85 MHz 15.36 MHz

IF Outputs, RX Path
(Connector IF3 RX CH1 OUT)

IF level range		up to +4 dBm, PEP
Standard IF frequencies	RF/GSM/IS136/AMPS/IS95/CDMA2000 WCDMA	10.7 MHz 7.68 MHz

Aspects to be considered, if TX or RX signal paths are interrupted *:

The RF frequency of the R&S CMU influences the rotating direction of the IQ vector.
The direction is inverted for RF < 1200.1 MHz, this can be compensated by changing I and Q

	R&S CMU generator or analyzer RF frequency	
	100 kHz.. 1200.0999999 MHz	1200.1.. 2700.0 MHz
R&S CMU IQ output vector	Inverted rotation. Swap I-output with Q-output for proper operation	Normal rotation
R&S CMU IQ input vector	Inverted rotation. Swap I-input with Q-input for proper operation	Normal rotation

*) Please refer to Annex 1. The rotating direction must be considered, if the R&S CMU signal path from Link Handler Board to Frontend and vice versa is interrupted; i.e. if the signal is not returned to the same R&S CMU block after external treatment. Examples:

- The rotating direction must **not** be taken into account, if the transmitted signal is routed from IQ output of R&S CMU-B17 to an external fading simulator and than returned to IQ input of CMU (pls. refer to chapter Applications, R&S CMU in combination with fading simulator R&S ABFS or R&S SMIQ/SMIQB14, R&S CMU provides the faded RF signal).
- The rotating direction must be considered, if the transmitted signal is forwarded to an external fading simulator and is not returned to IQ input of R&S CMU (pls. refer to chapter Applications, R&S CMU in combination with R&S SMIQ, R&S SMIQ provides the faded RF signal).

Notes for measuring IQ / IF signals, applied to inputs of option R&S CMU-B17 on R&S CMU RX path:

- The RF spectrum analyzer function (RF Function Group) is not applicable.
- The displayed RF power levels are not directly related to applied IQ / IF voltages. The analyzer settings of R&S CMU RF interface (RF1, RF2, RF 4 IN) have to be considered additionally (softkeys Analyzer Level / RF Max. Level).
  - IQ inputs have a fixed attenuation of 2 dB; e.g. the RF power meter readout for an applied 500 mV IQ peak voltage will be 2 dB below the set RF Max. Level value.
  - IF inputs do not have a fixed attenuation. The max. IF input level is 2 dBm. The RF power meter readout for the mentioned max. IF signal level (2 dBm) will be 2 dB below the set RF Max. Level value.
- It is recommended to switch off the Autoranging Function.
- RF and IF trigger functions are not possible.
- WCDMA RF Compensation filter is switched off (I/Q IN/OUT, IF IN/OUT, IFIN_I/Q IN/OUT)
- WCDMA UE-Test: ACLR/SEM measurement is not applicable

CE

Certificate No.: 99035, page 1

This is to certify that:

Equipment type	Stock No.	Designation
CMU200	1100.0008.02/.53	Universal Radio Communication Tester
CMU300	1100.0008.03	

complies with the provisions of the Directive of the Council of the European Union on the approximation of the laws of the Member States

- relating to electrical equipment for use within defined voltage limits (73/23/EEC revised by 93/68/EEC)
- relating to electromagnetic compatibility (89/336/EEC revised by 91/263/EEC, 92/31/EEC, 93/68/EEC)

Conformity is proven by compliance with the following standards:

EN61010-1 : 1993 + A2 : 1995
EN61326-1 : 1997 + A1 : 1998

For the assessment of electromagnetic compatibility, the limits of radio interference for Class B equipment as well as the immunity to interference for operation in industry have been used as a basis.

Affixing the EC conformity mark as from 1999

ROHDE & SCHWARZ GmbH & Co. KG
Mühldorfstr. 15, D-81671 München

Munich, 2002-11-28

Central Quality Management FS-QZ / Becker

ROHDE&SCHWARZ
EC Certificate of Conformity

CE

Certificate No.: 99035, page 2

This is to certify that:

Equipment type	Stock No.	Designation
CMU-B11	1100.5000.02	Reference Oscillator
CMU-B12	1100.5100.02	Reference Oscillator
CMU-B15	1100.6006.02	Additional RF und IF Connections
CMU-B17	1100.6906.02	IQ and IF Interfaces
CMU-B21	1100.5200.02	Versatile Signalling Unit
CMU-B41	1100.5300.02	Audio Generator and Analyzer
CMU-B52	1100.5400.02	Spreech Codec for Versatile Signalling Unit
CMU-B53	1100.5700.02	Bluetooth Extension
CMU-B66	1149.9509.02	Versatile Base Band Board
CMU-B68	1149.9809.02	Layer1 Board
CMU-B71	1100.6406.02	ABIS Interface Unit
CMU-B73	1150.2004.02	Analog Telephon Line Interface
CMU-B76	1150.0601.02	Layer1 Board for WCDMA

complies with the provisions of the Directive of the Council of the European Union on the approximation of the laws of the Member States

- relating to electrical equipment for use within defined voltage limits (73/23/EEC revised by 93/68/EEC)

- relating to electromagnetic compatibility (89/336/EEC revised by 91/263/EEC, 92/31/EEC, 93/68/EEC)

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ROHDE & SCHWARZ GmbH & Co. KG
Mühldorfstr. 15, D-81671 München

Munich, 2002-09-02

Central Quality Management FS-QZ / Becker

CE

Certificate No.: 99035, page 3

This is to certify that:

Equipment type	Stock No.	Designation
CMU-B81	1100.6506.02	CDMA(IS95) Signalling Unit
CMU-B82	1150.0201.02/.04	ACCESS Board für CDMA Signalling Unit
CMU-B83	1150.0301.02/.04 1150.0301.12/.14	CDMA2000 Signalling Unit
CMU-B85	1100.7002.02/.04	Speech Codec for CDMA2000
CMU-B87	1150.2404.02/.04	Message Monitor for CDMA2000
CMU-B99	1150.1250.02	RF1 Level Range identical to RF2
CMU-U61	1100.5500.02	Floppy Disk Drive
CMU-Z1	1100.7490.02	Memory Card

complies with the provisions of the Directive of the Council of the European Union on the approximation of the laws of the Member States

- relating to electrical equipment for use within defined voltage limits (73/23/EEC revised by 93/68/EEC)

- relating to electromagnetic compatibility (89/336/EEC revised by 91/263/EEC, 92/31/EEC, 93/68/EEC)

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EN61326-1 : 1997 + A1 : 1998

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Affixing the EC conformity mark as from 1999

ROHDE & SCHWARZ GmbH & Co. KG
Mühldorfstr. 15, D-81671 München
Central Quality Management FS-QZ / Becker

Munich, 2002-09-02

Certified Quality System
ISO 9001
DQS REG. NO 1954 QM

Certified Environmental System
ISO 14001
DQS REG. NO 1954 UM

Qualitätszertifikat

Sehr geehrter Kunde,

Sie haben sich für den Kauf eines Rohde & Schwarz-Produktes entschieden. Hiermit erhalten Sie ein nach modernsten Fertigungsmethoden hergestelltes Produkt. Es wurde nach den Regeln unseres Qualitätsmanagementsystems entwickelt, gefertigt und geprüft. Das Rohde & Schwarz-Qualitätsmanagementsystem ist u.a. nach ISO 9001 und ISO 14001 zertifiziert.

Certificate of quality

Dear Customer,

You have decided to buy a Rohde & Schwarz product. You are thus assured of receiving a product that is manufactured using the most modern methods available. This product was developed, manufactured and tested in compliance with our quality management system standards. The Rohde & Schwarz quality management system is certified according to standards such as ISO 9001 and ISO 14001.

Certificat de qualité

Cher client,

Vous avez choisi d'acheter un produit Rohde & Schwarz. Vous disposez donc d'un produit fabriqué d'après les méthodes les plus avancées. Le développement, la fabrication et les tests respectent nos normes de gestion qualité. Le système de gestion qualité de Rohde & Schwarz a été homologué, entre autres, conformément aux normes ISO 9001 et ISO 14001.

ROHDE&SCHWARZ

Support Center

Telefon / Telephone: **+49 (0)180 512 42 42**

Fax: **+49 89 41 29 137 77**

E-mail: **CustomerSupport@rohde-schwarz.com**

Für technische Fragen zu diesem Rohde & Schwarz-Gerät steht Ihnen die Hotline der Rohde & Schwarz Vertriebs-GmbH, Support Center, zur Verfügung.

Unser Team bespricht mit Ihnen Ihre Fragen und sucht Lösungen für Ihre Probleme.

Die Hotline ist Montag bis Freitag von 8.00 bis 17.00 Uhr MEZ besetzt.

Bei Anfragen außerhalb der Geschäftszeiten hinterlassen Sie bitte eine Nachricht oder senden Sie eine Notiz per Fax oder E-Mail. Wir setzen uns dann baldmöglichst mit Ihnen in Verbindung.

Um Ihr Gerät stets auf dem neuesten Stand zu halten, abonnieren Sie bitte Ihren persönlichen Newsletter unter

http://www.rohde-schwarz.com/www/response.nsf/newsletterpreselection.

Sie erhalten dann regelmäßig Informationen über Rohde & Schwarz-Produkte Ihrer Wahl, über Firmware-Erweiterungen, neue Teiber und Applikationsschriften.

Should you have any technical questions concerning this Rohde & Schwarz product, please contact the hotline of Rohde & Schwarz Vertriebs-GmbH, Support Center.

Our hotline team will answer your questions and find solutions to your problems.

You can reach the hotline Monday through Friday from 8:00 until 17:00 CET.

If you need assistance outside office hours, please leave a message or send us a fax or e-mail. We will contact you as soon as possible.

To keep your instrument always up to date, please subscribe to your personal newsletter at

http://www.rohde-schwarz.com/www/response.nsf/newsletterpreselection.

As a subscriber, you will receive information about your selection of Rohde & Schwarz products, about firmware extensions, new drivers and application notes on a regular basis.

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West Indies	siehe / see Mexico	

Contents of Manuals for Universal Radio Communication Tester CMU

The user documentation for the R&S CMU 200/300 is divided in this 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. The latest revisions of all manuals are also posted on the CMU Customer Web on GLORIS.

Operating Manual CMU200/CMU300

The present operating manual contains comprehensive information about the technical data of the instrument, its setup and putting into operation, the operating concept and controls as well as the operation of the CMU via the menus of the graphical user interface and via remote control. Typical measurement tasks for the CMU are explained in detail using the functions on the graphical user interface and a selection of program examples.

The manual is subdivided into the data sheet plus 10 chapters:

The data sheet	Informs about guaranteed specifications and characteristics of the instrument.
Chapter 1	Describes the control elements and connectors on the front and rear panel as well as all procedures required for putting the instrument into operation and integrating it into a test setup.
Chapter 2	Gives an introduction to typical measurement tasks of the CMU which are explained step by step.
Chapter 3	Describes key operating modes, the structure of the graphical interface and the principles of measurement control.
Chapter 4	Forms a reference for manual control of the CMU and contains a detailed description of all instrument functions belonging to function groups *Base* and *RF Non Signalling.* All software options that come without a separate operating manual are also described at the end of chapter 4. The chapter lists the remote control command for each instrument function.
Chapter 5	Describes the basics for programming the CMU, command processing and the status reporting system.
Chapter 6	Lists all the remote-control commands of the function groups and options reported in chapter 4. At the end of the chapter the commands are listed by their function and in alphabetical order.
Chapter 7	Contains program examples for a number of typical CMU applications.
Chapter 8	Describes preventive maintenance and the characteristics of the instrument's hardware interfaces.
Chapter 9	Gives a list of error messages that the CMU may generate.
Chapter 10	Contains an index for the operating manual.

Service Manual Instrument

The service manual instrument informs on how to check compliance with rated specifications, on instrument function, repair, troubleshooting and fault elimination. It contains all information required for the maintenance of CMU by exchanging modules.

Service Manual Modules

The service manual modules is not delivered with the instrument but may be obtained from your R&S service department using the order number 1100.4903.91.

Service manual modules contains information about the individual modules of CMU. This comprises the test and adjustment of the modules, fault detection within the modules and the interface description.

Operating Manuals for Digital and Analog Network Tests

The operating manuals listed in the following table describe the test of mobile phones supporting different standards by means of the CMU200/CMU300 and the appropriate software and hardware options. Except for hardware-specific chapters that are not relevant to the software options, the network test operating manuals are organized like the present CMU operating manual.

		For Options		
Manual	**Order Number**	**Type**	**Description**	**Stock No.**
Operating Manual CMU-K20/-K21/-K22/-K23/-K24	1115.6088.12	CMU-K20 CMU-K21 CMU-K22 CMU-K23 CMU-K24 CMU-K42 CMU-K43 CMU-K45	GSM400-MS for CMU-B21 GSM900-MS for CMU-B21 GSM1800-MS for CMU-B21 GSM1900-MS for CMU-B21 GSM850-MS for CMU-B21 GPRS software extension for GSM EGPRS software extension for GSM AMR GSM for CMU200	1115.5900.02 1115.6007.02 1115.6107.02 1115.6207.02 1115.6307.02 1115.4691.02 1115.6907.02 1150.3100.02
Operating Manual CMU-K27/-K28	1115.6688.12	CMU-K27 CMU-K28	TDMA800-MS for CMU-B21 TDMA1900-MS for CMU-B21	1115.6607.02 1115.6707.02
Operating Manual CMU-K29	1115.6888.12	CMU-K29	AMPS-MS for CMU-B21	1115.6807.02
Operating Manual CMU-K30/-K31/-K32/-K33	1115.4185.12	CMU-K30 CMU-K31 CMU-K32 CMU-K33 CMU-K39 CMU-K41	GSM400-BS for CMU-B21 GSM900-BS for CMU-B21 GSM1800-BS for CMU-B21 GSM1900-BS for CMU-B21 MOC/MTC EDGE for CMU-K30/31/32/33	1115.4004.02 1115.4104.02 1115.4104.02 1115.4104.02 1115.4791.02 1115.4604.02
Operating Manual CMU-K53	1115.5081.12	CMU-K53	Bluetooth for CMU	1115.5000.02
Operating Manual CMU-K65/…/-K69	1115.4962.12	CMU-K65 CMU-K66 CMU-K67 CMU-K68 CMU-K69	WCDMA UE TX Test (3GPP/FDD) WCDMA UE DL Generator WCDMA UE Band III Signalling WCDMA UE Band I Signalling WCDMA UE Band II Signalling	1115.4891.02 1115.5100.02 1150.3000.02 1115.5300.02 1115.5400.02
Operating Manual CMU-K75/-K76	1150.3398.12	CMU-K75 CMU-K76	WCDMA Node B TX Tests WCDMA Generator (3GPP/FDD, Release 99, Uplink)	1150.3200.02 1150.3300.02
Operating Manual CMU-K81/-K82	1115.5581.12	CMU-K81 CMU-K82	CDMA800-MS (IS95) for CMU-B81 CDMA1900-MS (IS95) for CMU-B81	1115.5500.02 1115.5600.02
Operating Manual CMU-K83/-K84/-K85/-K86	1150.0382.12	CMU-K83 CMU-K84 CMU-K85 CMU-K86	CDMA2000-MS (450 MHz band) CDMA2000-MS (cellular band) CDMA2000-MS (PCS band) CDMA2000-MS (IMT-2000 band)	1150.3500.02 1150.3600.02 1150.3700.02 1150.3800.02

The GSM base station tests described in operating manual CMU-K30/-K31/-K32/-K33/-K34 and the WCDMA UL generator described in operating manual CMU-K75/-K76 require a CMU300 (Universal Radio Communication Tester for BTS). Bluetooth tests are performed with model CMU200, var. 53. All other radio communication equipment is tested with model CMU200, var.02.

What's new in this Revision...

This operating manual describes version V3.40 of the CMU base software including *RF* and *Audio* measurements and the IQ-IF interface. 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...**
RF User Correction	Correction of a frequency and level response in the test setup by means of interpolation tables.	Chapter 1, → RF User Correction
RF Aux Tx	Second, configurable RF signal in function group RF (with option CMU-B95, Additional RF Generator).	Chapter 4, RF Measurements → Generator Settings
Extended selftests	Selftests for new hardware components and generators added	Chapter 4, → Maintenance
*GTL	Device-specific *Go to Local* command, also works with serial interface	Chapter 5, → Return to Manual Operation
Extended status reporting system	Invalid measurement results cause bit no. 4 of the STATus:OPERation register to be set.	Chapter 5, → STATus:OPERation Register
Higher data rates	The serial interface supports data rates up to 115200 baud.	Chapter 4, → Serial Interfaces

Frequently Used Abbreviations

Att.	*Attenuation*
Cnt	*Center*
Ext.	*External*
Freq.	*Frequency*
GPIB	*General Purpose Interface Bus = IEEE Bus according to standard IEC 625.1/IEEE 488.1*
IF	*Intermediate Frequency*
Max.	*Maximum (Level)*
Pk	*Peak*
RBW	*Resolution Bandwidth*
Ref.	*Reference*
Rel.	*Relative*
RF	*Radio Frequency*
SSB	*Single Side Band*
SW	*Software*

Supplement to the Operating Manual
for Universal Radio Communication Tester
R&S CMU 200

Addendum to the data sheet, no. 757.4318.25 (1001)

With CMU-U99/-B99 installed, the input/output level range and the input/output level uncertainty for RF1 is the same as for RF2. With CMU-U99/-B99 installed, the VSWR of the RF generator and analyzer at RF1 is as follows:

VSWR at RF1 connector (RF generator and RF analyzer) **page 34**

10 MHz to 2000 MHz	<1.2
2000 MHz to 2200 MHz	**<1.4**
2200 MHz to 2700 MHz	<1.6

Contents

1 Preparation for Use

This chapter describes the controls and connectors of the Universal Radio Communication Tester CMU and gives all information that is necessary to put the instrument into operation and connect external devices. Notes on reinstallation of the CMU software and a description of the *VersionManager* terminate this chapter.

Caution!

Please make sure to observe the instructions of the following sections in order not to cause damage to the instrument or endanger people. This is of particular importance when the instrument is used for the first time. Also observe the general safety instructions at the beginning of this manual.

A more detailed description of the hardware connectors and interfaces can be found in chapter 8. Chapter 2 provides an introduction to the operation of the CMU by means of typical examples of configuration and measurement; for a description of the operating concept refer to chapter 3.

For remote control of the CMU refer to the general description of the SCPI commands, the instrument model, the status reporting system and measurement control in chapter 5.

Front and Rear View

The front panel of the CMU consists of the VGA display with the softkey area (left side) and the hardkey area (right side, see Fig. 1-1). Brief explanations on the controls and connectors of the hardkey area and the rear panel are to be found on the next pages. Operation by means of softkeys is described in chapter 3, *Manual Operation*.

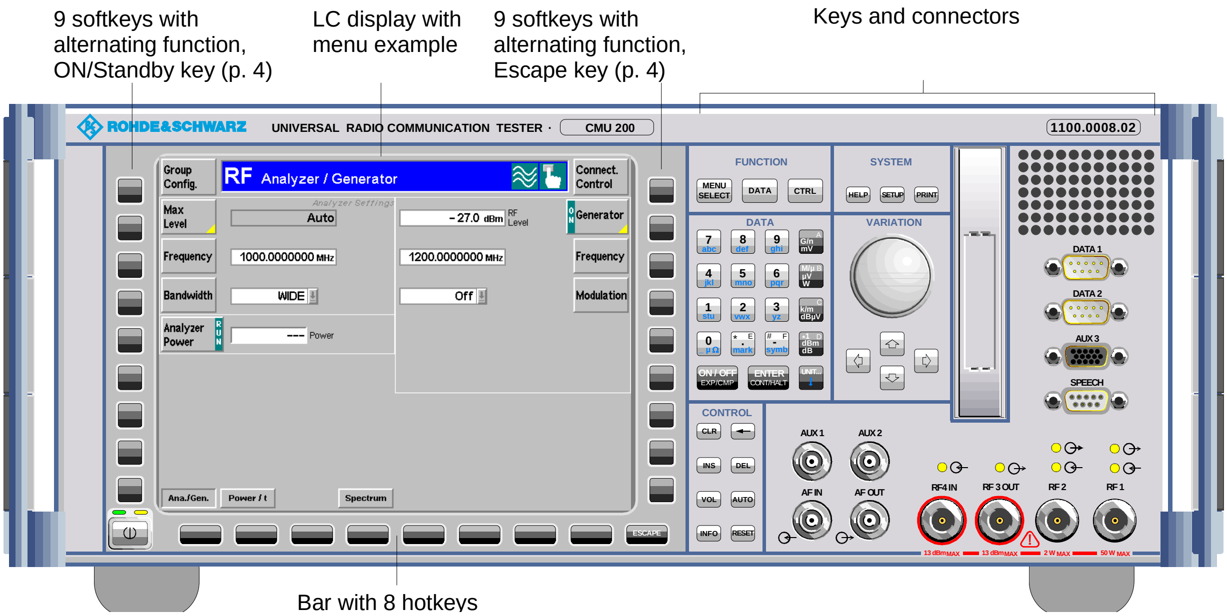


Fig. 1-1 CMU front view

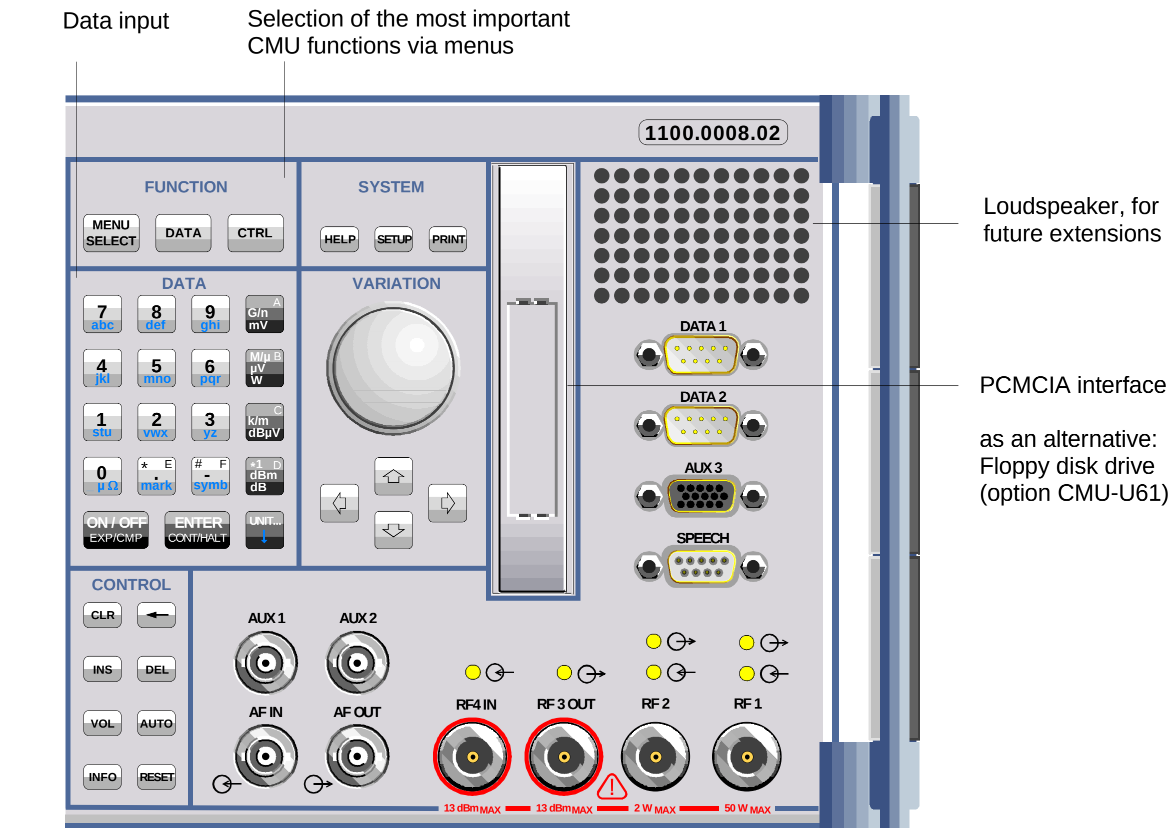
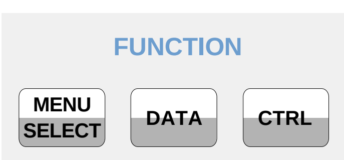


Fig. 1-2 CMU front view – hardkeys

FUNCTION



Preselection of the menus:

MENU SELECT	Menu selection	☞ Chap. 3
DATA	File manager	Chap. 4
CTRL	For future extensions	

DATA

Data input:

0 ... 9	Numerical input (letters for string editors)	☞ Chap. 3
** . E*	Special characters, dec. point, hex value "E"	
# - F	Spec. characters, sign change, hex value "F"	
G/n mV A	Factor $10^{9}/10^{-9}$, unit, hex value "A"	
M/µ µV W	Factor $10^{6}/10^{-6}$, unit, hex value "B"	
k/m dB µV	Factor $10^{3}/10^{-3}$, unit, hex value "C"	
**1 dBm dB*	Factor 10^{0}, unit, hex value "D"	
ON / OFF EXP/COMP	Switching on/off editors/measurements	
ENTER	Confirmation of entry in editors	
CONT/HALT	Calling/quitting editors, measurement control	
UNIT ⇩	For future extensions	

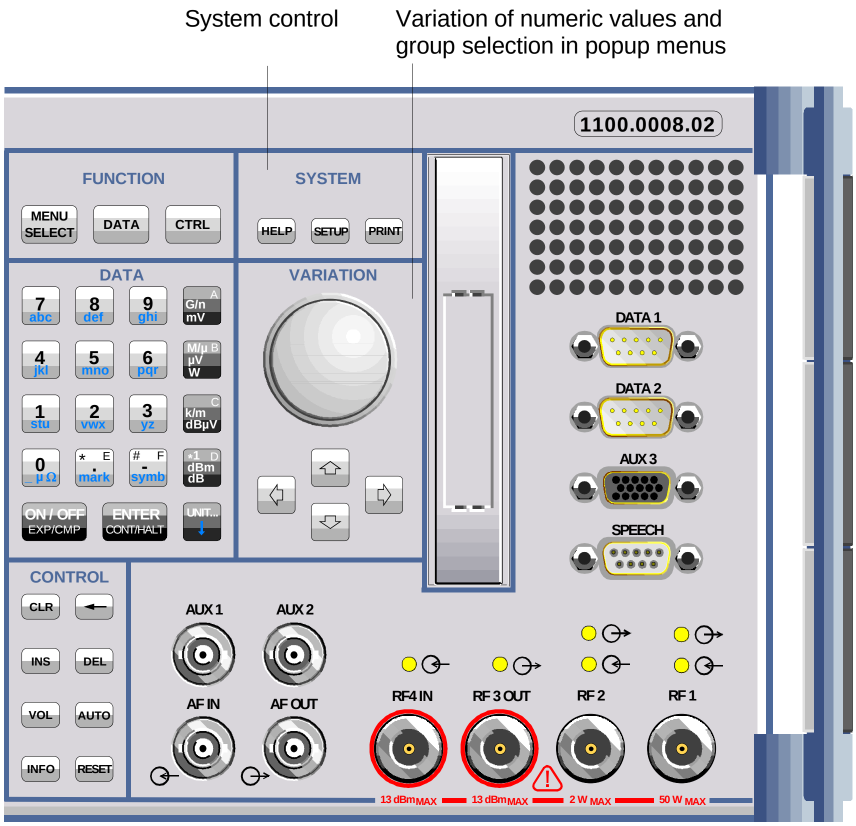
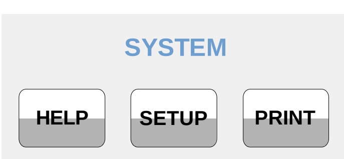


Fig. 1-3 CMU front view – hardkeys

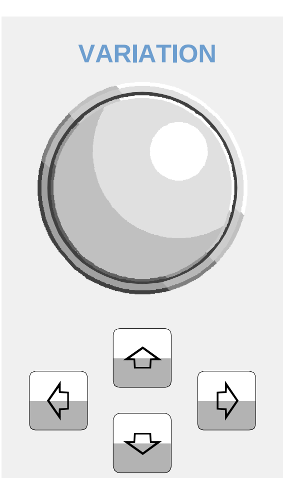
SYSTEM



System control:

HELP	Displays online help	☞ Chap. 3
SETUP	Instrument settings	
PRINT	Initialize printing of a screenshot	

VARIATION



Value variation and group selection:

Rotary knob	Value variation in input fields and parameters, line selection in tables, field selection in popup menus. Press to expand/compress tables and pull-down lists and to confirm entries and selections.	☞ Chap. 3
Cursor key vertical	Group selection in popup menus (vertical)	
Cursor key horizontal	Group selection in popup menus (horizontal), Cursor positioning in editors and tables	

Extended editor and instrument control functions

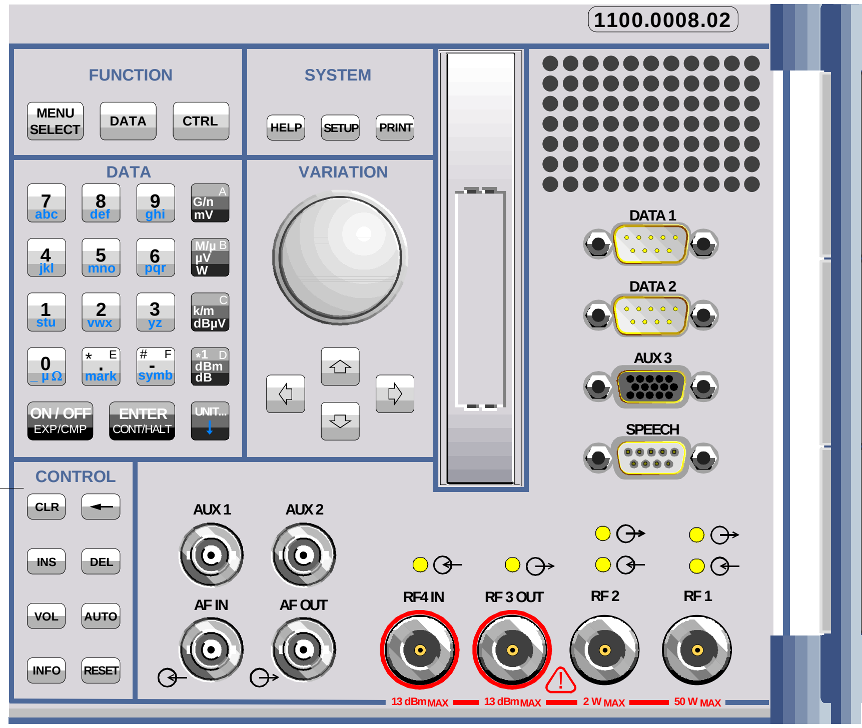


Fig. 1-4 CMU front view – hardkeys

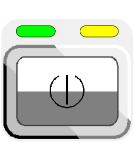
CONTROL

Extended control functions: ☞ Chap. 3

CLR	Clears the complete editor string
⇦	Deletes the character to the left of the cursor (back space)
INS	Changes between insertion and overwriting in the editor
DEL	Deletes the character marked by the cursor
VOL	For future extensions
AUTO	For future extensions
INFO	System info and hardware diagnosis
RESET	Resets to default values

Further Keys

ESCAPE Quits popup menus, closes an editor discarding the entries made ☞ Chap. 3



ON/STANDBY Switches between operation (green LED) and standby (orange LED)

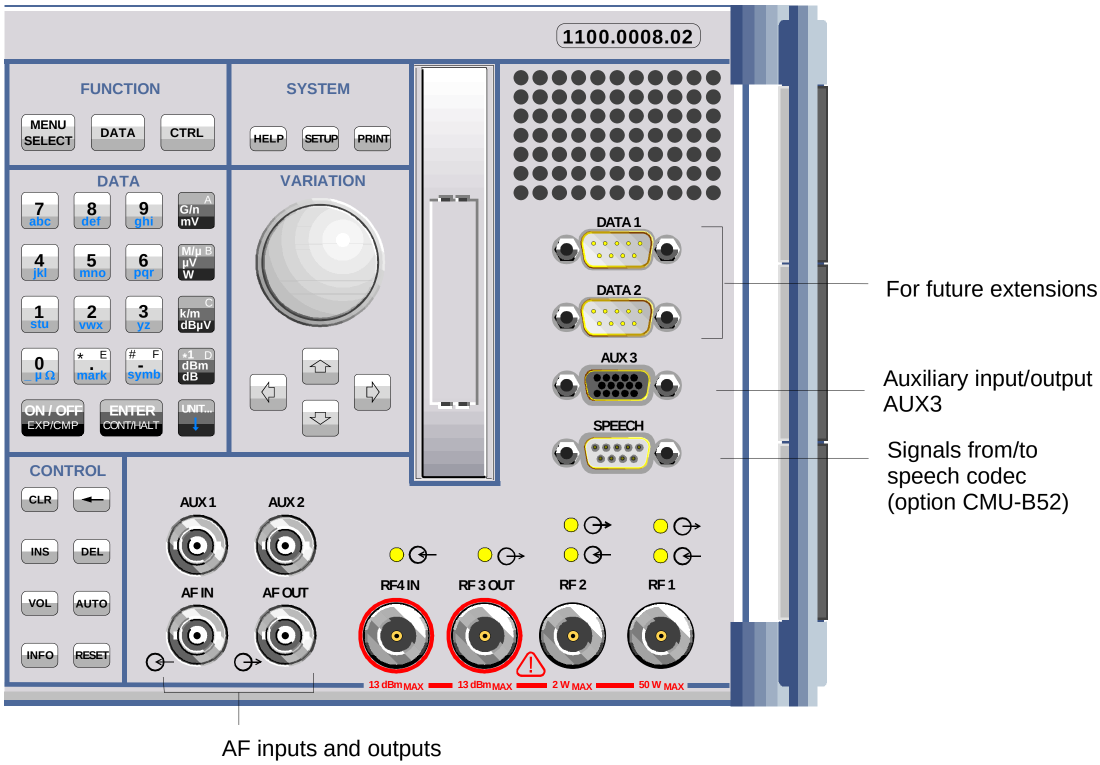
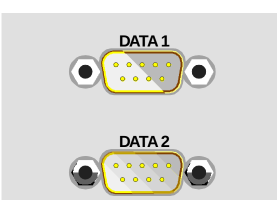


Fig. 1-5 CMU front view connectors

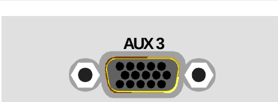
DATA1, DATA2



For future extensions

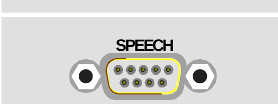
☞ Chapter 8, "Hardware connectors"

AUX 3 and SPEECH



Input/output for timing and external trigger signal
CMU300: External trigger signal for wired synchronization

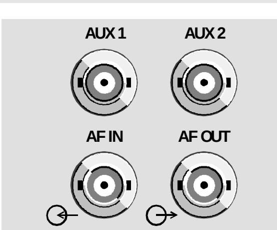
☞ Chapter 8, "Hardware connectors "



Signals from/to speech codec (option CMU-B52)

☞ Chapter 8, "Hardware connectors"

AF connectors



Connectors for audio signals:

AUX1/2 Additional input/output for audio signals that may be used in remote control (secondary audio analyzer)

AF IN/OUT Standard input/output for the (primary) audio analyzer

☞ Chapter 4, "Audio Generator and Analyzer"; Chapter 8, "Hardware connectors"

Caution: *Note the maximum permissible input levels for all AF connectors according to the data sheet in order to prevent damage to the instrument!*

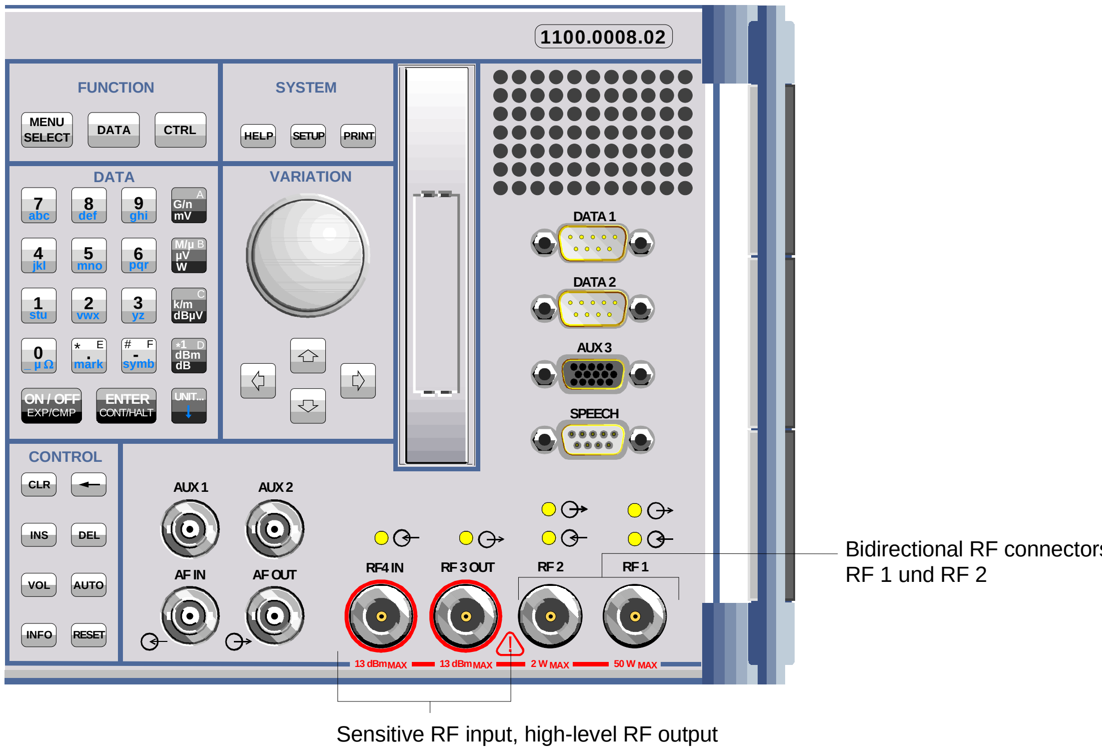
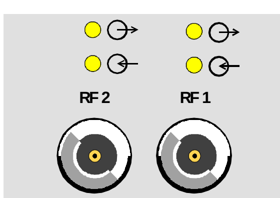


Fig. 1-6 CMU front view– connectors

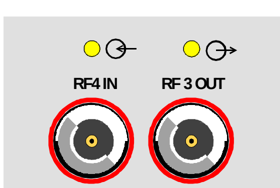
RF connectors



Bidirectional RF connectors for various power ranges according to the data sheet.

The two LEDs above the connectors are illuminated as long as the CMU sends signals or is ready for reception.

Chapter 8, "Hardware connectors "



Connector with high output level and connector for sensitive RF measurements (antennas). Power ranges according to the data sheet. Maximum permissible input and output level according to the label on the front panel.

Chapter 8, "Hardware connectors"

The two LEDs above the connectors are illuminated as long as the CMU sends signals or is ready for reception.

Caution:

Note the maximum permissible input levels for all RF connectors according to the label on the front panel or the data sheet in order to prevent damage to the instrument!

RF connectors may warm up very much when high RF power is fed in!

Rear View

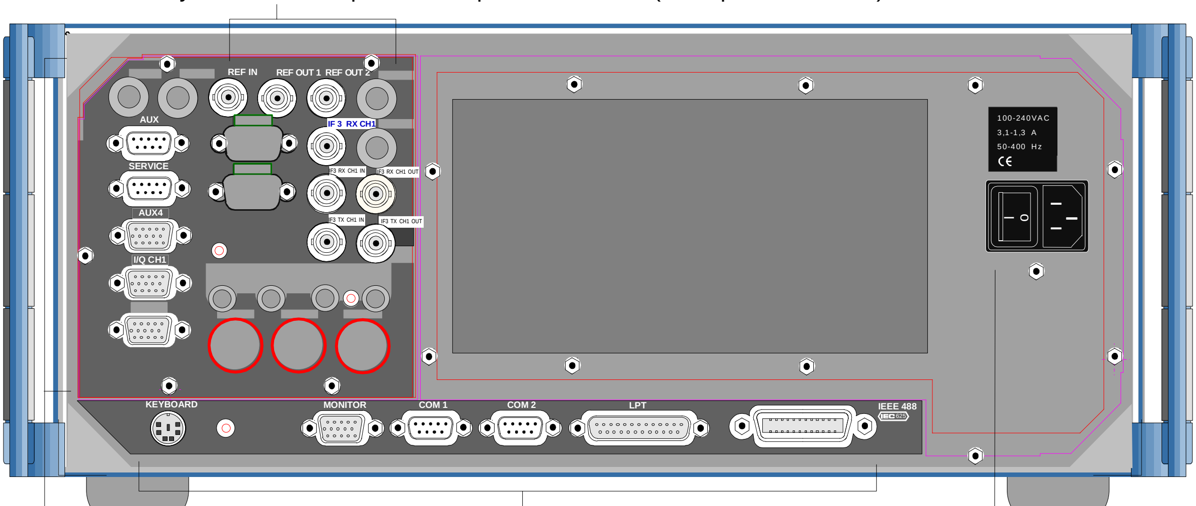
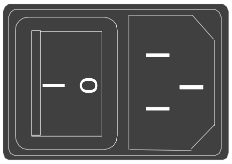
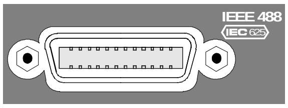
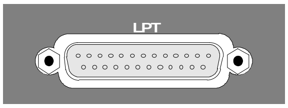
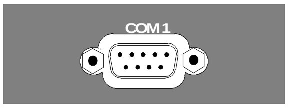
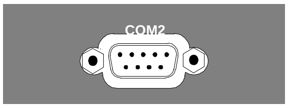
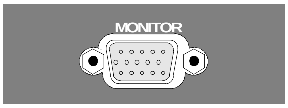
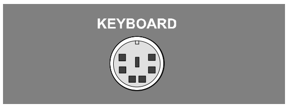


Fig. 1-7 CMU rear view

Mains switch

	Mains power switch	☞	Chapter 1, "Switching on the Instrument, Startup test"
	Mains connector	☞	Chapter 1, "Connecting the instrument to the AC supply"

Interfaces

	GPIB-bus connector (IEEE 488 / IEC 625),	☞	Chapter 8, "Hardware Interfaces "
	Parallel interface: 25-contact printer connector, Centronics-compatible	☞	Chapt. 1, "Connecting an Output Device" Chapter 8, "Hardware Interfaces"
	Connector for serial interface 1: 9-contact Sub-D connector	☞	Chapter 8, "Hardware Interfaces"
	Connector for serial interface 2: 9-contact Sub-D connector	☞	Chapter 8, "Hardware Interfaces"
	Connector for an external VGA monitor: 15-contact Sub-D connector	☞	Chapter 1, "Connecting a Monitor" Chapter 8, "Hardware Interfaces"
	Connector for external keyboard (PS/2), 6-contact Mini DIN connector	☞	Chapter 1, "Connecting an External Keyboard" Chapter. 8, "Hardware Interfaces"

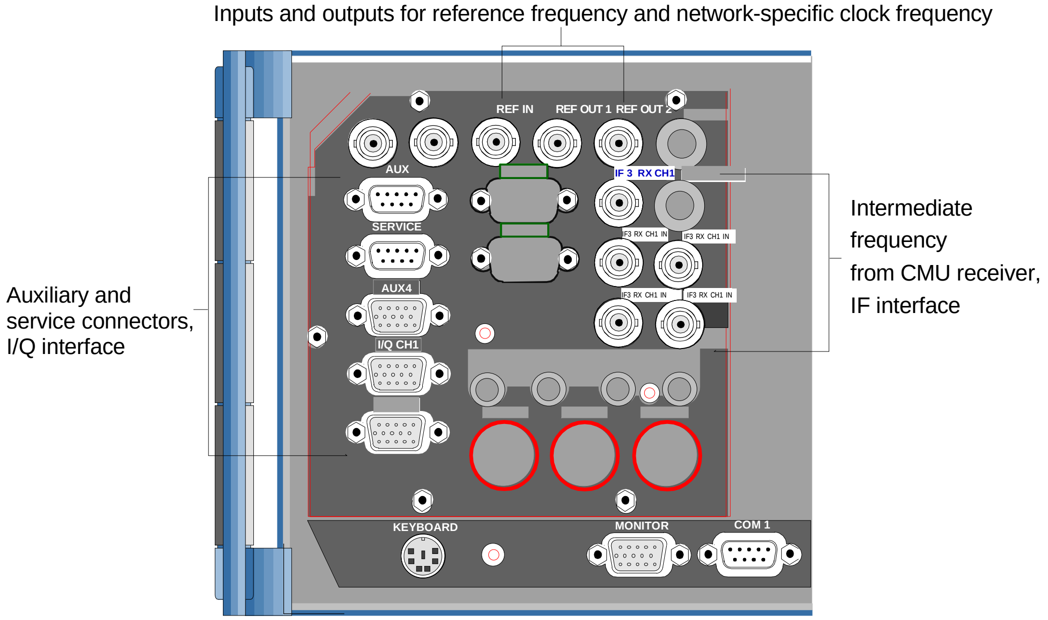
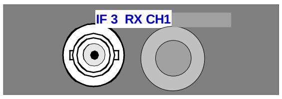


Fig. 1-8 CMU rear view – signal inputs and outputs

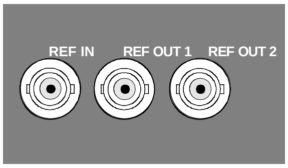
Intermediate frequency



IF3 RX CH1 (BNC connector) from CMU receiver

Chapter 8, "Hardware Connectors"

Reference frequency

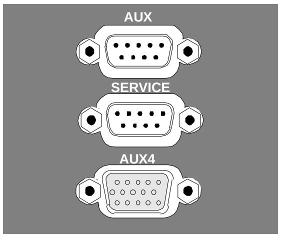


REF IN	Input for external reference frequency	Chapter 8, "Hardware Connectors
REF OUT 1	Output of reference frequency of CMU: 10 MHz or the signal of input REF IN	
REF OUT 2	Output for network-specific clock frequency	Chapter 3, "RF Connection Control"

Caution!

Do not use open or unshielded cables in order to comply with EMC directives!

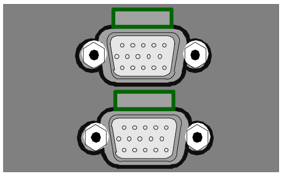
AUX, SERVICE, AUX4, extensions



Two 9-contact and one 15-contact SUB-D connectors:

AUX	Auxiliary connector providing a DC voltage to supply external equipment such as CMU-Z6
SERVICE	Service connector for RXTX board (only for internal test purposes)
AUX4	Bidirectional input/output for digital status, control, and trigger signal

Chapter 8, "Hardware Connectors



The remaining 15-contact SUB-D connectors are reserved for future extensions.

Chapter 8, "Hardware Connectors

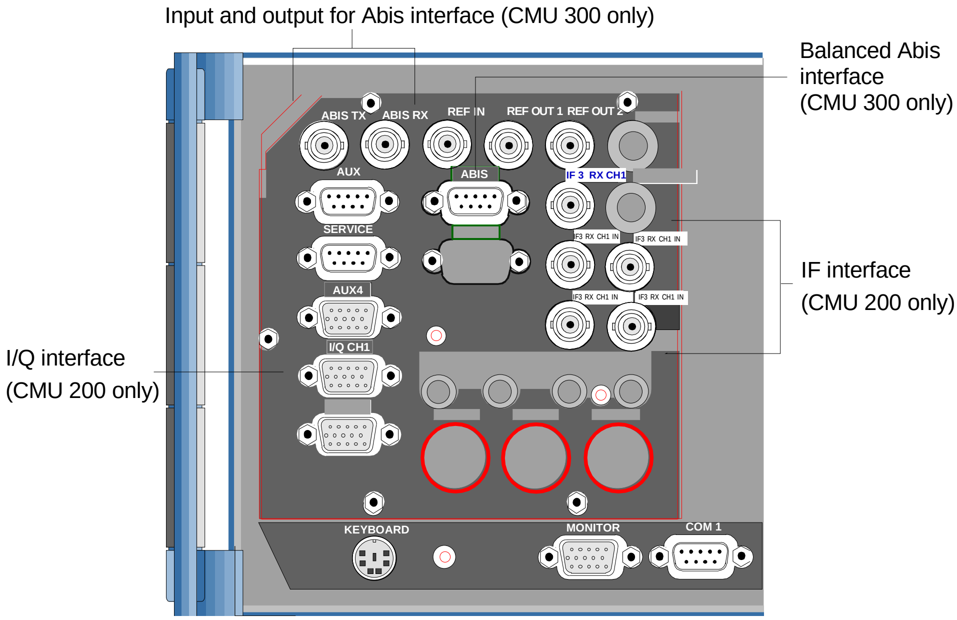
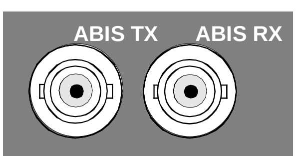


Fig. 1-9 CMU rear view – Abis and I/Q-IF inputs and outputs

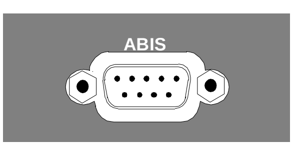
Abis connectors (CMU300 with option CMU-B71)



Two 75 Ω BNC connectors for option CMU-B71, *Abis Interface Unit for CMU* (for CMU300 only):

ABIS TX	For future extensions
ABIS RX	Input for PCM signals from a BTS under test to be applied to the CMU's Abis interface

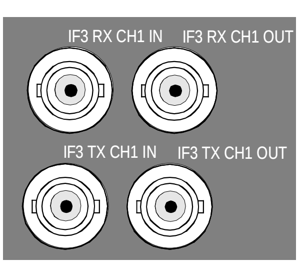
☞ Operating manual CMU-K30/-K31/-K32/-K33/-K34



9-contact SUB-D connector with alternative 120 Ω balanced input for Abis interface .

☞ Chapter 8, "Hardware Connectors"

I/Q-IF Interface (CMU200 with option CMU-B17)

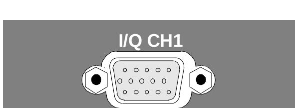


Four 50 Ω BNC connectors for option CMU-B17, *I/Q and IF Interface* (for CMU200 only):

IF3 RX CH1 IN	RX path, IF IN
IF3 RX CH1 OUT	RX path, IF OUT
IF3 TX CH1 IN	TX path, IF IN
IF3 TX CH1 OUT	TX path, IF OUT

☞ Chapter 4, "Hardware Connectors"

Chapter 8, "Hardware Connectors"



15-contact SUB-D connector for input and output of I/Q signals (option CMU-B17, *I/Q and IF Interface,* for CMU200 only)

☞ Chapter 8, "Hardware Connectors"

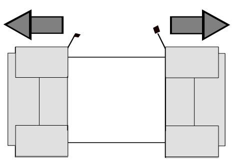
Note: *The CMU is delivered with different rear panel designs, however, the names of the connectors are unambiguous and used irrespective of the design.*

Putting the Instrument into Operation

Caution!

Please make sure to follow the instructions of the following sections in order not to cause damage to the instrument or endanger people. This is of particular importance when using the instrument for the first time.

Unpacking the Instrument



remove protective cabs

- ➢ Take the instrument out of the shipping box and check whether the items listed in the packing list (see separate yellow sheet after the title page of this manual) are all included.
- ➢ Remove the two protective caps from the front and rear of the CMU and carefully check the instrument for damage.

Should the instrument be damaged, immediately notify the forwarder who shipped the instrument to you and keep the box and packing material.

For further transport or shipment of the CMU the original packing should be used, too. It is recommended to keep at least the two protective caps for front and rear side in order to prevent damage to the controls and connectors. The caps are also necessary if the CMU is transported in its transit case that can be ordered from Rohde & Schwarz.

Setting up the Instrument

Permissible operating positions of the CMU

- Horizontal position, standing on the feet.
- For applications in the laboratory or on a work bench, it is recommended that the support feet on the bottom of the instrument be extended. For the LCD display, this provides the optimum viewing angle which typically ranges from perpendicular to the display front to approximately 30° below.

Warning!

The feet must be fully folded in or out. Only in this way can the stability of CMU be guaranteed and reliable operation be ensured. With the feet out, the weight of other units put onto CMU must not exceed 30 kg. The units must be secured against slipping (e.g. by locking the feet of the unit at the top side of the enclosure).

When moving the unit with the feet out, the feet might collapse and fold in. To avoid injuries, the unit must therefore not be moved with the feet out.

Notes: *For safe and convenient operation of the instrument note the following:*

- ➢ Do not cover the rear and lateral ventilation holes.
- ➢ Note the permissible ambient temperature according to the data sheet.
- ➢ Avoid moisture condensation. If it however occurs, the instrument must be wiped dry before switching on.
- ➢ Note the warm-up time of the temperature-controlled OCXO reference oscillator (Option CMU-B11/B12), see data sheet.

Mounting in a Rack

Using the adapter ZZA-411 (order number 1096.3283.00) the instrument can be mounted in 19" racks according to the mounting instructions supplied with the rack adapter.

Note: *For convenient operation of the instrument note the following:*

- Allow for sufficient air supply in the rack.
- Make sure that there is sufficient space between the ventilation holes and the rack casing.

Connecting the Instrument to the AC Supply

Caution!

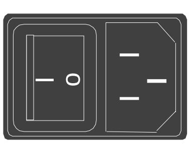
After moisture condensation, allow the instrument to dry before switching on.

Note the permissible ambient temperature according to the data sheet.

Do not cover the lateral and rear ventilation holes.

The CMU may be connected to one-phase AC supplies with nominal voltages ranging from 100 V to 240 V and nominal frequencies ranging from 50 Hz to 400 Hz (see inscription on the rear panel and data sheet). Depending on the options installed, the power consumption ranges from 120 W to 230 W.

Note: *The CMU is automatically adapted to the AC supply voltage applied. External switchover or adaptation of the fuses are not necessary.*



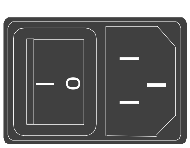
Mains connector

For the mains connection use the supplied mains connector.

As the instrument is designed according to the regulations for safety class EN61010, it must be connected to a power outlet with earthing contact.

Switching on the Instrument / Startup Test

The CMU can be switched on using the mains switch at the rear of the instrument and the *ON/STANDBY* key at the bottom left of the instrument front.

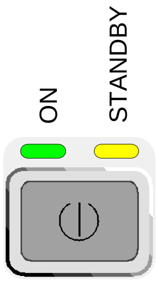


Mains switch

The *mains switch* can be set to two positions:

0 The *0* position implies an all-pole disconnection of the instrument from the mains.

I In the *I* position, the instrument is in standby mode or in operation, depending on the position of the ON/STANDBY key at the front of the instrument.



ON/ STANDBY key

The *ON/STANDBY* key activates two different operating modes indicated by colored LEDs:

Standby Only the OCXO reference frequency oscillator (Option CMU-B11/B12), if installed, is supplied with operating voltage. The orange LED (STANDBY) on the right is illuminated.

Operation In this operating mode, all modules of the instrument are supplied with operating voltage. The green LED (ON) on the left is illuminated.

Start procedure

➢ To switch on the CMU set the mains switch to the position I.

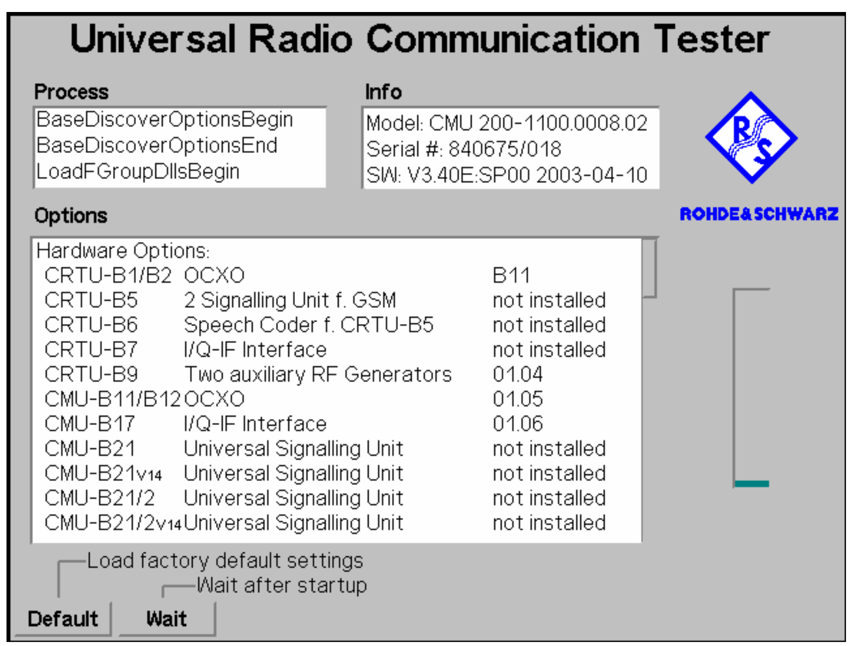
The CMU enters standby mode.

➢ Set the CMU to operating mode by pressing the *ON/STANDBY* key once.

Caution! *When switching on the CMU, no disk should be inserted in the drive; otherwise, one of the actions stored on the flash disk will be performed.*

Startup menu

After activation of the operating mode, the startup menu appears for a few seconds. While it is displayed the CMU performs a startup test.



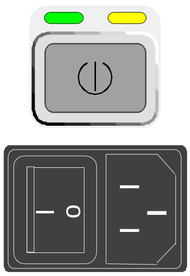
Displays in startup menu

The display windows of the startup menu provide information on

- 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).

After terminating the startup procedure, the instrument changes to the last main menu or graphical measurement menu of the previous session.

Switching off the Instrument



In order not to lose any settings that have been made, proceed in the following order to switch off the CMU:

- ➢ Remove any storage medium from the PCMCIA interface or floppy disk drive.
- ➢ **Shortly** press *ON/STANDBY* to initiate the shutdown process and save the current data to the internal hard disk.
- ➢ Wait until the shutdown process has been terminated before setting the mains switch at the rear to the 0 position.

Note: *Instruments equipped with a Front Module controller FMR 6 display the message* Shutdown in Progress *after the ON/STANDBY key has been pressed. Keeping ON/STANDBY pressed for about 4 s on those instruments initiates a hardware shutdown where data may be lost.*

How to Ensure EMC

In order to avoid electromagnetic interference, the instrument may only be operated when it is closed and with all shielding covers fitted. Only appropriate shielded signal and control cables may be used.

Input Level

Caution!

– *In order to prevent damage to the instrument note the maximum permissible input levels at the AF inputs AF IN and AUX 1 as well as for the RF inputs RF 1, RF 2 and RF 4 IN at the front of the instrument.*

Connecting the CMU to the Test Setup

Warning:

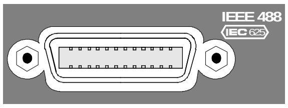
Connect external devices and peripherals only when the instrument is switched off or in STANDBY mode. Otherwise, future errors cannot be excluded.

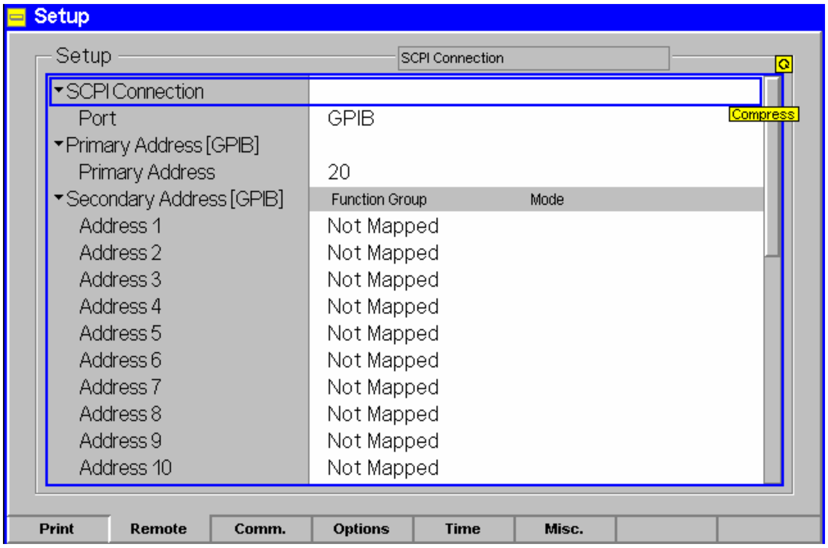
Connecting a Controller

The CMU can be connected to an external controller via the GPIB bus (IEEE bus according to standard IEEE 488; throughout this documentation we will primarily use the term GPIB bus which is also used in the operating menus and in the SCPI command syntax) or via serial interface:

Connection via GPIB bus

The CMU is connected to the GPIB interface of the controller via the GPIB bus connector (IEEE 488 / IEC 625) at the rear of the instrument and a shielded cable. The technical specifications of the GPIB interface are listed in section "Hardware Interfaces " in Chapter 8.





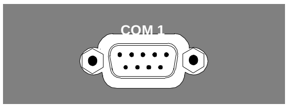
GPIB Bus Configuration

The parameters for GPIB bus control of the CMU are set in the *Remote* tab of the *Setup* popup menu (in the following abbreviated by *Setup – Remote,* see also chapter 4, *Settings for Remote Control*).

- ➢ To open the *Setup - Remote* menu, press the *SETUP* key at the front of the instrument and activate the *Remote* hotkey at the lower edge of the screen.
- ➢ Use the rotary knob to move the focus onto the *SCPI Connection* section of the *Setup* table. If necessary, press the rotary knob or the *ON/OFF* key to expand the parameters in the table (see Chapter 3).
- ➢ In the *Port* table row select the *GPIB* bus interface for transmission.

The bus address is factory-set to 20. It can be changed in the *Primary Address* input field.

Connection via serial interface



The CMU can be connected to the serial interface of a controller via one of the serial interfaces COM 1 or COM 2 and a so-called null-modem cable. The pin assignment and wiring of a null-modem cable are described in section *Handshake* of chapter 8. The technical specifications of the serial (RS-232-C) interface are also discussed in chapter 8 (refer to section *Hardware Interfaces*).

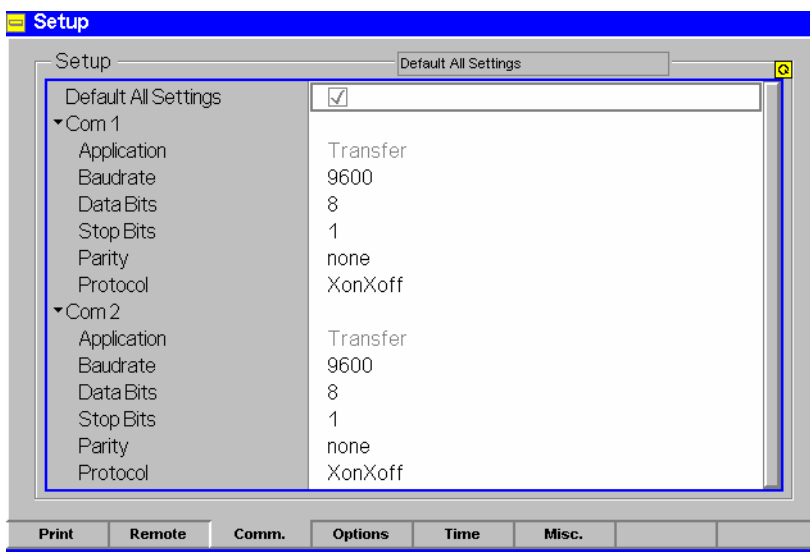
Either a 25-pin or a 9-pin connector can be used on the controller side. It may be necessary to use an appropriate adapter (see chapter 8, *Hardware Interfaces*).

Selection

- ➢ Proceed as described above to activate the *Remote* tab of the *Setup* menu.
- ➢ In the *Port* table row, select COM 1 or COM 2 to activate one of the RS-232 interfaces for data transfer.

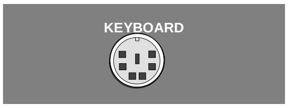
Configuration

After selection of a serial interface, the transmission parameters must be set to comply with the parameters of the addressed device. This is done in *the Comm. (communications)* tab of the *Setup* menu:



- ➢ To open the *Setup – Comm.* tab press the *SETUP* key at the front of the instrument and activate the *Comm.* hotkey at the lower edge of the screen.
- ➢ In the table section corresponding to the selected COM port check the settings for the *Baudrate, Data Bits, Parity,* and *Protocol.*

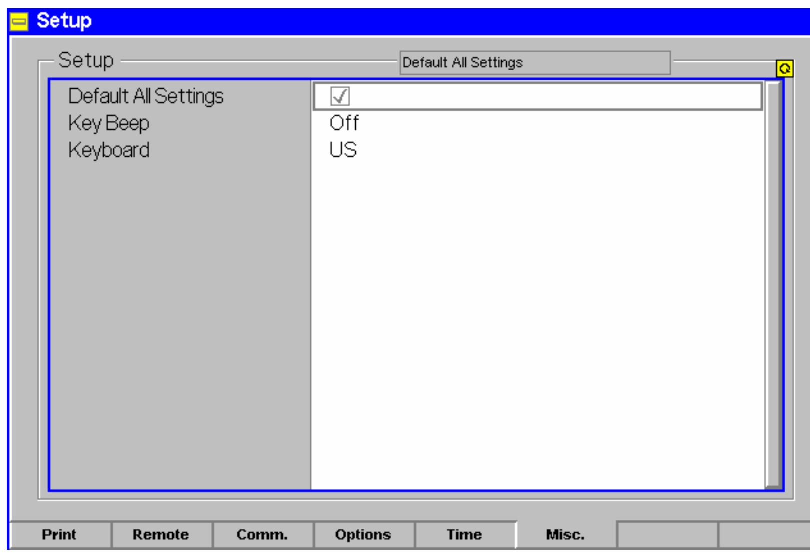
Connecting an External Keyboard



The 6-contact Mini DIN connector at the rear of the instrument permits to connect an external PC keyboard (PS/2) to the CMU. An external keyboard facilitates the input of numbers and texts.

For the interface description see section "Hardware Interfaces" in chapter 8.

The assignment of the keys can be changed in the *Misc.* tab of the *Setup* menu:

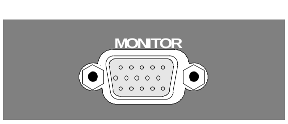


Language assignment

➢ To open the *Setup – Misc.* tab press the *SETUP* key at the front of the instrument and activate the *Misc.* hotkey at the lower edge of the screen.

➢ Press the *Keyboard* softkey and set the desired key assignment *(US* or *German).*

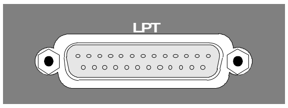
Connecting a Monitor



The 15-contact Sub-D connector at the rear of the instrument permits an external VGA monitor to be connected to the CMU.

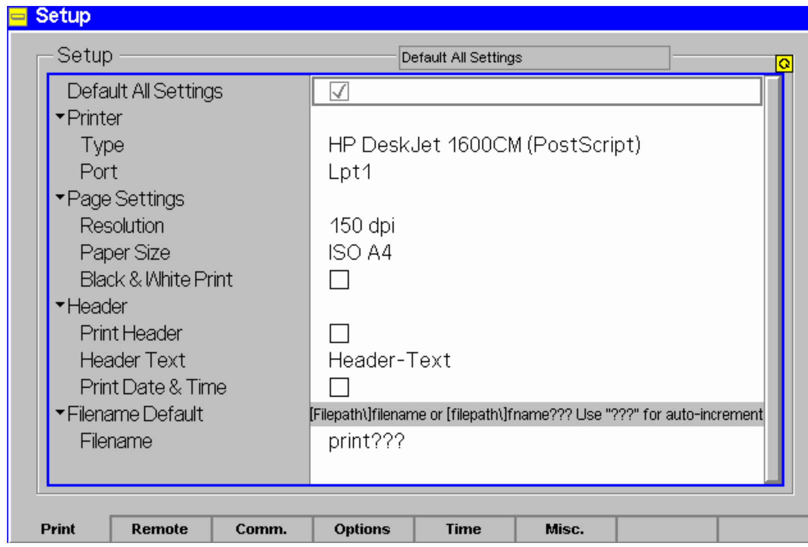
For the interface description see section "Hardware Interfaces" in chapter 8.

Connecting a Printer



A printer can be connected via the 25-contact parallel interface *LPT* at the rear of the instrument (recommended) or one of the serial interfaces COM 1 or COM 2. For the interface description see section "Hardware Interfaces" in chapter 8.

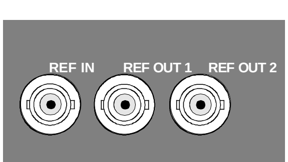
The printer type and port must be set in the *Print* tab of the *Setup* menu:



- ➢ To open the *Setup – Print* tab press the *SETUP* key at the front of the instrument and activate the *Print* hotkey at the lower edge of the screen.
- ➢ In the *Printer* section set the printer type and port *(COM 1* or *COM 2* for the serial (RS-232) ports; *LPT 1* for the parallel printer port).

It is recommended to connect the output device to the parallel interface *LPT*, if possible: With this selection, configuration of the interface is not necessary; besides, the serial connectors may be used for GPIB bus etc.

Synchronization with External Devices; Connection of Further Components



The three BNC female connectors REF IN, REF OUT 1, REF OUT 2 are provided for synchronization of the CMU with external devices.

Software Update and Version Management

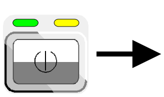
Your CMU was delivered with the latest software and firmware version available. New firmware can be easily installed via the floppy disk drive (option CMU-U61) or the PCMCIA interface on the front of the instrument. In this case, the additional software options must be enabled by means of a key code entered in the *Setup – Options* menu (see chapter 4).

Installation of new firmware versions and the use of different applications and versions on the same instrument is made easier by the *VersionManager* described in the following section. Installation instructions are also given in chapter 1 of the operating manuals for the individual software options.

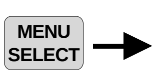
CMU VersionManager

The *VersionManager* is a tool designed to activate, delete, install, combine, or list different software versions in a convenient way. Moreover, it provides information on the hardware and software configuration of the instrument *(Edit service tables, Scan disk)*, resets the startup settings stored in the *non volatile ram,* copies information to an external storage medium *(Write log files to disk, List all versions to disk),* and loads and activates user correction tables (see section RF User Correction on p. 1.27 ff.).

The *VersionManager* is part of each CMU firmware version. It is opened automatically after the boot-up process if the CMU detects a storage medium in its floppy disk drive/PCMCIA slot that contains an installation version of the CMU firmware. Alternatively, it can be called up by pressing the *Menu Select* key after the boot-up sequence is terminated (from the moment when the CMU display turns black until the end of the 3-beep acoustic signal).



with floppy / PCMCIA card or



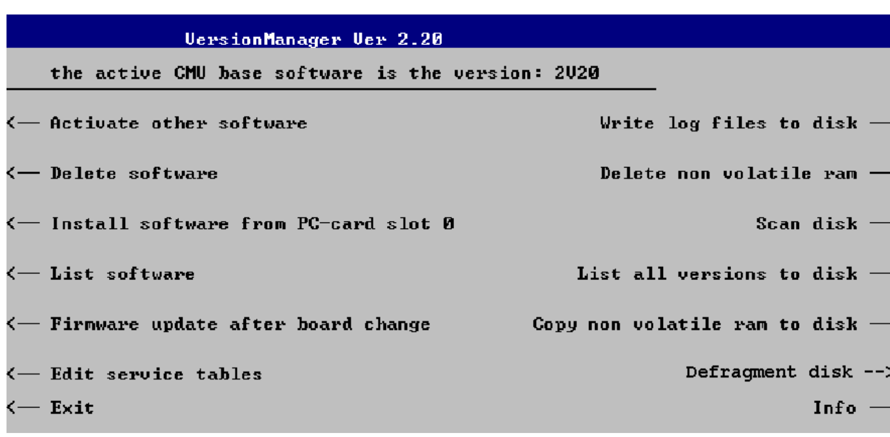
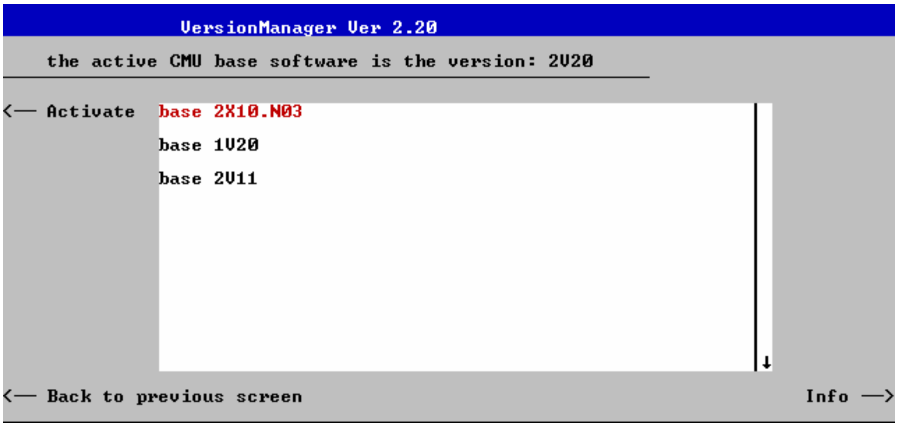


Fig. 1-9 VersionManager main screen (example)

The different functions of the *VersionManager* are activated by pressing the corresponding softkeys. Some of them (labeled optional below) are available in a particular configuration of the hard disk only. The upper two softkeys in both softkey bars are not assigned.

Activate other software (optional)

Activate other software opens a list of all firmware configurations stored on the CMU hard disk except the current configuration. Therefore, this function is not available if the hard disk contains only a single configuration (to retrieve information, *List software* can be used instead).

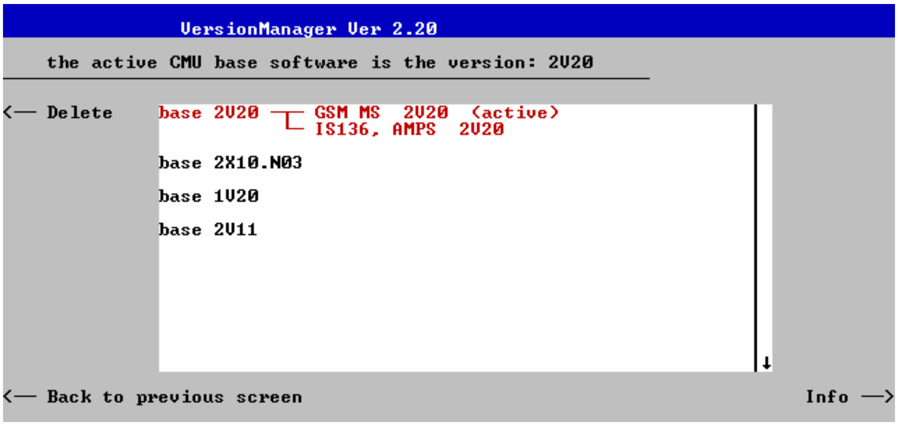


Each entry in the list corresponds to a firmware configuration consisting of exactly one CMU base software version (top level on the left side) plus a set of associated options[1] (network tests, second level). The version to be activated is displayed in red color on top of the list. To select another version, the list can be scrolled using the rotary knob or the cursor keys.

Activate	Activate the current firmware configuration.
Back to previous screen	Close the current screen and go back to the main screen. This option is identical in all *VersionManager* submenus.
Info	Open the *Info* screen associated to the current screen; see *Info on* p. 1.25. This option is identical in all *VersionManager* submenus.

Delete software (optional)

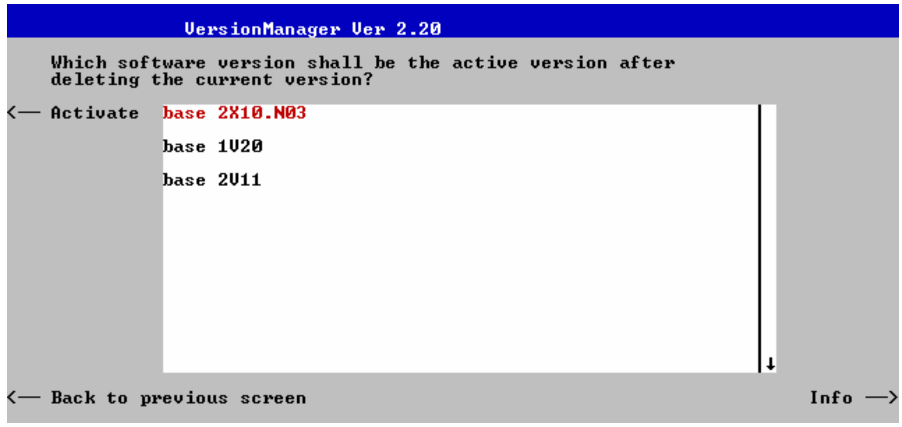
Delete software opens a list of all firmware configurations stored on the CMU hard disk. The dialog can be operated as explained above; see *Activate software*. The last firmware configuration can not be deleted, so this function is not available if the hard disk contains only a single configuration.



Delete	Delete the current firmware configuration.

If the active firmware configuration is deleted, the CMU asks which of the remaining versions shall be activated:

[1] Several related options may be displayed in a single line. These combinations of options can be installed together and will be simply referred to as "options" through the remainder of this section.



Activate Activate the current firmware configuration.

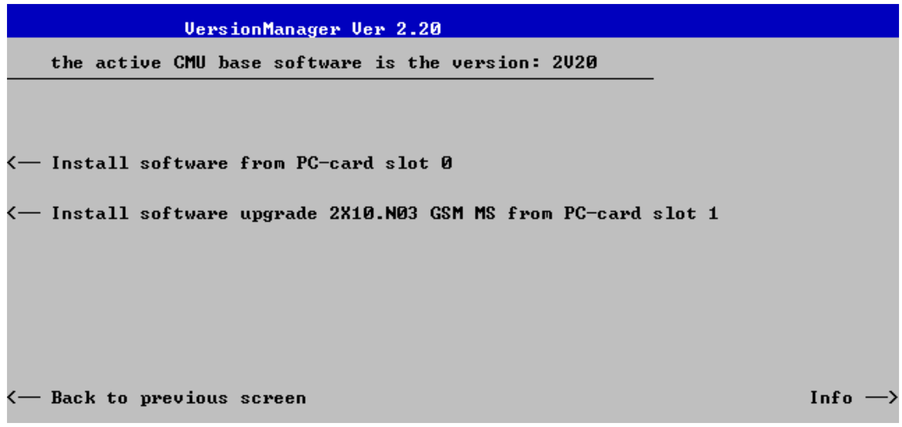
Install software... *Install software...* opens a list of all firmware installation versions available on an external storage medium (floppy disk/PCMCIA card). As explained in *Table 1-1*, this function depends on the type and number of storage media and on the number of installation versions available.

Table 1-1 Software installation with the *VersionManager*

Storage medium with FW installation version[2]	Number of FW installation versions	VersionManager function
Floppy	1	*Install software version <version> from floppy*
	several	*Install software from floppy* –> Open software version selection dialog (see below).
PCMCIA card in slot 0 or 1 (right or left side)	1	*Install software version <version> from PC-card slot <slot_no>*
	several	*Install software from PC-card slot <slot_no>* –> Open software version selection dialog (see below).
PCMCIA card in slot 0 and in slot 1	1 (per PC-card)	*Install software version <version> from PC-card* –> Open PC-card selection dialog (see below).
	several	*Install software from PC-card* –> Open PC-card selection dialog (see below).

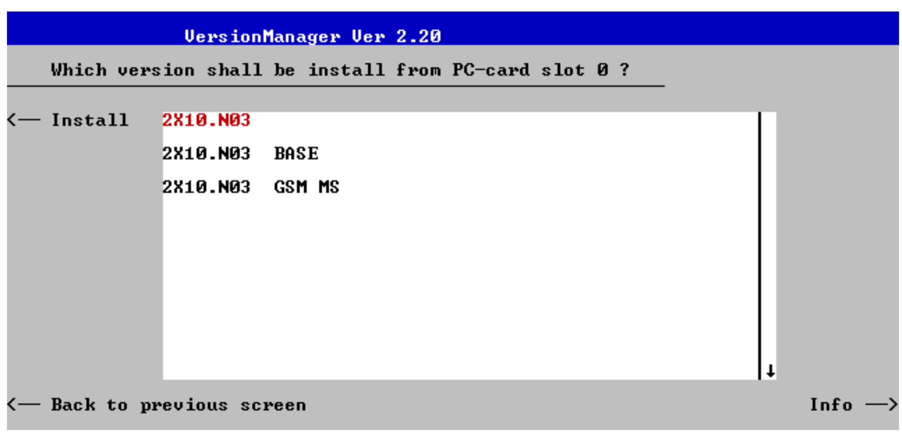
PC-card selection dialog: The *PC-card* selection dialog selects either PCMCIA card slot 0 (right side) or slot 1 (left side) for installation.

[2] Media without FW installation versions are ignored.



Install software... Select the card in slot 0 or slot 1 as an installation medium. If the medium contains several installation versions, the *software version* selection dialog is called up, see below.

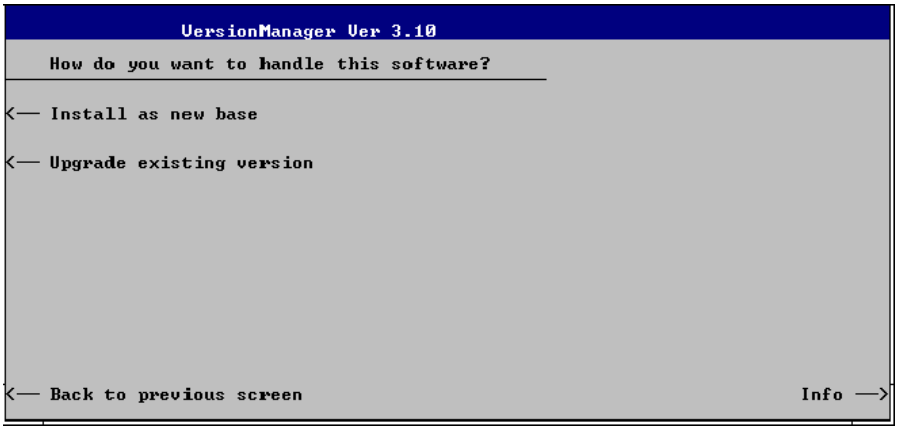
Software version selection dialog: The *software version* selection dialog lists all installation versions on the current medium (floppy, PCMCIA card). The dialog can be operated as explained above; see *Activate software*.



Install Install the current firmware version.

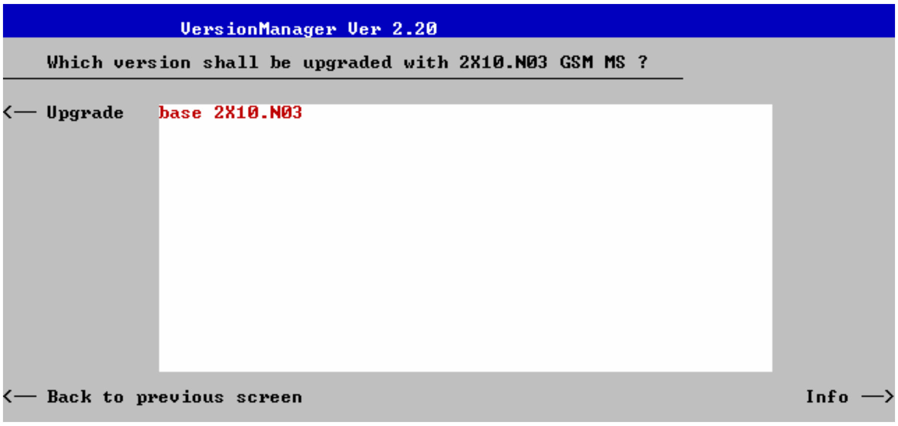
Upgrade options: In contrast to the *Activate software* dialog, the software selection dialog handles base software versions and network options separately. As a consequence, different versions of the base software can be combined with different options to create new firmware configurations. For example, 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. The following simple rules apply:

- With a new version of a network option, it is only possible to update one of the existing configurations. The following selection dialog is automatically skipped.
- 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:



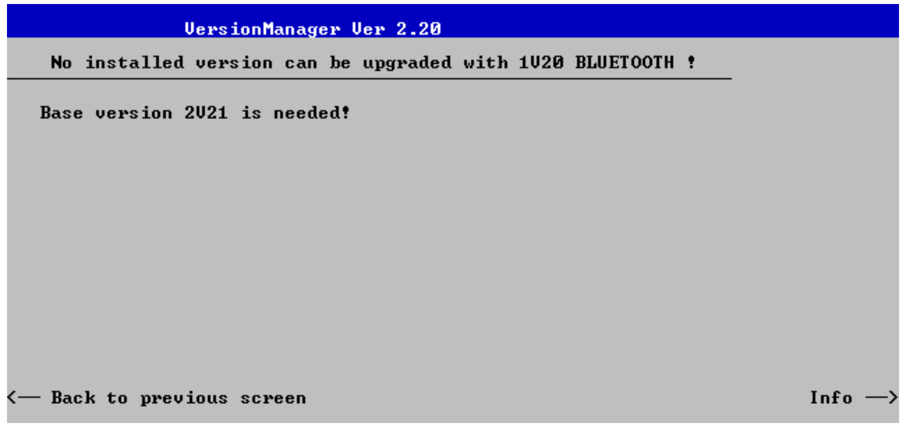
Note:	*This dialog is skipped if the new base software version is not compatible with any of the existing configurations. An incompatible new base software must be installed as a new base software.*
Install as new base	Create a new configuration based on the base software to be installed. The upgrade selection dialog described below is skipped. Network options can be assigned to this base software in a second stage of the installation.
Upgrade existing v.	Select an existing configuration and replace the base software of this version. To this end, the upgrade selection dialog described below is opened.
Force verm update	If the option is checked the current *VersionManager* is overwritten every time that a new base system is installed, even if this means a downgrade of the *VersionManager* version. This feature is primarily for service purposes.

After selection of an upgrade software version compatible with one of the configurations stored on the hard disk, the upgrade selection dialog is called up:



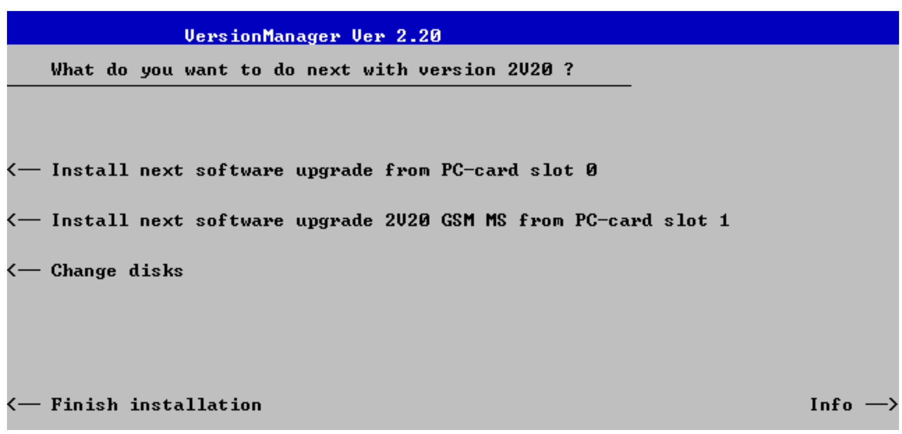
Upgrade	Replace the base software version or network option selected in the *software version* selection dialog.

Alternatively, if none of the configurations stored on the hard disk is compatible with the software version selected, an error message is displayed. E.g., for an incompatible Bluetooth version:



Back to... Close the current screen and go back to the *software version* selection dialog to select a compatible software version.

Terminating the software update: After successful installation of each software version the CMU displays the following screen:

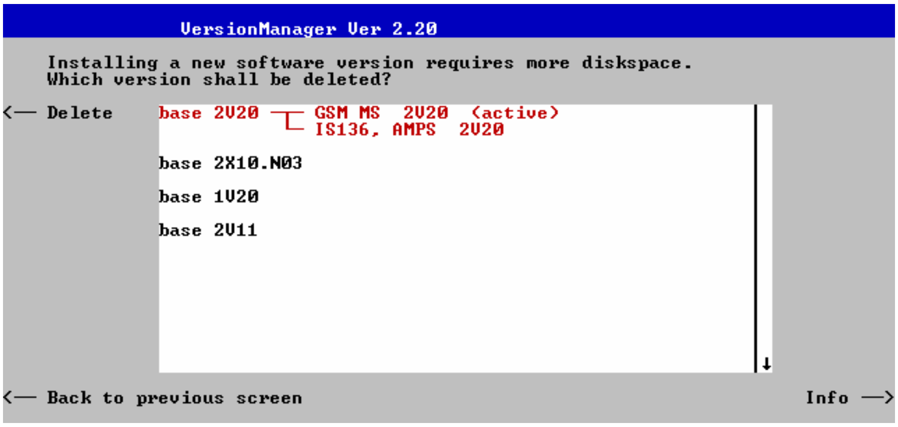


Install next software... Go back to the *software version* selection dialog to select additional software modules to be installed in the same *VersionManager* session. This function depends on the storage media and the number of software installation versions available; see *Table 1-1* on page 1.20.

Change disks Update the current screen after a change of the storage medium.

Finish installation Close the *VersionManager* and reboot the CMU (remove the external disk from the disk drive). The installed firmware configurations are then operational. The last configuration installed is taken as the active configuration in the subsequent measurement session.

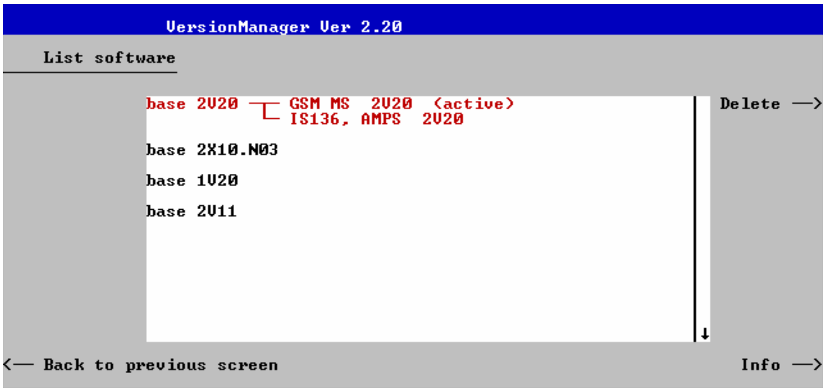
Lack of disk space: Before installing the next software version, the CMU checks whether there is enough disk space on the hard disk. If not, the following dialog is displayed:



Delete Delete the current version and return back to the previous screen.

List software

List software opens a list of all available firmware configurations. It is possible to activate and delete configurations from the list; see description of *Activate software* and *Delete software* functions above.



Firmware update after board change(…)

This function depends on whether a user correction file named *USERCOR1.DAT* is stored in the directory *INTERNAL\USERCOR* of the internal hard disk.

- If no user correction file is available, *Firmware update after board change* performs an update of the current firmware including a complete CMU hardware detection. No external installation disk is required. The update takes some time and should be attempted in case of problems or after a modification of the CMU hardware configuration only (also after a combined hardware/software exchange).
- If a user correction file is found, *Firmware update after board change…* opens a submenu to activate or deactivate the RF user correction; see section *Compiling and Loading User Correction Tables* on p. 1.28 ff.

Edit service tables

Edit service tables calls up the *Service Table Editor* menu showing all hardware modules that are possibly fitted in your instrument. For service purposes, further information can be obtained by typing a particular board name and board index in the two lines below the table.

Exit

Exit closes the *VersionManager* and resumes the CMU start-up procedure.

Write log files to disk

Write log files to disk copies all *.log files stored on the CMU hard disk to an external storage medium (floppy or PCMCIA card). The *.log source files on the hard disk are not deleted.

The *Write log files to disk* function opens a blue message box indicating the storage capacity of the external disk needed. The *.log files can be distributed over several disks. If no disk is available, the *VersionManager* displays a warning and does not start copying.

Delete non volatile ram

Delete non volatile ram deletes all entries stored in the non volatile ram of the CMU. This memory contains particular settings of the last CMU session that can be reused in the next session (e.g. the last active function group and measurement menu, special configuration etc.).

Deleting the non volatile ram can be useful after an abnormal termination of a CMU measurement session.

Note: *The settings stored in the non volatile ram can also be written to a configuration file and reused in later sessions; see Chapter 3, section* Saving Configurations*.*

Scan disk

Scan disk closes the *VersionManager,* executes the MS *Scan Disk* program and finally returns you to the *VersionManager*. Refer to your *Scan Disk* documentation for further information.

Note: *This function is not available while a base software version <V3.00 is active.*

List all versions to disk

List all versions to disk writes the software configurations indicated via *List software* to an ASCII text file that is stored on the external disk.

Copy non volatile ram to disk

Copy non volatile ram to disk copies the contents of the non volatile ram to the external disk (floppy, PCMCIA).
In this way, the settings stored in the non volatile ram can be used on another CMU.

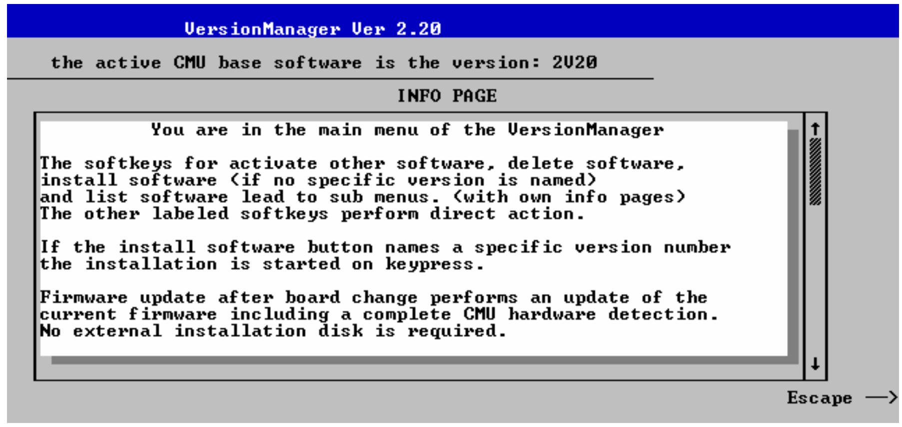
Defragment disk

Defragment disk closes the *VersionManager,* executes the MS *Defrag.exe* program and finally returns you to the *VersionManager*. Defragmenting the hard disk is suitable to improve performance after installing and deleting many different software versions. Refer to your *Defrag.exe* documentation for further information.

Note: *This function is not available while a base software version <V3.00 is active.*

Info

Info opens an output window displaying information on the current screen. Separate *Info* windows are provided for the different *VersionManager* dialogs.

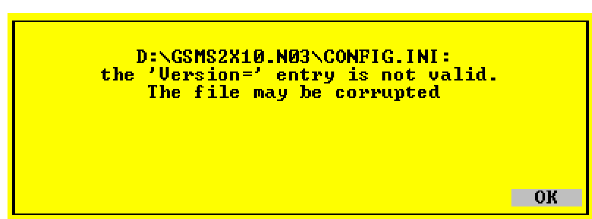


Escape Close the Info screen and return to the previous screen.

Error and notify message

During operation, the *VersionManager* can display two different types of messages:

- Error messages indicating that an action could not be successfully performed are displayed in yellow boxes. All error messages with possible reasons and remedial actions are explained in Chapter 9 of this manual.



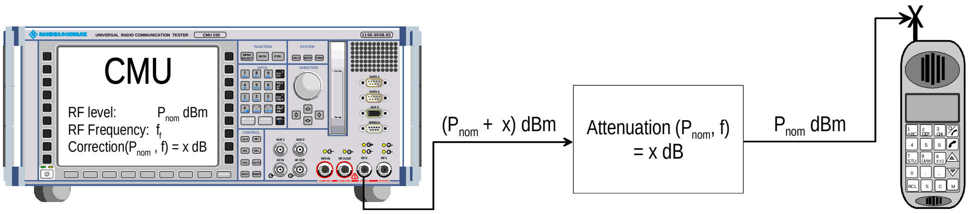
- Notify messages describing ongoing processes of the instrument are displayed in blue boxes. These messages are self-explanatory and do not require an action to be taken by the user.

RF User Correction

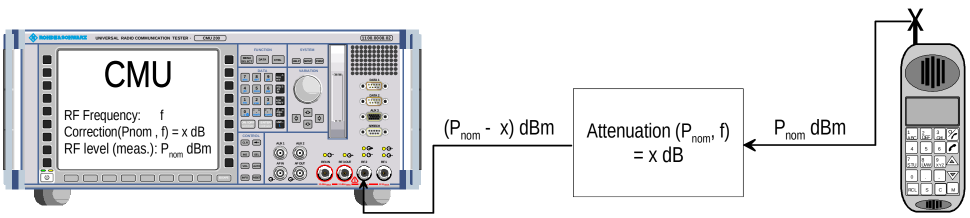
The purpose of the RF user correction is to compensate for an inevitable frequency and level-dependent attenuation in the test setup (frequency and level response correction). Level correction values are determined by means of a signal generator or power meter connected to the CMU's input and output ports and stored to a file, which is transferred to the CMU in order to modify its RF generator level and to correct its RF analyzer results.

The correction values must be acquired independently for the input and output connectors of the instrument.

Output level correction The correction values for output signals (connectors RF1, RF2 or RF3 OUT) modify the RF generator level so that the actual RF signal power at the input of the DUT is equal to the nominal RF generator level.



Input level correction The correction values for input signals (connectors RF1, RF2 or RF4 IN) modify the measured analyzer level so that the result for the RF signal power is equal to the power transmitted by the DUT.



Once the correction tables have been transferred to the instrument, the RF user correction is an internal procedure. There are several advantages of using this internal correction method rather than post-processing the CMU results by means of an external measurement program:

- The input level correction affects all acquired RF power results[3] including derived quantities (e.g. the results of the limit check) without slowing down the speed of the measurements. Evaluating derived quantities by means of an external program can be tedious. The RF user correction ensures that all results, including the derived ones, are consistent.
- The user correction is included in all results displayed in the measurement menus.
- Correction data can be acquired individually for each instrument and stored to its internal hard disk. If several testers are used in a production measurement system, the individual units are independent from each other and interchangeable.

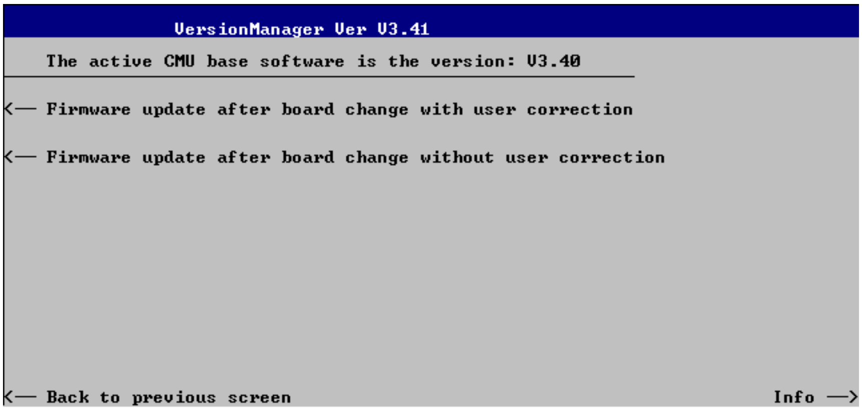
[3] Exception: The wideband power, which is provided in the *Analyzer/Generator* menu of the *RF* function group and in many network test applications, is always uncorrected.

Compiling and Loading User Correction Tables

To generate user correction tables and activate the user correction proceed as follows:

To deactivate old user correction (if available)…

1. Start the CMU and press the *Menu Select* key after the boot-up sequence is terminated (from the moment when the CMU display turns black until the end of the 3-beep acoustic signal) to activate the *VersionManager.*
2. Select *Firmware update after board change…*
3. In the submenu opened, select *Firmware update after board change without user correction* and *Back to previous screen.*



The CMU closes the *VersionManager* and resumes the start-up procedure.

4. Open the *Data* menu and access the *Arrange* tab. Delete or rename the old user correction file stored in the directory *INTERNAL\USERCOR\USERCOR1.DAT*.
5. Press *Menu Select* to close the *Data* menu and access the *Menu Select* menu.

Settings for acquiring correction values

The following settings and precautions will ensure maximum accuracy of the user correction:

6. From the *Menu Select* menu, access the *RF* function group or one of the network test options that will be used for the corrected measurements.
7. In the *RF* tab of the *Connection Control* menu, select the external input and output attenuation factors *(Ext. Att. Input, Ext. Att. Output)* that will be used for the corrected measurements.
8. In the *Analyzer* tab of the *Connection Control* menu, select the RF input path attenuation *(Analyzer Level – RF Attenuation: Normal, Low Noise* or *Low distortion)* that will be used for the corrected measurements and set the *RF Mode* to *Manual*.

   Note: *The CMU provides a various mechanisms for automatic input level control, e.g. the* Analyzer Level – RF Modes *Auto (autoranging) and PCL (in GSM-MS networks). To avoid unexpected effects, it is recommended to deactivate these control mechanisms and always measure the correction values at constant* (Manual) *maximum input level.*

To acquire the input correction values…

9. Apply the RF output signal of an external signal generator to one of the RF input connectors RF1, RF2, or RF4 IN of the CMU using the test setup (cables, power splitters, antenna coupler…) that will be used for the corrected measurements.
10. Vary the level and frequency of the signal generator and calculate the correction values as the difference between the external generator level and the measurement result at the CMU. If necessary, adapt the external input attenuation (see step 7) to force the correction values into the allowed range of [–1.2 dB, +1.2 dB].

To acquire the output correction values…

11. Apply the RF generator signal of the CMU to one of the RF output connectors RF1, RF2, or RF3 OUT of the CMU and feed it to a power meter, using the test setup (cables, power splitters, antenna coupler…) that will be used for the corrected measurements.
12. Vary the level and frequency of the CMU generator signal and calculate the correction values as the difference between the generator level and the measurement result at the external power meter. If necessary, adapt the external output attenuation (see step 7) to force the correction values into the allowed range of [–1.2 dB, +1.2 dB].

To activate the user correction…

13. Repeat the steps no. 9 and 11 for all input and output connectors needed and write the acquired correction values into a common file named *USERCOR1.DAT* with the format specified in section *File Format for User Correction Tables* on p. 1.30 ff.
14. Transfer the file to the CMU using the IEEE bus, the serial interface or the PCMCIA interface and copy it to the directory *INTERNAL\USERCOR*.
15. Shutdown and re-start the CMU and press the *Menu Select* key after the boot-up sequence is terminated (from the moment when the CMU display turns black until the end of the 3-beep acoustic signal) to activate the *VersionManager* again.
16. Select *Firmware update after board change…*
17. In the submenu opened (see step no. 3), select *Firmware update after board change with user correction.*

The CMU checks the file *USERCOR1.DAT* for compatibility with the file format specification and generates a message, should an error be detected. Afterwards, the CMU closes the *VersionManager* and resumes the start-up procedure. A message indicates that the user correction is active.

Final test

18. Repeat the steps no. 9 and 11 with active user correction to make sure that the entire procedure was performed without errors.

File Format for User Correction Tables

The user correction file is an ASCII file named *USERCOR1.DAT* that is stored in the directory C:\INTERNAL\USERCOR\ on the internal hard disk of the CMU. The file contains up to 6 independent tables to store the correction values for the 3 RF output connectors and the 3 RF input connectors of the instrument. Each table has the following structure:

[PortID]:	[Freq*1*]	[Freq*2*]	...	[Freq*n*]
[Level*1*]:	[Dev*11*]	[Dev*12*]	...	[Dev*1n*]
[Level*2*]:	[Dev*21*]	[Dev*22*]		[Dev*2n*]
...	...	...	...	...
[Level*m*]:	[Dev*m1*]	[Dev*m2*]	...	[Dev*mn*]

Comments in the file must be introduced by a double dagger #. Spaces and indentations are allowed for easier readability of the file. The first character in a line can be a minus sign but must not be a plus sign. The following example shows a valid user correction file:

```
# This is a comment
#  (any number of spaces is allowed)
    # indentations are allowed,

# spaces and TAB are used for separation

RF2in:   500   1000   1500   2000
 10:    1.20  -1.2   -.23    -0.5  # comments are allowed at the end of a line
  0:    0.34   1.14  1.20    -1.2
-10:    1.19  -1.19  -1.12   1.00
-14:    -0.32  +1.11 -0.50   1.10

 RF1in:   200    800    1500
 10:      +1.20  -.91   .5
 0:       -0.12  +1.11  -0.50

RF3OUT:  400   1000   1555   2500
 10:    1.20  -1.20  -0.23   -0.5
  0:    0.34   1.14   1.20   -1.2
-10:    1.19  -1.19  -1.12    1.00
-14:   -0.12  +1.11  -0.50    1.10
```

Note: *In general RF user correction tables are no longer valid after an update of the path correction data, e.g. by means of the automatic calibration system R&S ACS. To ensure that outdated user correction data are not used inadvertently, the ACS renames all files c:\internal\usercor\ *.dat ➠ c:\internal\usercor\ *.bak after a change of the path correction data. Existing *.bak files are overwritten.*

Ranges of Values and Limitations

The table contains the following elements:

PortID Identifier for the RF connector, written in upper or lower case letters and followed by a colon. The following port IDs are valid:

RF1IN, RF2IN, RF4IN	for the 3 RF input connectors (input level correction)
RF1OUT, RF2OUT, RF3OUT	for the 3 RF output connectors (output level correction)

Frequency points Frequency of the measured or generated signal in MHz, to be arranged in ascending order, starting in column 2 (lowest frequency). The frequency points must be integer numbers (i.e. integer multiples of 1 MHz) and can be distributed across the entire RF input and output frequency range of the instrument (see data sheet).

Level points Level of the measured or generated signal in dBm, to be arranged in descending order, starting in row 2 (highest level). The level points must be positive or negative integer numbers, followed by a colon, and can be distributed across the entire RF input and output power range of the connectors (see data sheet). Negative levels must be preceded by a minus sign “-“; using a plus sign “+” for positive numbers is not allowed.

Correction values n times m level correction values for the measured or generated signal in dB (if n is the number of frequency points, which is equal to the number of correction values per table row, and m is the number of level points). The total number of correction values n times m must not exceed 120 (it is possible though to choose m=120 and n=1 and vice versa).

The level correction values must be in the range between -1.20 dB and +1.20 dB. This is sufficient to compensate for a frequency response or level response caused by the test setup. Larger, correction factors can be defined by combining the user correction with a constant external input or output attenuation (see section *RF Connectors* in Chapter 4). Two consecutive correction values may be separated by any number of spaces or tabs.

Positive (negative) correction values for an output signal compensate for an external attenuation (gain) and increase (decrease) the generator level. Positive (negative) correction values for an input signal are added to (subtracted from) the measured RF signal levels.

Interpolation Rules

The CMU uses the values in the correction tables to interpolate correction factors at arbitrary frequency and level values. The following rules apply:

- At constant frequency, the correction value associated to the level point P_m is valid in the level range between $(P_{m+1} + P_m)/2$ and $(P_{m-1} + P_m)/2$: The ranges with constant value adjoin each other in the middle between two consecutive level points.
- At constant level, the correction factors are linearly interpolated between consecutive frequency points.

Contents

2 Getting Started

The following Chapter presents a sample session with the universal radio communication tester CMU. It is intended to provide a quick overview of the settings provided in the base system and the *RF* function group. No specific device under test is required. For an introduction to mobile network tests (e.g. tests of GSM900/1800/1900 mobile phones) please refer to the relevant operating manuals.

Before starting any measurement with the CMU, please note the instructions given in Chapter 1 for putting the instrument into operation. In Chapters 2 to 4 you will find detailed information on customizing the instrument and the display according to your personal preferences.

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.

For a systematic explanation of all menus, functions and parameters and background information refer to the reference part in Chapter 4.

A Short Tutorial on CMU Operation

The principles of manual operation – controls, operating menus, dialog elements and measurement control – are discussed in Chapter 3. Below we list some essentials for first users:

Condensed Operating Instructions

1. When using CMU for the first time it is useful to set it to the default state (*RESET* hardkey).

2. *ENTER* key: press even if "No" or "Yes" is displayed.

3. There is no Home menu but the *MENU SELECT* hardkey can be pressed in any state of the unit. A large popup menu is then displayed in which the function group (network etc.), signalling mode and measurement menus can be selected. Activate by pressing *ENTER*.

4. A front-panel LED indicates which of the RF connectors is configured as output. In the menu, the RF generator can be activated or deactivated with *ON/OFF* (green/red). The front-panel LED goes out if the generator is in the *OFF* position.

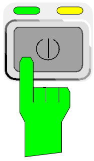
5. A front-panel LED indicates which of the RF connectors is configured as input. In the menu, the measurement can be controlled via the *ON/OFF* and *CONT/HALT* keys (*ON* (green), *OFF* (red) and *HLT* (yellow) states). In the *OFF* state, the LED goes out.

6. The *SETUP* hardkey allows to make static, measurement-independent default settings such as *Remote* or *Time*, to check which options are installed and to activate new software options.

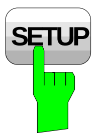
7. The left softkey row is missing in the graphical menus. The softkeys on the right-hand side are used to change the hotkeys across the bottom and their functions. Pressing the *Menus* softkey (bottom right) allows a fast switchover between related menus using the hotkeys.

8. Signalling does not necessarily have to be activated by means of a general menu; for example, the *Power* menu for GSM mobile tests can be called up immediately, without transferring any signalling information. The user is popup-menu guided (as default) through the different CMU signalling states (messages: switch mobile on, registered, call setup). This menu guidance via popup menu can be switched off.

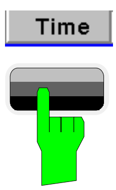
How to access and close menus



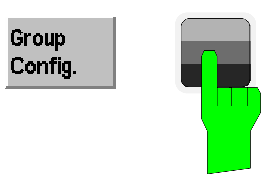
A startup menu is displayed automatically when the CMU is switched on.



Some general configuration and selection menus can be opened via the *MENU SELECT, RESET, INFO, PRINT, HELP* or *SETUP* keys on the front panel.

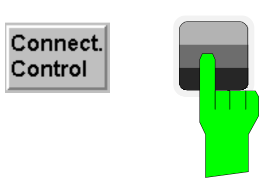


The hotkeys displayed across the bottom of a main menu or graphical measurement menu are used to switch over between different main menus or graphical measurement menus. Tabs in popup menus are also accessible via hotkeys.



In firmware versions <V3.05, the *Group Config.* softkey (always at the top left) is available in all measurement menus. This softkey opens a popup menu defining the input path and the trigger settings for the current function group and signalling state.

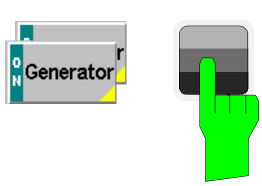
The *Group Config.* softkey is omitted in firmware V3.05 and later. Instead, the settings are available in the *Connection Control* menu, see below.



The *Connect. Control* softkey (always at the top right) is available in all measurement menus. This softkey opens a popup menu defining the input and output connectors, the external attenuation, the reference frequency as well as many network-specific settings.

In the *Signalling* test modes of many network options, the *Connection Control* menu is also used to set up and terminate a connection between the CMU and the DUT.

In firmware versions V3.05 and later, the *Connection Control* menu also contains the input path and the trigger settings for the current function group and signalling state.



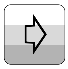
If a special configuration menu exists for a measurement or for a generator the corresponding softkey is marked with a yellow arrow. The configuration menu is opened by pressing the softkey twice.

All CMU popup menus can be closed with the *ESCAPE* key.

Main menus and graphical measurement menus are closed on switching to another main or graphical measurement menu.

How to use dialog elements in the menus

The dialog elements assigned to a softkey are selected by pressing the softkey.



Different input fields can be selected by means of the 4 cursor keys (blue frame shows active input field).

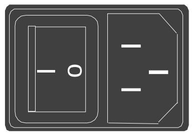
One of several elements in a list or toggle switch can be selected with the rotary knob.

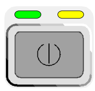
Numeric values can be either incremented/decremented using the rotary knob or entered via the numeric keypad or an external keyboard.

For a comprehensive introduction to manual operation of the CMU refer to Chapter 3.

Startup of the CMU

This Chapter describes how to customize the CMU and perform simple RF measurements. As a pre-requisite for starting the session, the instrument must be correctly set up and connected to the AC power supply as described in Chapter 1.

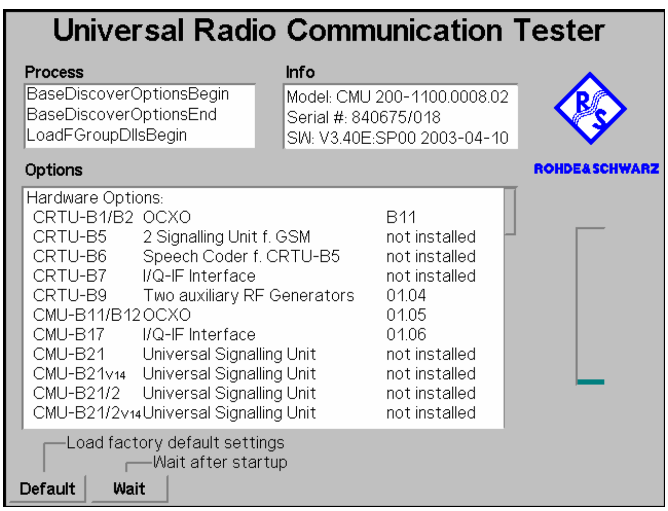




Step 1

➢ 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. If the CMU is in standby mode, press the *ON/STANDBY* key. ②



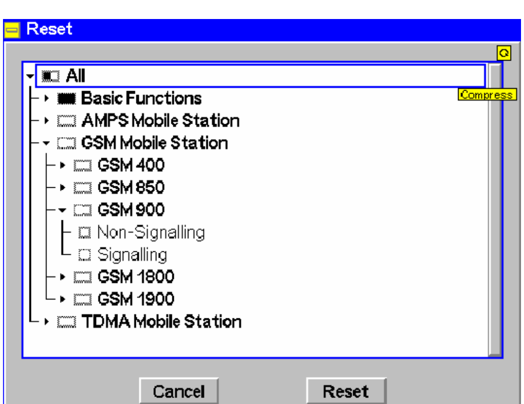
Step 2

The CMU is booted and after a short while displays the startup menu. This menu is usually closed as soon as the instrument software is loaded and the startup test is finished. ③

➢ Press the *Wait* hotkey to prevent the instrument from switching to another menu. ④

The *Wait* hotkey changes to *Cont.* with the additional message *Change to last menu* displayed on top.

➢ Press the *Cont.* hotkey to resume the startup process.



Step 3

➢ Press the *RESET* key to open the *Reset* popup menu.

➢ Proceed as described in Chapter 4, section *Reset of Instrument Settings,* to expand the tree of function groups.

➢ Select the function groups *Base* and *RF* to be reset (the corresponding nodes must be black).

➢ Use the cursor keys to activate the *Reset* button and press *ENTER.*

➢ In the popup window opened *(Are you sure?)*, select *Yes* to confirm the instrument reset.

The CMU indicates that it performs a partial reset of the two selected function groups 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 *O* position, the complete instrument is disconnected from the power supply. When the mains power switch is set to the *I* 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 OCXO reference frequency oscillator (option CMU-B11/B12), if installed, is supplied with operating voltage. The orange LED (STANDBY) is illuminated.

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

... on Step 2

③ **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).

④ **Wait hotkey**
By default the CMU switches to the last main menu of the previous session after terminating the startup process. This is convenient if an interrupted session is to be resumed or if the instrument is generally used in a definite operating mode.

On the other hand, the *Wait* function can be used to access the configuration menus which can be opened by means of the front panel keys before the actual measurement is started.

While the *Wait* hotkey is active, a reset of the instrument is not possible.

Alternative Settings and Measurements

☞ Chapter 1

The CMU is automatically set to the AC supply voltage and frequency applied. Note the permissible ranges of AC voltages and frequencies indicated at the rear of the instrument and in the data sheet.

☞ Chapter 1

The behavior of the CMU when it is switched off depends on the Front Module controller type installed; see Chapter 1.

☞ Chapter 4

The *Default* hotkey can be used to load the factory default settings for all function groups. Settings made and stored in the previous session are overwritten.

The CMU's user interface has been optimized with the aim of facilitating fast and easy switchover between the menus and measurement modes. This includes the general configurations which can be accessed from any measurement menu.

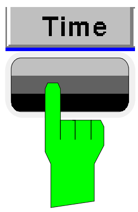
The most important selection and configuration menus such as *Reset, Setup, Menu Select* etc.are directly accessible via front panel keys.

⇓

Step 4

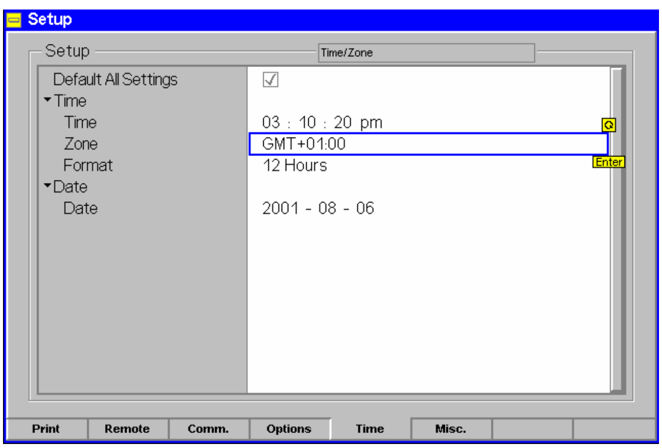
- Press the *SETUP* key to access general device settings.

⇓



- Press the *Time* hotkey to switch over to the *Time* tab of the *Setup* menu. ①

⇓



Step 5

The *Time* tab of the *Setup* menu displays the current time zone, time and date. ②

- Use the rotary knob to move the focus onto the *Time* section of the *Setup* table. If necessary, press the rotary knob or the *ON/OFF* key to expand the parameters in the table (see Chapter 3).
- Move to one of the input fields associated to the *Time* parameter, select with *ENTER* and use the rotary knob or the numeric keypad to correct the settings for the current time. Hours, minutes and seconds can be edited separately.
- Press *ENTER* to confirm the entries and quit the input fields.
- Move to *Zone* select field, activate with *ENTER,* and use the rotary knob to choose your own time zone.
- In the same way, activate the *Format* select field and use the rotary knob to switch over between European and North American time conventions.

Additional Information...

... on Step 4

① **Softkeys and hotkeys**
Softkeys and hotkeys are activated by pressing the associated keys on both sides and across the bottom of the display. The general purpose of softkeys is to provide settings, control the generator and the measurements. Hotkeys are used to switch over between different menus and different tabs belonging to a popup menu.

... on Step 5

② **Setup menu**

The *Setup* menu comprises several tabs providing general instrument settings. It is advisable to check and adjust the factory settings when you operate the CMU for the first time.

To switch over between the tabs of the setup menu use the hotkeys displayed at the bottom of the display.

Alternative Settings and Measurements

☞ Chapter 3

☞ Chapter 4

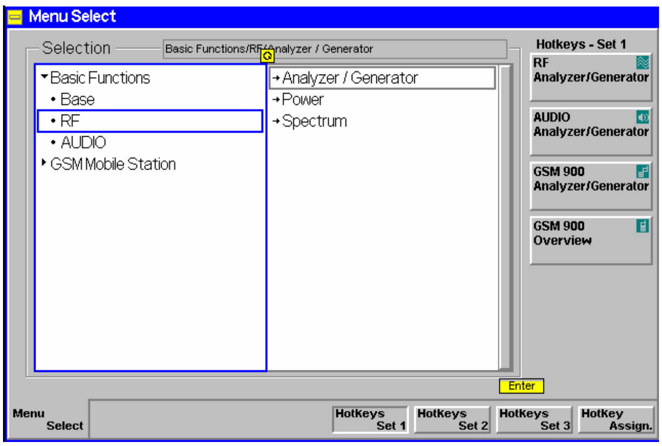
The different types of menus and control elements of the graphical user interface is explained in Chapter 3. In the same Chapter you can find a short tutorial on the entry of numbers and characters.

RF Non Signalling Measurements

In the *RF Non Signalling* mode, a continuous or pulsed RF signal can be generated and a RF signal with definite frequency characteristics can be analyzed. The signal level can be plotted in oscillographical *(Power)* or spectral *(Spectrum)* representation.

Step 1

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

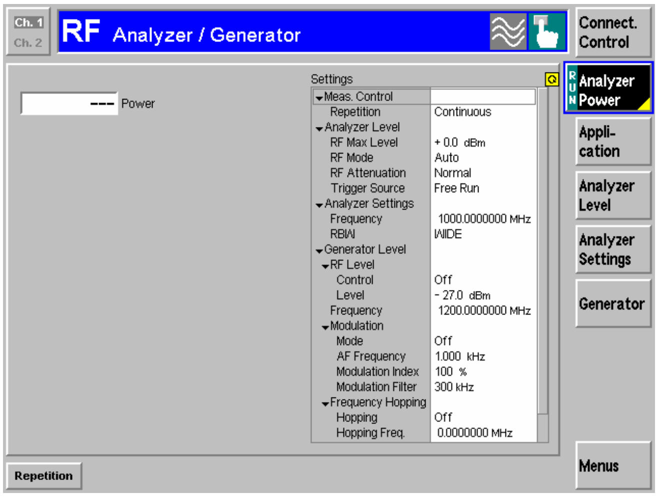


➢ Use the cursor keys and the rotary knob to select the *RF* function group in the left half of the *Selection* table.

➢ In the right half of the table, select the *Analyzer/Generator* menu.

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

Step 2



In the *Settings* table the *Analyzer/Generator* menu indicates the parameters of the signal generated and those of the signal received and analyzed. ②

At present, all parameters have been reset to factory default values. Different softkey/hotkey combinations and popup menus are provided to change the settings. User-defined parameters will be saved for later sessions when the CMU is switched off.

The *Power* output field in the *Analyzer/Generator* menu shows an invalid result ("---") because at present no RF input signal is applied to the CMU.

Additional Information...

Alternative Settings and Measurements

... on Step 1

① **Menu Select menu**

The *Menu Select* menu shows all function groups installed on your CMU. If a function group is selected the available test modes and measurement menus are indicated. Function groups representing digital network tests (such as *GSM400/850/900/1800/1900-MS)* are generally subdivided in the two test modes *Non Signalling* and *Signalling*, each containing a number of measurement menus.

The *RF* function group is available on any CMU regardless of the software options purchased. It comprises the three measurement menus *Analyzer/Generator*, *Power* and *Spectrum*. All three measurement menus are directly accessible from the *Menu Select* menu.

☞ Chapter 4

For digital network tests refer to the relevant operating manuals. e.g. *GSM400/850/900/1800/1900-MS.*

... on Step 2

② **Analyzer/Generator menu**

The *Analyzer/Generator* menu contains several softkeys to

- Control the RF signals received and analyzed *(Analyzer Level, Analyzer Settings*)
- Control the RF signals generated *(Generator*)

Defining a level and frequency via the *Generator* softkey and the associated hotkeys implies that a continuous signal (CW) with this level and frequency is generated.

The *RF Max. Level* defined via *Analyzer Level*, however, denotes the maximum input power which can be measured. This is identical with the upper edge of the *Power* diagram (see below). The permissible range of *Max. Level* depends on the input connector and external attenuation used (see section *Analyzer Settings* in Chapter 4).

Defining a (center) *Analyzer Settings – Frequency* implies that only signals around this frequency are analyzed.

The *Analyzer Settings – RBW* hotkey defines the resolution bandwidth of the analyzer.

☞ Chapter 4

The *Generator* softkey provides the most important settings of the *Generator* tab of the *Connection Control* menu.

The *Analyzer Level* and *Analyzer Settings* softkeys correspond to the *Analyzer* tab of the *Connection Control* menu.

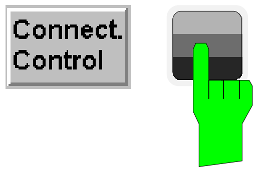
③ The status of the *Analyzer Power* measurement is shown in the corresponding softkey. For ongoing measurements, the result in the *Power* output field is constantly updated.

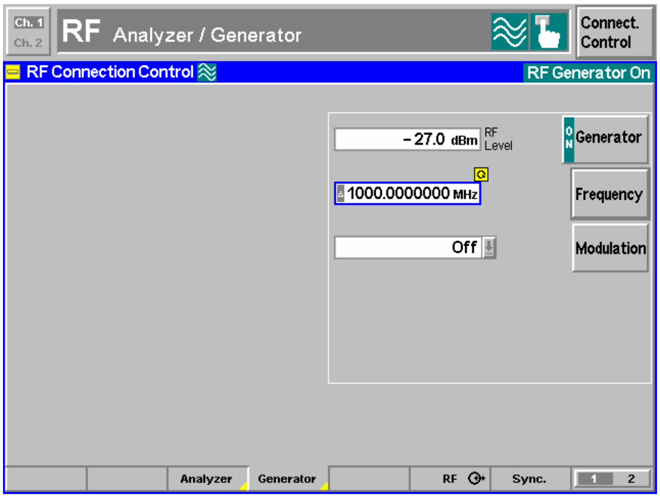
At present no input signal is available so that the *Power* output field shows an invalid result "– – –"

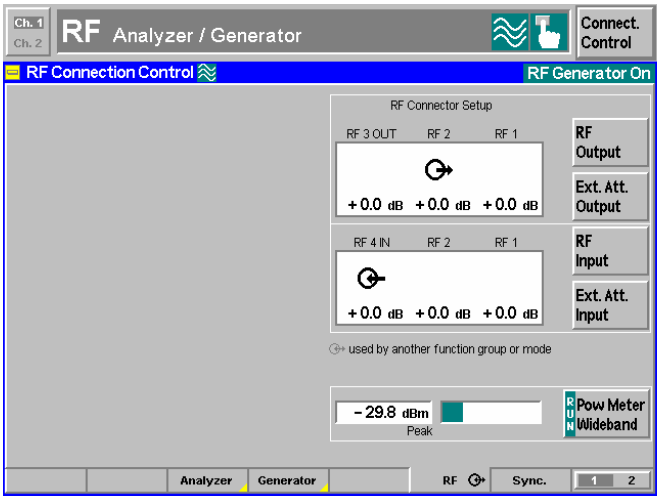
Once the softkey is selected, the *Analyzer Power* measurement can be switched off and on by means of the *ON/OFF* key. In contrast, the *CONT/HALT* toggle key halts the measurement after the next valid result has been obtained.

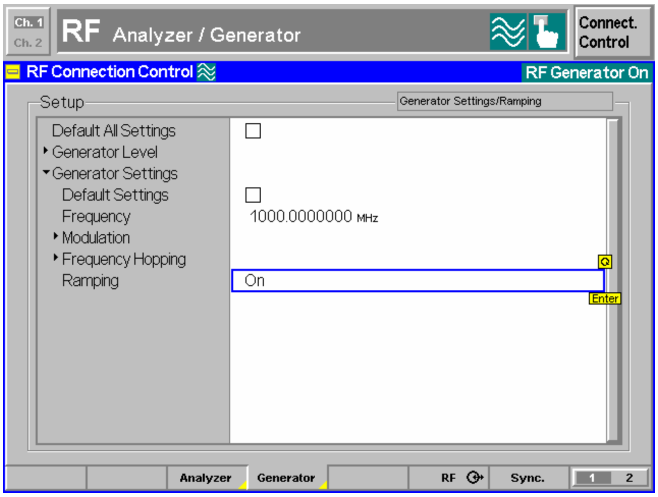
☞ Ch. 4 and Ch. 5

The options for the measurement status are *ON, OFF, or HLT*. The *HLT* state is reached after the end of a single shot measurement (see the section about measurement control in Chapter 5).









Step 3

➢ Press the *Connect. Control* softkey and use the *Generator* hotkey to open the *Generator* tab. ①

The *Generator* tab controls the RF generator and defines the *Frequency* and *Modulation* of the generated RF signal.

➢ Select the *Generator* softkey by pressing once.

➢ Press the *ON/OFF* key to switch the RF generator on. ③

➢ Set the generator frequency equal to the default frequency of the RF analyzer frequency as shown in the figure.

➢ Press the *RF* hotkey to open the tab defining the signal connectors and external attenuation.

➢ Select RF2 as output connector, RF4 IN as input connector. Do not define any external attenuation (all values equal to 0.0 dB).

Two yellow LEDs on the front panel indicate the input and output connectors selected.

➢ Use a coax cable to connect RF2 to RF4 IN.

➢ Press the *ESCAPE* key to close the popup menu and return to the *RF Analyzer/Generator* main menu.

The RF level measured is now indicated next to the *Analyzer Power* softkey. Due to the loss in the signal path it should be slightly below the generator power selected. ②

➢ Reopen the *Connection Control* menu and press the *Generator* softkey twice.

The table-oriented version of the *Generator* tab is opened.

➢ Press *ON/OFF* to expand the parameter tree, use the rotary knob to select the *Ramping* parameter, press *Enter* and use the rotary knob again to switch the power ramping *ON*.

Now the generator transmits a pulsed (instead of a continuous) signal.

➢ Press the *Connect. Control* softkey again or the *ESCAPE* key to close the popup menu.

Additional Information...

... on Step 3

① **RF connectors**

The *RF Connection Control* menu configures the input and output connectors in the *RF* function group. The four connectors on the front panel differ by their permissible range of input and output powers (see Chapter 4 and data sheet). The values quoted on the left side are compatible with the rated specifications.

② **External attenuation**

An external attenuation can be reported to the CMU in order to compensate for known losses between the signal source and the device under test or the analyzer.

In our example, the (positive) difference between the analyzer power measured and the generator power can be reported as an external output attenuation at RF 2. The RF generator increases its level to maintain the commanded power of –27 dBm at the analyzer. The nominal generator power set in the RF level field is thus measured and indicated next to the *Analyzer Power* softkey.

Note: RF User Correction

> *In addition to the static external attenuation settings, the CMU provides a systematic correction of the generated and measured RF power by means of user-defined, frequency and level-dependent correction tables; see section* RF User Correction *in Chapter 1.*

Alternative Settings and Measurements

☞ Chapter 4

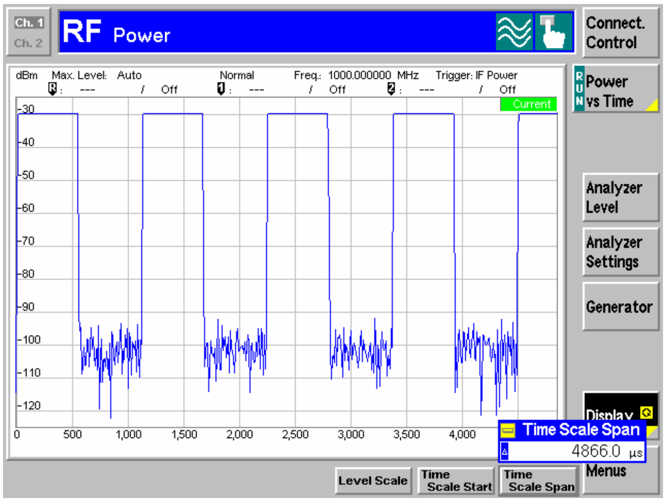
Settings made in the *Connect. Control* menus apply to the entire function group *RF Non Signalling*.

☞ Chapter 4

Note that an external attenuation reported to the CMU shifts the nominal permissible ranges of input and output levels.

Step 4

⇓



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

The *Power* menu shows the RF signal power measured as a function of time at a particular frequency and resolution bandwidth. An appropriate trigger condition must be selected to obtain a stable display. ①

Settings (default settings or the ones made in the *Analyzer/Generator* menu) and scalar results are displayed in two parameter lines above the diagram.

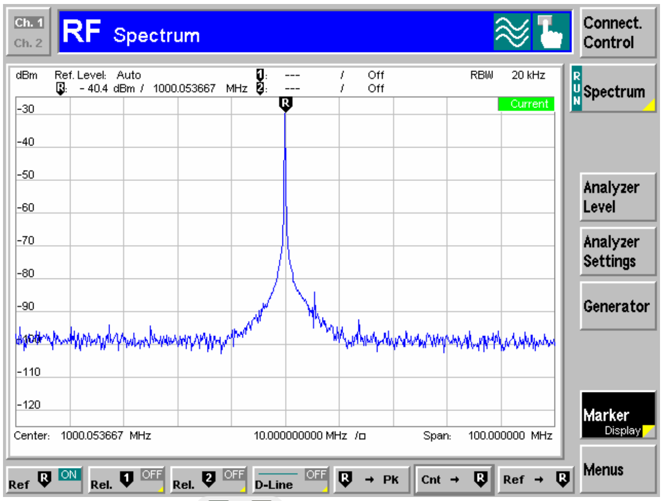
Various tools allowing to take a closer look at the measurement results are provided in the graphical measurement menu. ②

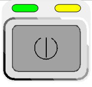
- Press the *Marker/Display* softkey twice and vary the *Time Scale* to display several pulses in the diagram.
- Press the *Analyzer Settings* softkey and vary the resolution bandwidth (hotkey *RBW)*. ③
- Press the *Menu* softkey to display the hotkeys used to change over to the other measurement menus.
- Press the *Spectrum* hotkey to switch over to the graphical menu *Spectrum*.

⇓

⇓

Step 5





The *Spectrum* menu shows the signal power in spectral representation, i.e. as a function of the frequency.

The settings and results displayed in the two parameter lines above the diagram are analogous to the ones shown in the *Power* menu.

- Press the *Marker* softkey and use the *R to Pk* and the *Cnt to R* hotkeys to center the diagram. ④
- Press the *Analyzer Settings* softkey to scale the diagram and adjust the resolution bandwidth.
- To close your session set the CMU to standby mode using the power switch on the front panel or use the mains switch at the rear.

Additional Information...

Alternative Settings and Measurements

... on Step 4

① Trigger mode

☞ Chapter 4

The trigger mode is set in the *Analyzer* tab of the *Connection Control* menu or via the *Trigger* softkey in the graphical measurement menus. With the default setting *Free Run* the measurement is not synchronized to the frequency of the incoming pulses: The trace is permanently shifted in horizontal direction.

To show a signal consisting of rectangular pulses (bursts) it is recommended to trigger by either the rising or falling edge of the IF power.

The *Frequency* softkey defines the frequency of the measured signal and the resolution bandwidth. The *Input Level* softkey configures the input level, the power range and an attenuation factor. The *Time* softkey configures the time axis.

② Markers

☞ Chapter 4

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 distance between their position and the reference marker. All marker coordinates are shown in the two parameter lines above the diagram.

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

③ Resolution bandwidth

☞ Chapter 4

A spectrum analyzer can differentiate two spectral lines separated by a minimum distance corresponding to the bandwidth of the resolution filter.

The smaller the bandwidth the better the resolution and the larger the signal-to-noise ratio. If the resolution bandwidth is too large only the envelope of the spectrum can be measured.

In the *Power* measurement, the signal-to-noise ratio improves but the time resolution **deteriorates** when the resolution bandwidth is reduced.

... on Step 5

④ Scaling of the spectral diagram

☞ Chapter 4

The tools provided in the *Spectrum* menu are particularly suitable for scaling a spectral diagram with a sharp main lobe and symmetric, lower side lobes:

- The *R to Pk* hotkey (*Marker* softkey) places the reference marker to the maximum (i.e. the main lobe) of the diagram.
- The *Cnt to R* hotkey (*Marker* softkey) centers the diagram to the frequency of the main marker.
- Equivalently, the *Center* hotkey *(Frequency/RBW* softkey) can be used to center the diagram.

Contents

3 Manual Operation

This chapter provides a survey of the CMU's operating concept. This includes a description of the basic menu types, the selection and setting of parameters, and a general discussion of measurement control. The operating menus in the CMU basic system, the *RF* function group, and optional function groups are presented in an overview at the end of this chapter and described in greater detail in Chapter 4.

Operating concept The CMU was designed for easy, intuitive operation. All menus rely upon a limited number of controls with analogous or identical function. Basic settings are discussed in section *Measurement Control* on page 3.16 and in Chapter 5.

Basic elements The CMU is operated via softkeys and tables. Softkeys provide a fast access to the instrument functions. Tables facilitate the management of larger amounts of data.

Flexibility and uniformity The CMU permits to switch over between various operating modes (multi-mode operation). For this purpose, it is possible to change between the menus in almost any instrument state. The different function groups (*RF, GSMxxx-MS* etc., see also separate operating manuals for network test applications) can be operated in the same way; measurements of the same type belonging to different applications are standardized.

Controls

The CMU is operated under menu control via keys, softkeys and hotkeys:

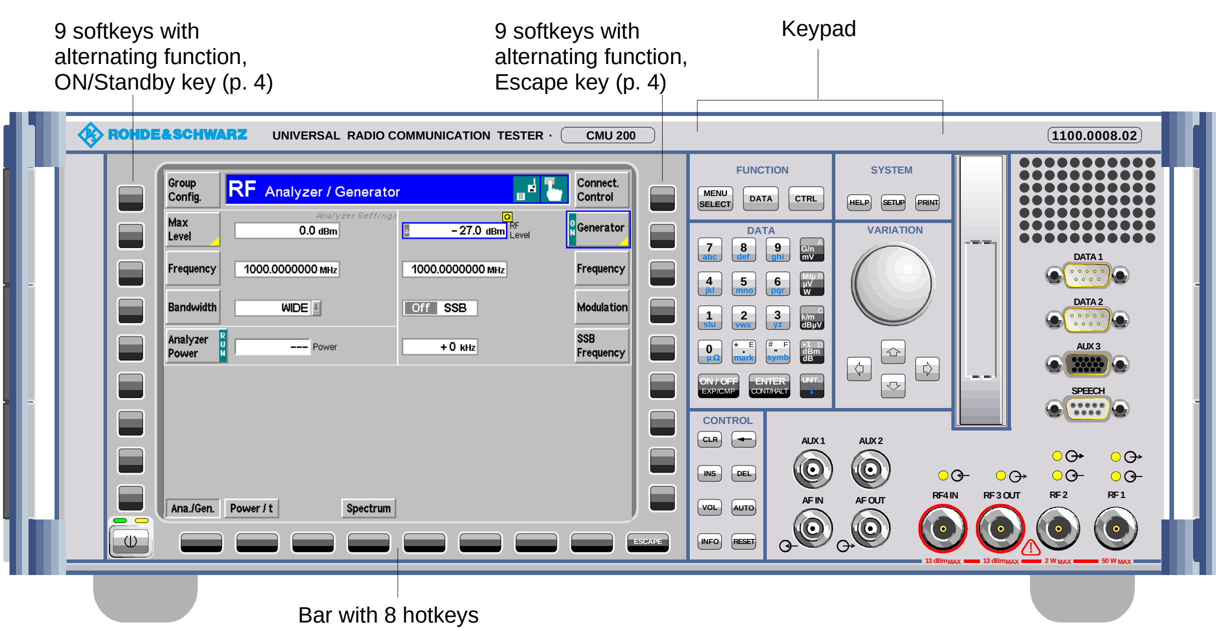


Fig. 3-1 Keys, softkeys and hotkeys

Rotary Knob

The rotary knob (spinwheel) can be used in two different ways:

- It is **turned** to select entries in list fields and tables and to vary (increment/decrement) numerical and alphanumerical entries.
- It is **pressed** to expand or compress table sections (thus replacing the *ON/OFF* key), to expand pull-down lists, to open auxiliary input fields, and to confirm numerical entries or selections (thus replacing the *ENTER* key).

Front Panel Keys

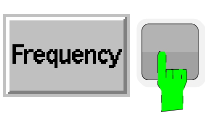
The keys located in the right-hand part of the front panel are combined to form groups according to their functions. They control

- Data input and variation
- Pre-selection of the menus
- Settings of the instrument, editor, help file and output

The keys are described with their function in Chapter 1, section *Front and Rear View*.

Softkeys

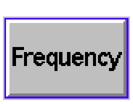
Softkeys are assigned to the nine keys located both at the left and at the right edge of the screen. To simplify the display, only the softkeys which are actually assigned in a menu are indicated (see menu example in *Fig. 3-1*).



⇓

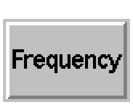
Selection of softkeys:

The CMU provides selectable and non-selectable softkeys. A softkey is selected by pressing the associated key.



⇓

A selected softkey is highlighted by a blue frame. Softkey selection establishes a connection to settings and functions related to the softkey. These related functions can be initiated via keys (e.g. *ON/OFF, CONT/HALT),* or via the selected softkey itself (e.g. calling up popup menus by pressing a selected softkey again).

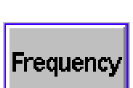


After the function has been terminated, or after another softkey is selected, the softkey returns to its initial state.

Softkey types and their function:

Softkeys perform definite tasks within the corresponding menus. Different types of softkeys are provided:

– Pressing the softkey (i.e. the associated key) causes an immediate response on the screen. Examples are the non-selectable softkeys *Group Config.* and *Connect. Control* used to call up popup menus.



– Pressing the softkey activates a dialog box, e.g. an input field.

– The softkey is a measurement control softkey (main softkey) indicating the measurement state (*RUN, OFF, HLT)*. A yellow triangle indicates that a popup menu providing configurations can be opened with the softkey (press once for selection, a second time for opening the popup).

A measurement can be started and aborted with the *ON/OFF* key (i.e. the ON/OFF key switches between the measurement states *RUN* and *OFF*). It can be stopped while preserving the valid results with the *CONT/HALT* key (i.e. the *CONT/HALT* key switches between the measurement states *RUN* and *HLT;* starting a measurement from the *OFF* state by means of the *CONT/HALT* key is not possible). In the *HLT* state, the instrument resources are not released; the application is still available. The formal aspects of measurement control are explained in Chapter 5.

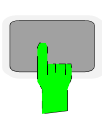
– The softkey indicates the generator status *(ON, OFF)*. A yellow triangle indicates that a popup menu providing configurations can be opened with the softkey (press once for selection, a second time for opening the popup).

A generator can be started and aborted with the *ON/OFF* key. The formal aspects of generator control are explained in Chapter 5, section *Measurement Control*.

The softkey toggles between two hotkey bars (corresponding to two groups of settings). The current group is indicated in large typeface in the first line of the softkey; the alternative group appears in smaller typeface next to a double triangle.

Hotkeys

Hotkeys are assigned to the eight keys at the lower edge of the screen. Only the hotkeys softkeys which are actually assigned in a menu are indicated (see *Fig. 3-1*).



Selection:

A hotkey is activated by pressing the associated key. After activation it changes its frame.

Function:

Hotkeys permit to

– Change from one measurement menu/graphical measurement menu to the other

– Select tabs in the popup menu

– A yellow triangle indicates that a second version of the current tab providing additional configurations can be opened with the hotkey. The hotkey toggles between the two versions of the tab.

In the graphical measurement menu (see page 3.7), hotkeys provide extended settings and can be used like ordinary function softkeys.

Operating Menus

The CMU offers a large variety of operating modes and applications. To ensure quick and easy operation, uniform menus have been implemented. They can be divided into three types:

Measurement menu	Offers the most important settings controlling a measurement and displays the main results.
Popup menu	Provides extended settings for a measurement menu or function group.
Graphical menu	Displays a measurement trace together with settings and further measurement results, contains softkeys and hotkeys used to access measurement control settings.

Measurement Menus

A measurement menu provides the basic settings controlling a measurement and at the same time displays the main results. Together with the graphical measurement menus, measurement menus constitute the basic level in the operating system of the CMU. They can only be replaced by other measurement menus or graphical measurement menus. To change the menu, the hotkeys at the lower edge of the measurement menu are used.

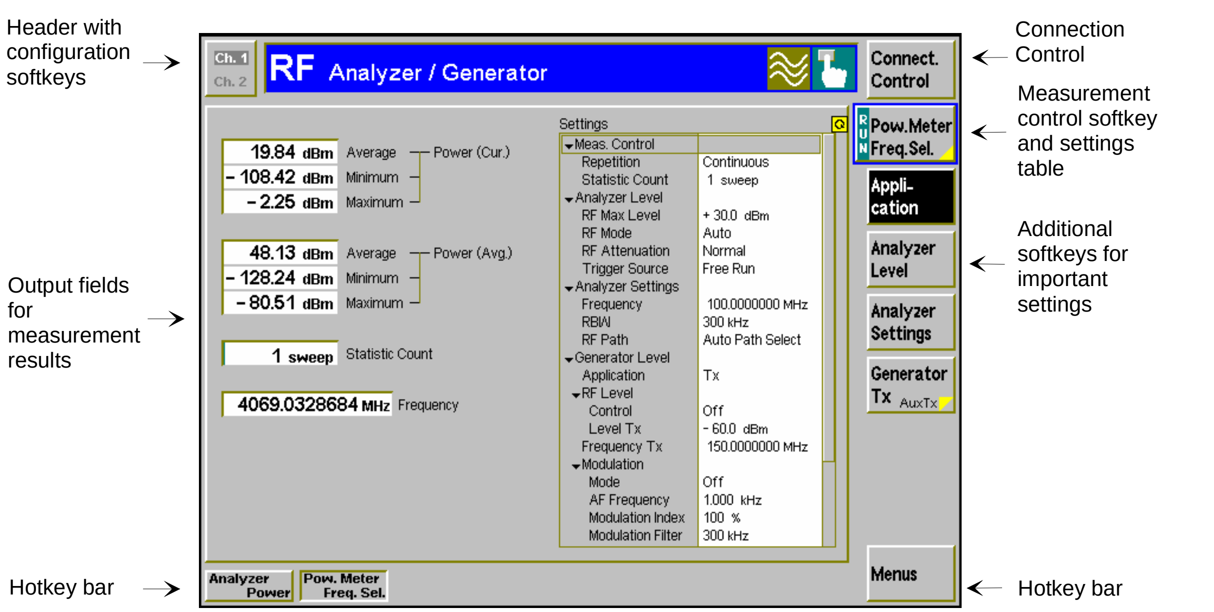
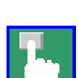


Fig. 3-2 Example of a measurement menu

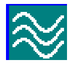
Header The header consists of the heading and the symbols for the operating mode and test mode (signalling state, if applicable in the function group).

- The *heading* briefly describes the purpose of the menu (e.g. type of settings, measurement group, function group, etc.).
- The *operating mode*, i.e. the type of operation/control of the CMU, is indicated by the symbols at the right edge of the header. The following operating modes are available:

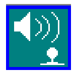
 Manual mode

Remote control via IEC-bus

- The *function group* is indicated to the left of the operating mode:



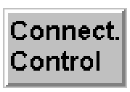
RF measurements



Audio Analyzer and Generator (with option CMU-B41)

In network test applications, the *signalling states* that are specific to the applications are indicated. The corresponding icons are discussed in the relevant manuals (see *GSMxxx-MS* etc.).

General settings



The *Connect. Control* softkey is located to the right of the header of each measurement or graphical measurement menu. This softkey opens a popup menu defining the input and output connectors, the external attenuation, the reference frequency as well as many network-specific settings.

In the *Signalling* test modes of many network options, the *Connection Control* menu is also used to set up and terminate a connection between the CMU and the DUT.

The *Connection Control* menu also contains the input path and the trigger settings for the current function group and signalling state.

Measurement control softkey

The measurement control softkey (main softkey) controls the measurement application and indicates its state *(RUN | HLT | OFF);* see section *Softkeys* on p. 3.1 ff. Its labeling corresponds to the menu heading. For large measurement groups that are subdivided into several applications, the labeling indicates the current application.

The hotkey bar associated to the measurement control softkey provides parameters to define the scope of the measurement (statistical settings).

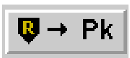
Pressing the measurement control softkey twice opens a popup menu providing measurement-specific settings.

Softkeys for important settings

The softkeys below the measurement control softkey provide groups of important measurement settings. Each softkey activates an associated hotkey bar. An active softkey is displayed in inverse video.

The *Menus* softkey displays all measurements in the function group, so it is possible to change from one measurement to another.

Hotkeys



If one of the softkeys is activated, the hotkeys below the test diagram provide sub-functions for this softkey.

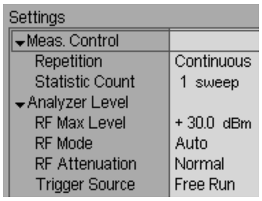
If the Menus softkey is activated, the hotkeys change between the various measurement groups of the current function group.

Popup box

Popup boxes are associated to all hotkeys that require a selection or input of parameters. These popup boxes are operated like input fields in the measurement menus (input of numbers and characters) or list fields (selection from a range of alternative settings).

Popup boxes are closed when the calling hotkey is pressed again or when another popup box is opened. They remain open when another softkey is selected, so it is possible to easily test the effect of repeated changes of a parameter.

Settings table



The *Settings* table in the right half of the menu gives an overview of the current measurement settings. The entries vary with the measurement and measurement applications. The rotary knob scrolls and expands the *Settings* table.

Graphical Measurement Menus

The CMU displays arrays of measurement results in the form of two-dimensional diagrams. In order to obtain additional space for the test diagram, no settings table is displayed. The header and the functionality of the softkeys and associated hotkeys is identical to the measurement menu; see section *Measurement Menus* on page 3.4.

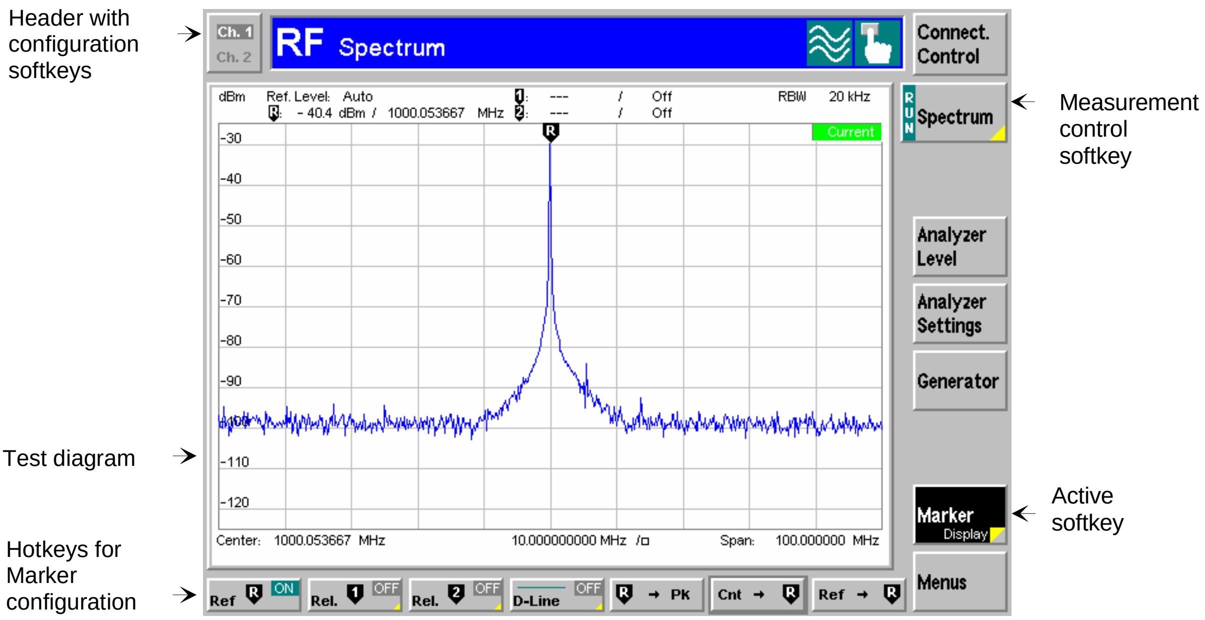


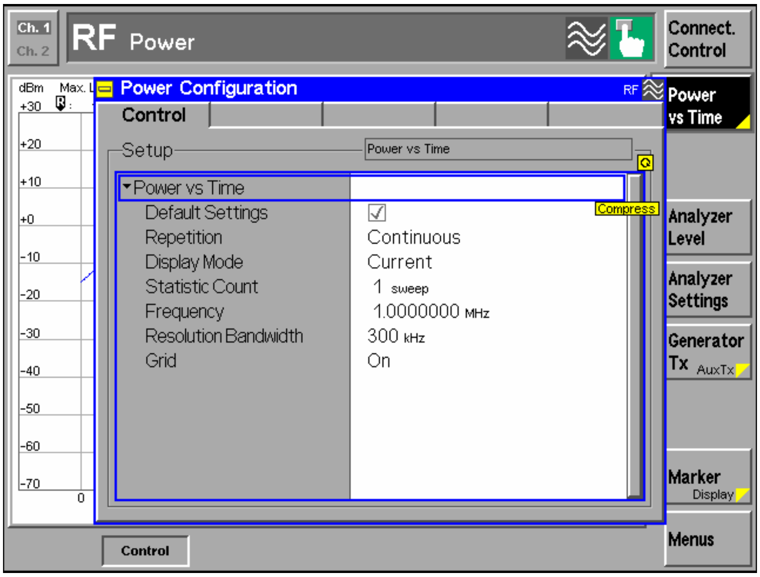
Fig. 3-3 Example of graphical measurement menu

Popup Menus

Popup menus extend the functionality of a measurement menu. They are assigned to the configuration softkey *Connect. Control* as well as to all measurement control softkeys in a measurement menu that are marked by a yellow triangle at the bottom right. They may be divided into several tabs that are selected via hotkeys in the measurement menu.

The popup menu *Connection Control* is activated by pressing the associated softkeys. Popup menus which configure a measurement are activated by pressing the measurement control softkey twice (selection of softkey and subsequent opening of popup menu). A popup menu is closed by means of the *ESCAPE* key or by pressing the calling softkey again.

Popup menu with Header and two tabs →



← Calling softkey, press twice

Hotkeys for selecting the tabs →

Fig. 3-4 Example of a popup menu

Header The header consists of

- The heading (<*name of the measurement group*> *Configuration*; the function group is indicated on the right in small characters),
- The symbol for the signalling state on the right. See section *Measurement Menus* on page 3.4.

Tabs Popup menus come without tabs (1 single window) or with several tabs.

The tabs may contain input fields, select fields, command and on/off switches (check boxes). Various fields can be combined to form groups (panels).

(Expanding) menu tables Configuration settings in popup menus are often arranged in tables. If a table provides a large number of settings, these are usually grouped under several header lines marked by a black triangle. The items belonging to a group can be shown (expanded, triangle points down) and hidden (compressed, triangle points to the right) by selecting the corresponding header line and pressing the *ON/OFF* key or the rotary knob.

Operation of Popup Menus

The following table provides an overview of the operation of popup menus.

Table 3-1 Operation of popup menus

Action		Operation via keys
Open menu		Press the softkey twice (selection plus opening of menu), press only once in the case of *Connect. Control*
Select	tabs dialog elements	Press hotkey softkeys *(Connect. Control)*, cursor keys ⇦⇨⇧⇩
Edit fields		Keys *ON/OFF, ENTER,* number and unit keys, rotary knob, see section *Dialog Elements in the Menu* on page 3.10.
Edit table entries		Keys ON/OFF, ENTER, number and unit keys, rotary knob, see section *Dialog Elements in the Menu* on page 3.10.
Quit and close menu		Any assigned softkey / *ESCAPE* key

Dialog Elements in the Menu

This section describes the various types of dialog fields and the procedure for the input of values and parameters.

In many input or select field types, a selection made must be confirmed using the *ENTER* key. The cursor can be freely shifted over these fields; only after confirmation is the setting transferred to the instrument software.

In the case of select fields without confirmation, settings take effect immediately with the cursor selection.

Input Fields

An input field (editor) is a white, rectangular area on the screen which permits numbers or characters to be entered. Input fields are available both in measurement and in popup menus. In graphical measurement menus, the input fields are popup windows which can be called up by means of hotkeys while the instrument is in the function mode.

Note: *The easiest and quickest way to enter numbers or characters is by means of an external keyboard that is connected to the* KEYBOARD *connector at the rear of the CMU (see Chapter 1). Alternatively, follow the directions given in the next two sections.*

Input of Numbers

Input fields for numerical values are activated by pressing the respective softkey. Numerical values can either be varied using the rotary knob (by incrementing/decrementing individual digits) or directly entered via the numerical keypad *(DATA)* on the front panel or an external keyboard. To this end, the insert and overwrite mode is available. It may be necessary to confirm the input for transfer to the instrument hardware.

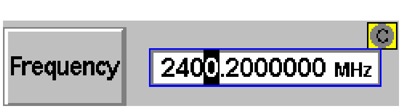
In the following, the most important possible inputs using the rotary knob or the numerical keys will be described.

Activating an input field and a digit

➢ To activate the input field press the associated softkey.

The input field appears with a blue frame. The symbol for the rotary knob appears at the top right of the input field.

The input field is in start mode, indicated by a small white triangle on a gray background. From the start mode, it can be switched to either insert or overwrite mode.



Input using the rotary knob – Overwrite mode

➢ In the start mode, turn the rotary knob to activate the overwrite mode and vary the last digit of the current number.

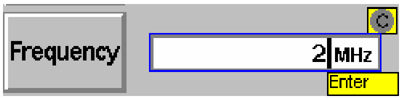
➢ Use the left or right *cursor key* to switch between the decimal places of the indicated number.

➢ Increment/decrement the active digit by turning the *rotary knob.*

The individual digits can be varied without restriction. Incrementing a “9“ produces 0 and causes the next higher digit to be incremented by 1. The editor behaves analogously when a “0“ is decremented.

An *Enter* symbol at the bottom right of the input field indicates that the current value has yet to be written to the CMU software.

- ➢ Confirm the entry and terminate the input using the *ENTER* key or by pressing the rotary knob or another softkey or ...
- ➢ Press *ESCAPE* to discard the entry.



Input using the numerical keypad – Insert Mode

- ➢ In the start mode, type one of the number keys of the numerical keypad.

  The previous numeric value of the editor is completely replaced. The CMU changes to the insert mode characterized by a cursor symbol. Further digits are inserted to the left of the cursor.
- ➢ Entries made in insert mode via the numerical keypad must always be confirmed using the *ENTER* key or by pressing the rotary knob.

Further control keys

The keys of the *CONTROL* group extend the functions of numerical input.

- ➢ Use the INS *(insert)* key to change between the modes *insert* and *overwrite*.

  In the insert mode, the cursor appears in the input field.
- ➢ Use the ← *(backspace)* key to delete the character to the left of the cursor (in insert mode).
- ➢ Use the DEL *(delete)* key to delete the highlighted character (in overwrite mode) and the digit right from the cursor key (in insert mode).
- ➢ Use the CLR *(clear)* key to delete all characters.

Confirming/discarding the input

The behavior of the editors depends on whether the values were entered in the insert or in the overwrite mode:

- ➢ If only the overwrite mode was used to define the input value no confirmation is necessary. The input value is valid as soon as another softkey or hotkey is pressed.
- ➢ If the insert mode is used, or if it was used before swapping over to the overwrite mode, the input must be confirmed with the *ENTER* key or by pressing the rotary knob. By pressing *ESCAPE* or another softkey, the input will be discarded and the previous value restored.

If the number entered conflicts with the resolution of the CMU, it will be rounded to the maximum number of digits allowed.

Error message during input

If the value defined in the input field is too high or too low, a window with the error message „*<numerical value> is out of range. <permissible maximum value> is limit.*“ will appear together with three buttons:

Accept	Permissible maximum value accepted for input field,
Re-edit	New entry
Cancel	Last valid input value is retained.

Input of alphanumerical characters

Input fields for alphanumerical characters are activated by pressing the respective softkey. Characters can be either varied using the rotary knob (by variation of individual characters in alphabetical order) or entered via the numerical keypad *(DATA)* on the front panel or an external keyboard. The input must be confirmed using the *ENTER* key in order to be transferred to the instrument hardware. The input is terminated upon confirmation.

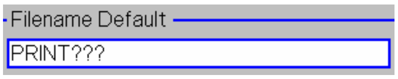
The table below shows the assignment of the numerical keys.

Table 3-2 Assignment of numerical keys and alphanumeric characters

Key	**Character (upper case)**	**Character (lower case)**
7 abc	A B C 7 Ä Æ Å Ç	a b c 7 ä æ å ç
8 def	D E F 8 É	d e f 8 é è
9 ghi	G H I 9	g h i 9 ì
4 jkl	J K L 4	j k l 4
5 mno	M N O 5 Ñ Ö	m n o 5 ñ ö ò
6 pqr	P Q R 6	p q r 6 ß
1 stu	S T U 1 Ü	s t u 1 ü ù
2 vwx	V W X 2	v w x 2
3 yz	Y Z 3	y z 3
0 _µΩ	space µ Ω 0 £ $ ¥ €	space µΩ 0 £ $ ¥ €
. * mark	\ _ * , : ; ' " ? ( )	\ _ * , : ; ' " ? ( )
- # symb	- # / ( ) < = > % &	- # / ( ) < = > % &
UNIT.. ⇩	Upper / lower case	Upper / lower case

The full character set may be restricted if required for reasons of compatibility (e.g. for input fields defining file names).

The most important possible inputs using the rotary knob or the digital keys are described in the following.



Activating the input field and auxiliary editor

- To activate the input field press the associated softkey. If the softkey is assigned to a panel with several controls, use the cursor key to select the desired input field.

- Press or turn the rotary knob to open the auxiliary editor associated to the input field.

  The auxiliary editor is used to edit a name that may extend over several lines. The cursor is placed at the end of the current character string.

Input using the numerical keys

- Press one of the numerical keys to write a character to the current cursor position.

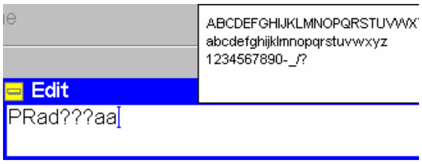
- To change a character, position the cursor to the desired character using the left or right *cursor key* and overwrite the character.

- Press a numerical key repeatedly to access the different characters assigned to it (see assignment of keys in *Table 3-2*).
- Press the *UNIT* key plus a numerical key to switch to the upper case character set.
- Confirm the input using the *ENTER* key.

  If the syntax specified is invalid (e.g. an invalid file name was defined), an error message of the type *Filename syntax <name> is invalid Cancel / Re-edit* is displayed. Otherwise the edited character string is written to the input field in the menu.

- Press another softkey or change the menu to close the auxiliary editor.

Input using the rotary knob



- After opening the auxiliary editor, turn the rotary knob in either direction. A list of all valid (upper and lower case) characters for the current input field is opened.
- Turn the rotary knob and select the character to be written to the cursor position in the auxiliary editor. Selected characters are shown in inverse video.
- Press the rotary knob to confirm your selection and enter the selected character into the auxiliary editor.
- Select a character and turn the rotary knob to increment/decrement the character in alphabetical order.

Insert/overwrite

The keys of the *CONTROL* group extend the functions of character input.

- Use the INS *(insert)* key to change between the modes *insert* and *delete*.

In insert mode, the cursor appears in the input field.

- Use the *(backspace)* key to delete the character to the left of the cursor.
- Use the DEL *(delete)* key to delete the inversely displayed character (in overwrite mode).
- Use the CLR *(clear)* key to delete all characters.

Confirming/discarding the input

- Use the ESCAPE *(ESCAPE)* key or another softkey to abort character input and deactivate the input field and the softkey.
- Use the ENTER CONT/HALT *(ENTER)* key to confirm the character input.

If the syntax specified is invalid (e.g. an invalid file name was defined), an error message of the type *Filename syntax <name> is invalid Cancel / Re-edit* is displayed. Otherwise the edited character string is written to the input field in the menu.

- Press another softkey or change the menu to close the auxiliary editor.

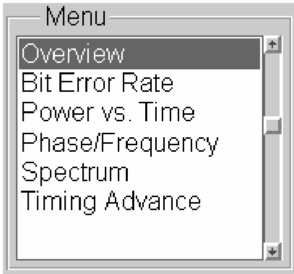
Select Fields in Popup Menus

Various types of fields permit to select one or several settings out of a number of given options. The desired settings are to be marked; the selection is to be confirmed using the *ENTER* key, if required.

Popup menus may or may not contain softkeys; they contain input or select fields which can be combined to form panels or groups and tables. Select fields and tables in the popup menus can be controlled intuitively using the cursor keys. The following overview applies to all field types.

Table 3-3 Operation of select fields

Action	**Key operation**
Select field group / list	Cursor keys, softkey
Select single field, command button, or line in list field or table	Rotary knob
Switch on or off single field or line in list field	*On/Off* key, in the case of buttons also rotary knob, *ENTER* key
Confirmation (if required)	*ENTER* key

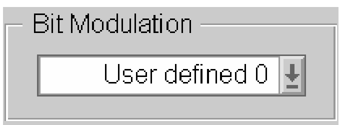


List fields (selection 1 out of n)

provide a choice of several text lines in a rectangular window:

- ➢ Select one out of several list fields using the cursor keys.
- ➢ To select a line use the rotary knob. If a line beyond the edge of the list is to be selected, the whole list will be shifted (scroll function).

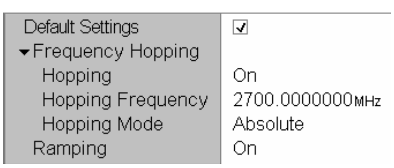
For operation of list fields see *Table 3-3*.



Pull-down list fields

are similar to the list fields described above as far as their function and operation is concerned; however, they are compressed into one line in the popup menu.

- ➢ Press the associated softkey (if available) or use the cursor keys to select the list. Press *ENTER* or the rotary knob to expand the list (expand in upward or downward direction depending on the space available).
- ➢ To select a line use the rotary knob.
- ➢ Press *ENTER* to confirm your selection and close the list.
- ➢ Press *ESCAPE* or another key to discard your selection and close the list.



(Expanding) menu tables

usually cover the whole popup menu or tab so they are active as soon as the menu is opened. The right-hand fields of a menu table (white background) can be edited. Table lines without any input option but with a black triangle are headers with several sub-items that can be expanded or compressed:

- ➢ To move the control frame to a line use the rotary knob or the cursor up/down keys.
- ➢ Press *ENTER* to select a line and start editing. Numerical values can be entered as described in section *Input of Numbers* on page 3.10. Alternative settings can be selected using the rotary knob.
- ➢ Press *ENTER* to confirm an entry and quit the table line.
- ➢ Press *ESCAPE* or another key to discard your entry and release the table line.
- ➢ Select a header line and press the rotary knob to expand (show) or compress (hide) a table section. Press the *ON/OFF* key to expand all compressed tables in the menu.

Measurement Control

This section gives a brief survey of the CMU's measurement control using the function group *RF Non Signalling* as an example. This includes a discussion of the different measurement modes and measured quantities. 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)*.

The menus of the graphical user interface can be arranged in different ways. According to their tasks, they form the following groups:

- The function groups *RF*, *Audio, GSM900-MS, GSM1800-MS* and *GSM1900-MS*, etc. The *RF* function group is supplied with the firmware for the CMU base system. The function groups for network test applications are optional and described in separate operating manuals.
- The two signalling modes *Signalling* and *Non Signalling.* The signalling properties are specific to the individual networks and devices under test. In the function group *RF* only *Non Signalling* measurements are provided.
- General configurations *(Group Configuration, Connection Control),* configurations specific to a measured quantity *(Power Configuration, Spectrum Configuration*, etc.), and menus displaying the results of the measurement *(Power, Spectrum* etc.).

In a more formal sense, the CMU uses measurement menus, popup menus, table menus, and graphical measurement menus and dialog windows of various sizes. This aspect is discussed in the preceding sections.

Configurations

The CMU offers a wide range of settings for input and output signals and measurements. Configurations either refer to the whole function group *(Connection Control)* or to a particular measurement.

Connection Control

In function group *RF*, the *Connect. Control* softkey is located on the right side of the title bar of each measurement and graphical measurement menu. It opens a popup menu with several tabs configuring

- The analyzer settings and input path configuration *(Analyzer).*
- The RF generator *(RF Generator)*
- The RF and possibly the AF connectors to be used and the external attenuation *(AF/RF).*
- The reference signal and system clock *(Sync.)*
- The trigger settings *(Trigger)*

All settings made in the *Connect. Control* menu apply to the whole function group and signalling mode. The *Connection Control* menu also contains the input path and the trigger settings for the current function group and signalling state.

Configuration of measurements

A *Configuration* popup menu offering specific settings is assigned to most measurement groups (see e.g. the *Power and Spectrum* measurements in the RF function group and the *Multitone* measurement in the *Audio* function group). The *Configuration* menu also provides general parameters that can be defined independently in many measurement groups:

- 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 3.18 ff.). For a detailed explanation refer to the manuals for network tests listed before tabbed divider no. 1.

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, frequency or another continuous parameter forming the x-axis scale. Power results are usually plotted in semi-logarithmic diagrams. 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 3.18), the indicated results are constantly updated. Each function group and measurement mode comprises a particular selection of measurement groups. The measurement groups belonging to function group *RF (Non Signalling)* and *Audio (with option CMU-B41)* are shown in the following tables.

Table 3-4 Measurements in function group *RF (Non Signalling)*

Menu	Function
Analyzer/Generator	Shows the settings for the signals generated and analyzed by the instrument, the generator status, and the state of the RF analysis. Moreover the current analyzer power is indicated.
Power	Shows the trace of the measured RF power in oscillographic representation, i.e. as a function of time. The maximum level and frequency of the input signal is indicated in addition. Single points of the trace may be evaluated using graphical tools (markers, D-Line).
Spectrum	Shows the trace of the measured RF power in spectral representation, i.e. as a function of the frequency. Parameters of the measurement are indicated in addition. Single points of the trace may be evaluated using graphical tools (markers, D-Line).

Table 3-5 Measurements in function group *Audio* (with option CMU-B41)

Menu	Function
Analyzer/Generator	Generates a single-tone sinusoidal audio signal and measures the DC and AC voltage and the Total Harmonic Distortion and Noise of a single-tone audio signal.
Multitone	Generates a composite audio signal consisting of up to 20 individual fixed-frequency tones with configurable frequency and level. An audio signal containing the same tones can be analyzed in a single measurement and displayed in a bar chart. A limit check is provided for all results.

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 individual measurement groups. In combination, these settings define the scope of each measurement, i.e. the number of results acquired and the type of 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 subgroups 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. The definition of an evaluation period changes from one measurement to another:

- The evaluation period for *Spectrum* measurements (function group *RF)* corresponds to the duration of a sweep.
- The evaluation period for *Multitone* measurements (function group *Audio)* corresponds to the time until the system has settled and a valid result is available.
- In all digital radio communication systems (GSM, TDMA, CDMA, ...), the information is transmitted in periodic timeslots of equal length. These slots provide natural evaluation periods for all measurements on digital network tests. See the relevant manuals for more specific information.

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. If this parameter is omitted, a statistics cycle always comprises just one evaluation period.

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 measurement configuration popup-menus.

Note: *In contrast to other instrument settings, the repetition modes in manual and remote control are independent and do not overwrite each other. 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 measurements providing a limit check, 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.

Some other stop conditions are defined for network tests. See the relevant manuals for more information.

The *stop condition* is set in the *Control* tab of the measurement configuration popup-menus.

Display Mode

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

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.

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 measurement configuration popup-menus.

Calculation of average quantities

The *Average* traces in the *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).

Note: *Some network tests (e.g. WCDMA) use a different prescription to calculate the average traces. See the relevant manuals for more information.*

Contents

4 Functions and their Application

This chapter explains in detail all functions of the CMU and their application. The structure of the chapter is based on the menu groups and their function. It is organized like a typical measurement session including the following stages:

1. Startup menu
2. Menu selection
3. General device configurations
4. System information and hardware diagnosis
5. RF measurements (measurements and measurement results, configurations)
6. A*udio Generator and Analyzer* (Option CMU-B41) including *Audio Multitone*

In contrast to Chapter 6, *Remote Control – Commands*, the measurement and results are explained first, special measurement configurations are relegated to the end of the chapter. The description of the softkeys is followed by the remote-control commands. Similarly, the description of the commands in Chapter 6 also contains the corresponding menus of the user interface.

The description of the operating concept is to be found in Chapter 3; besides, an overview of all menus is given at the end of Chapter 3. To find information on a particular topic please refer to the index at the end of the manual.

Startup Menu

The startup menu provides information on the instrument and the installed options. It appears for a few seconds in the display after switching on the CMU and activating the operating mode (see Chapter 1, *Switching on the Instrument/Startup Test*). During display of this menu, the CMU performs a startup test.

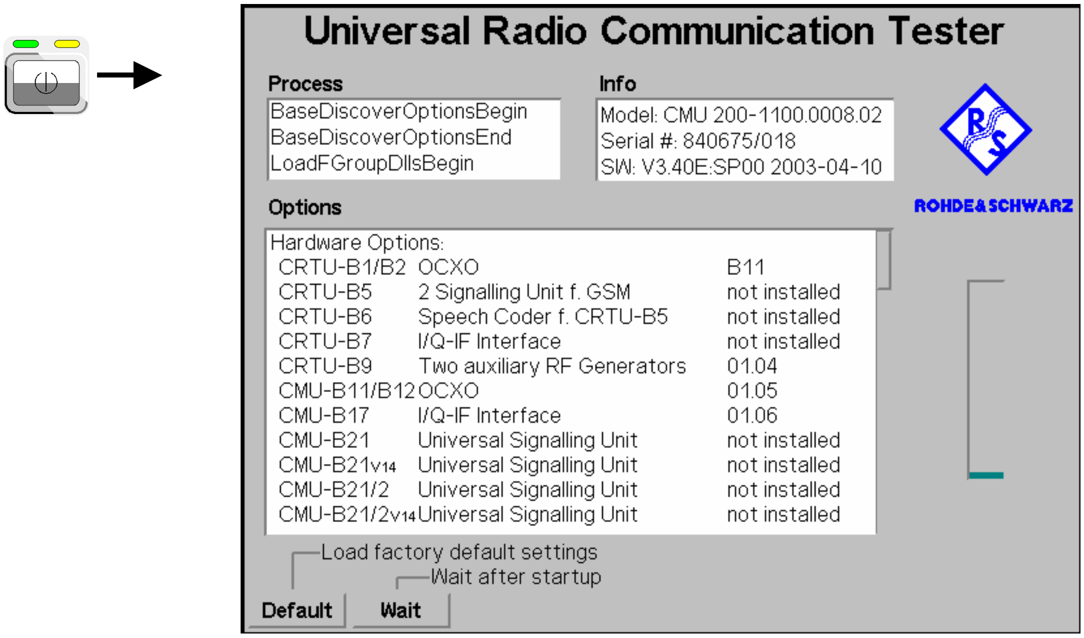


Fig. 4-1 Startup menu

Displays in the startup menu

The display windows of the startup menu provide information on

- 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).

After terminating the startup procedure, the instrument changes to the last main menu or graphical measurement menu of the previous session.

Options

All the options of the CMU are listed in the section "Installation of Options (Setup – Options)" in this chapter.

Further information on the options is to be found in the data sheet. Installation and removal of options is described in Chapter 4 of the service manual.

Hotkeys

During the startup procedure, the hotkeys of the startup menu are available.

Default

The *Default* hotkey activates the default settings of the instrument for all function groups and test modes. Alternatively, a reset can be performed any time using the *RESET* key; see section *Reset of Instrument Settings (RESET Key)* on p. 4.3 ff.

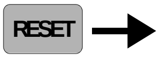
Wait

The *Wait* hotkey prevents the instrument from closing the *Startup* menu.

As a result of this, the *Wait* softkey changes to *Cont.* with the additional message *Change to last menu* displayed on top. Instead of changing to the last main menu or graphical measurement menu of the previous session the measurement can be continued by pressing a key *(Menu Select, Setup, ...*).

On-Screen Help (HELP Key)

The *Help* menu displays help on the basic menus, controls and keys. It is possible to expand and compress the topics using the *ON/OFF* key. The menu is opened via the *HELP* key *(SYSTEM keypad)*.



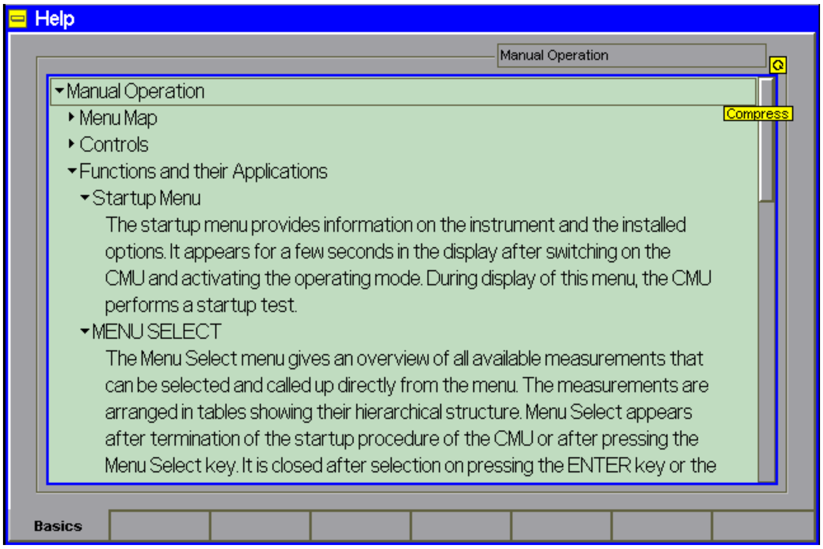


Fig. 4-2 Popup window Help

Reset of Instrument Settings (RESET Key)

The popup window *Reset* sets the instrument settings in all or some function groups and test modes to their default values. It is opened via the *RESET* key *(CONTROL keypad)*.

Note: *A reset of the instrument does not necessarily mean that the current instrument settings are lost. The CMU can store the settings in a configuration file and re-use them in a later session; see section Saving Configurations (Data – Save) on p. 4.22 ff..*

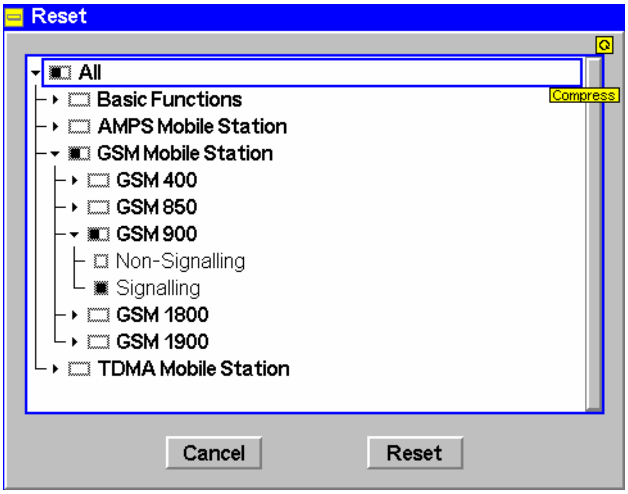


Fig. 4-3 Popup window Reset

Selection of the settings

All function groups and test modes available on the instrument are arranged in a tree view. When the popup is opened, this configuration tree is expanded and the active function group and test mode is selected.

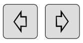
Nodes containing subnodes (e.g. function groups containing the test modes *Non Signalling* and *Signalling)* are marked with rectangular symbols, lowest-level nodes (e.g. the individual test modes within a function group) with smaller, quadratic symbols:

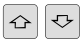
 The node is deselected

 The node is partially selected, i.e. some but not all of the subnodes are selected

 The entire node is selected, i.e. all of the subnodes are selected

The controls in the *Reset* window are manipulated with the roll-key, the cursor keys and the *ENTER* key:

 Toggle between the *Cancel* and the *Reset* buttons

 Toggle between the control buttons *(Cancel, Reset)* and the tree view

Roll-key Toggles between the *Cancel* and the *Reset* buttons (when turned) or activates a button (when pressed). In the tree view, the roll-key moves the control frame up and down (when turned) or expands/compresses a node (when pressed). Pressing the roll-key on a lowest-level node selects or deselects the node.

ENTER Activates a button or selects/deselects a node including all subnodes.

Reset

The *Reset* button resets all settings in the selected function groups and test modes.

A box pops up to confirm the reset. While the reset is performed, the message *Reset in progress* is displayed. All running measurements are aborted and a connection to a DUT is dropped. Then the *Reset* popup window is closed and the CMU returns to the function group and test mode that was active when the reset was initiated.

Note: *A reset of the active function group is faster because no additional software modules must be loaded. Additive function groups (e.g. an Audio function group which complements a GSM function group) are reset together with the selected function groups.*

A reset of all instrument settings can also be performed during the startup procedure; see Default *softkey in section Startup Menu on p. 4.1 ff.*

The reset button restores the default values for manual control. In cases where the remote control commands use distinct default values (e.g. the repetition modes) only the manual default values are restored.

Remote control
`SYSTem:PRESet[:ALL]` (base system)

Compare:	`SYSTem:RESet[:ALL]`	(default parameters in remote control, base system)
	`SYSTem:RESet:CURRent`	(default parameters in remote control, all function groups)

Cancel

The *Cancel* button cancels the selection that has been made and closes the menu. *Cancel* is selected by default when the *Reset* menu is opened.

Remote control
–

Print Menu (PRINT Menu)

The popup window *Print* permits to print the current screen as configured in the *Print* tab of the *Setup* menu. It is called up on pressing the *PRINT* key (*SYSTEM* keypad).

PRINT →

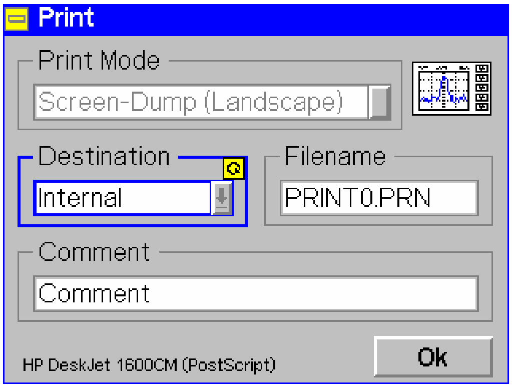


Fig. 4-4 Popup window Print

Print Mode

The *Print Mode* select field permits to specify the data type for the output:

Screen-Dump (Landscape) Copy of the current display in landscape format

An example of a screen-dump copy is shown in a preview to the right of the select field.

Destination

The *Destination* select field permits to specify the output destination for the data:

Printer Output to external printer connected via the parallel or one of the serial interfaces. The printer is configured in the *Setup – Print* tab; see p. 4.9 ff.

Internal Storing in the current printer format to directory c:\temp\<Dir> where <Dir> is the target directory specified in the *Filename Default* input field of the *Setup – Print* tab. If <Dir> is not explicitly defined, the files are written to c:\temp.

Internal WMF Storing in *.wmf format.

External Storing in the current printer format to the <Dir> target directory (see *Internal* above) on the PCMCIA card (slot 0, right-hand slot) or floppy disk (with option CMU-U61). A message box *Please insert disc ! Repeat ? Yes/No* pops up if no storage medium is inserted in the drive. To print, insert the appropriate medium and confirm with *Yes*.

External WMF Storing in *.wmf format to the PCMCIA card or floppy disk; see above.

Note: *To make processing of the generated data files easier, we recommend to use the External output destination.*

Filename

If the data is to be written to a file, a file name can be specified in the *Filename* input field. By default, files are stored with the file name defined in the *Setup –print* tab (see p. 4.9). The question mark (?) in this default name is replaced by current numbers starting with zero (auto-increment function). If a file name used before is specified, or if a file where the question mark has been replaced by "9" is already stored in the target directory*,* a message box *Print: overwrite existing file Yes/No* pops up. Pressing *No* aborts the print procedure and closes the *Print* popup menu.

Comment

The input field *Comment* contains a comment (comprising up to 160 characters) for the current output. This field is not available if a *.wmf output is generated. When the output is sent to a printer the comment is written across the upper edge of the page.

Printer format

The current printer format is indicated below the *Comment* input field. To change this format, open the *Setup –print* tab (see p. 4.9) to select another printer.

Ok

The *Ok* button starts the data output and closes the *Print* menu.

To cancel the print process while preserving the current settings and close the *Print* menu press the *PRINT* key again.

Remote control
–

Menu Select

The *Menu Select* menu gives an overview of all available measurements that can be selected and called up directly from the menu. The measurements are arranged in tables showing their hierarchical structure. *Menu Select* appears after termination of the startup procedure of the CMU or after pressing the *Menu Select* key. It is closed after selection on pressing the *ENTER* key or the *MENU SELECT* key again. The *ESCAPE* key discards the current selection.

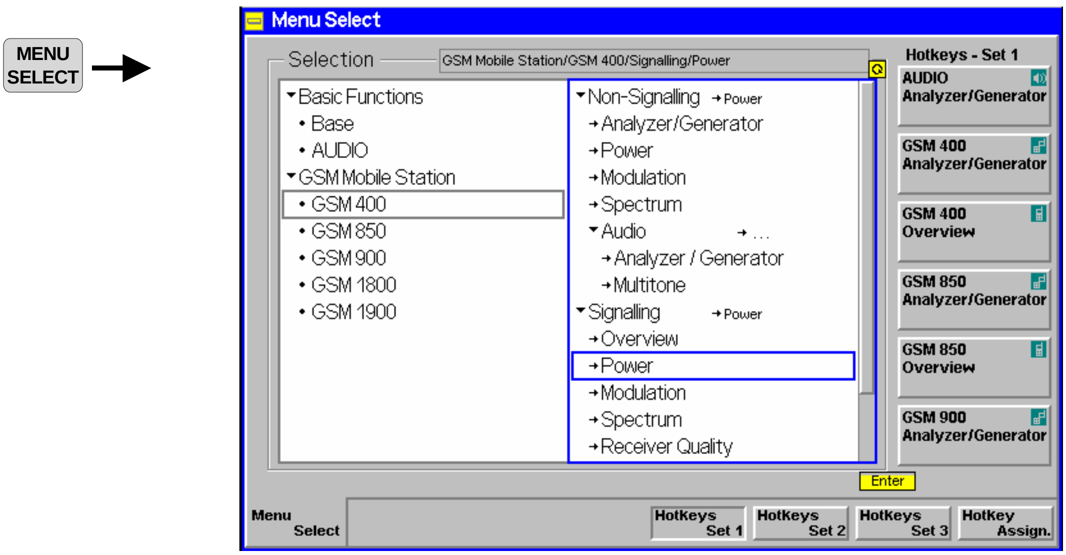


Fig. 4-5 Menu Select

Selection table: function groups

The left half of the *Selection* table contains all function groups available on the instrument. The CMU performs general RF measurements accessible via the function group:

RF RF measurements, see below in this Chapter

If equipped with option CMU-B41, it provides AF measurements via the function group:

Audio Audio generator and analyzer including multitone measurements, see below in this Chapter

It is a versatile measuring instrument for a large variety of digital and analog network tests (all of them are optional, see separate manuals). For a complete list of deliverable network tests please refer to the data sheet.

Selection table: test modes and menus

When a function group is selected, the measurements within this group are displayed in the right half of the table. A measurement generally consists of measurement menus and specific configuration menus. A complete graphical overview of all menus of the CMU basic system and the function groups *RF* and *Audio* can be found at the end of chapter 3 in this manual.

Most of the optional network test function groups are divided into the two independent test modes:

Non Signalling	Module tests; measurements without transmission of signalling parameters and call setup.
Signalling	Measurements with signalling and call setup to the device under test.

The test modes form the header lines of expandable table sections. A measurement may be available in both test modes of a function group, therefore, to uniquely define a measurement, it is necessary to specify its name, the test mode (if applicable) and the function group.

Example

In *Fig. 4-5*, the *Power* measurement is selected. This measurement belongs to the *Signalling* test mode in function group *GSM400-MS*. Another *Power* measurement belongs to the *Non Signalling* test mode of the same function group.

Hotkey Assign.

The *Hotkey Assign.* hotkey activates the assign mode used to assign a softkey to the function group, signalling mode and measurement menu currently selected.

The six softkeys of the *Menu Select* menu belonging to *Hotkeys Set 1* have a default assignment. In normal mode, each hotkey gives direct access to the menu assigned to it. Another two sets, each containing six softkeys, can be accessed by pressing the *Hotkeys Set 2* or *Hotkeys Set 3* hotkeys, respectively.

In the assign mode, the *Hotkey Assign.* softkey turns into *Exit Assign* softkey and *Hotkey Assignment* is displayed in the header of the *Menu Select* menu.

- To assign a softkey (or to change the current assignment), select the desired function group, mode and menu, and press *Hotkey Assign.* followed by the softkey. Press *Exit Assign.* to quit the assign mode.
- To cancel a hotkey assignment, press *Hotkey Assign.* followed by the *DEL* (delete) key and the softkey. Press *Exit Assign.* to quit the assign mode.

Note 1: *An empty configuration (all hotkeys de-assigned) will not be not stored after* Exit Assign. *Instead the CMU restores the default hotkey assignment of the current function group.*

Note 2: *A user-defined assignment is retained even after a Reset of all function groups* (Reset *key, see p. 4.3 f).*

Remote control

The CMU uses extended addressing: The instrument itself is identified by the primary GPIB address. Moreover, a secondary address must be assigned to any combination of a function group and a signalling mode. This is done with the command

```
SYSTem:REMote:ADDRess:SECondary <Address>,<FGrp>|NONE
```

Primary and secondary address handling is described in the remote control Chapters (in particular, refer to chapter 5 and the program examples in chapter 7).

Hotkeys Set 1

The *Hotkeys Set 1* hotkey selects the softkey set 1 for display. The hotkey is active in normal mode and in assign mode; see description of previous hotkey.

The two hotkeys *Hotkeys Set 2* and *Hotkeys Set 3* are analogous to *Hotkeys Set 1.*

Audio Multitone

The labeling of each softkey on the right side of the menu contains the function group, an icon indicating the test mode, and the measurement assigned to the softkey. The function of the softkeys is as follows:

- In normal mode, pressing a softkey calls up the corresponding measurement.
- In assign mode, pressing a softkey assigns this softkey to the measurement selected in the *Selection* table. Pressing the *DEL* (delete) key and then the softkey cancels the current assignment.

Popup Menu Setup

The popup menu *Setup* contains several tabs used to adapt the CMU to user requirements. The menus are opened by pressing the *Setup* key. It is possible to change between the tabs by pressing the associated hotkeys.

Printer Settings (Setup – Print)

The *Setup – Print* menu controls the output of data from the CMU to a printer or a storage medium. The following configurations are provided:

- Printer type and port selection *(Printer)*
- Page settings for the selected printer *(Page Settings)*
- A header for the printed page *(Header)*
- Default file name and directory *(Filename Default)*

Some of the *Setup – Print* configurations serve as default settings and can be modified in the *Print* popup menu before the print process is started (see p. 4.4).

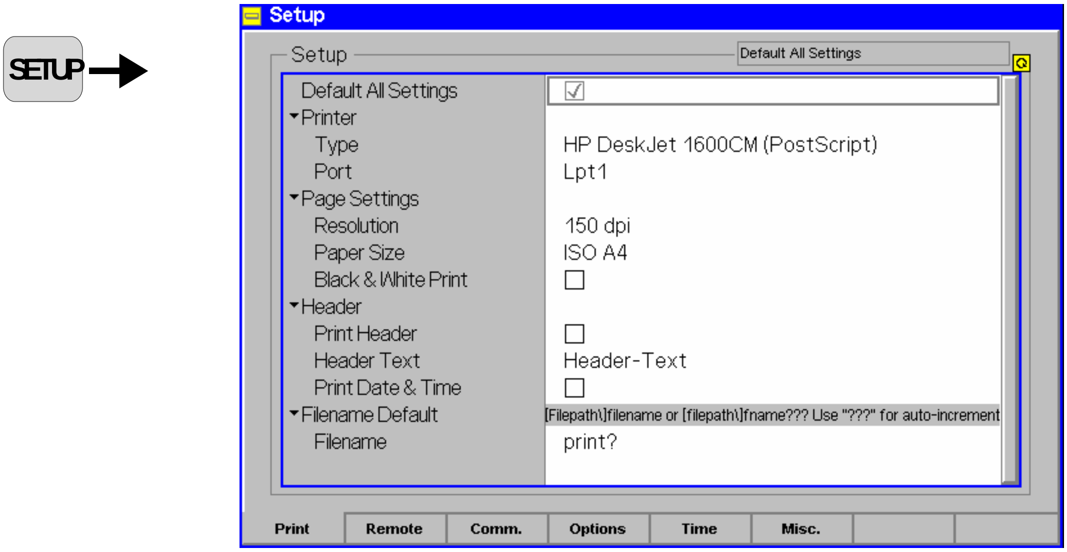


Fig. 4-6 Printer configuration menu (Setup – Print)

Default Settings The *Default All Settings* switch assigns default values to all settings in the *Print* tab (the default values are quoted in the command description in chapter 6 of this manual).

Printer The *Printer* table section selects a printer type and the printer port. The connection of a printer is described in chapter 1.

Page Settings The *Page Settings* section activates the input of the page settings for the selected printer.

Resolution	Fixed 150 dpi printer resolution
Paper Size	Selection of ISO A4 or US LETTER paper
Black & White print	Color (check box off) or black & white printer

Header

The *Header* section defines and activates header for the printed page.

Print header Print the header defined in the *Header Text* input field when a page is printed. An additional comment for every single page can be defined in the *Print* popup menu (see p. 4.4).

Header Text Input field for a header with a maximum length of two lines.

Print Date & Time Inclusion of the current date and time in the header, provided that a header is to be printed.

Filename Default

The *Filename Default* section defines a default file name and directory for an output that is written to an internal or external storage medium.

It is possible to specify a path separated from the filename by a backslash "\" in order to create a directory structure on the storage medium. This path is relative to directory c:\temp of the CMU hard disk *(Internal* storage) or the root directory of the *External* storage medium.

Auto-increment function

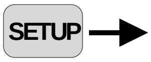
A question mark within the file name is replaced by current numbers that are automatically incremented, starting with zero. The file name *PRINT?* means that the first file stored will be *PRINT0*, the next one will be *PRINT1* etc. To create more than 10 different print files, another name or destination must be specified.

Remote control
–

Remote-control Settings (Setup – Remote)

The remote-control menu *(Setup Remote)* defines the remote-control parameters of the CMU:

- Selection of the interface *(SCPI-Connection),*Setting of the IEC-bus address of the CMU *(Primary Address)*,
- Selection of the desired function group *(Second. Address)*.



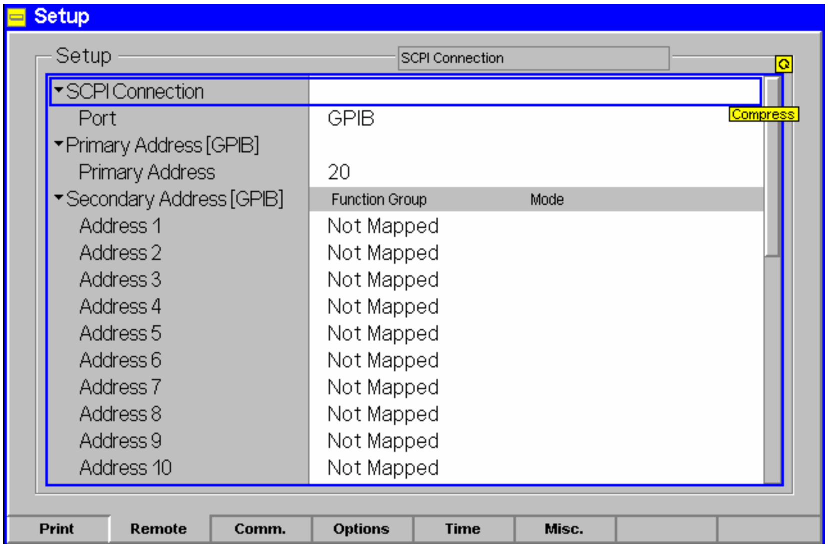


Fig. 4-7 IEC-bus menu

SCPI Connect

The *SCPI Connection* section determines the remote-control interface of the CMU.

The following interfaces are available:

GPIB	IEEE-bus interface according to IEEE 488
COM 1	Serial (RS-232-C) interface COM 1
COM 2	Serial (RS-232-C) interface COM 2

For the characteristics of the interfaces see Chapter 1 and Chapter 8, "Hardware Interfaces ".

Primary Address [GPIB]

The *Primary Address* section sets the IEC-bus address of the CMU. The default setting is 20; addresses 0 to 30 can be assigned.

The IEEE-bus address is addressed in the remote-control commands in the form of the associated primary address, see Chapter 5, *Switchover to Remote Control*, and Chapter 7, *Program Examples*.

Remote control

```
SYSTem:COMMunicate:GPIB[:SELF]:ADDRess  0 to 30
SYSTem:REMote:ADDRess:PRIMary  0 to 30
```

Second. Address [GPIB]

The *Second. Address* section assigns secondary addresses to up to 29 function group and test mode combinations (secondary address 0 is always mapped to the base system; no re-mapping is possible). The available function groups (e.g. *RF Non Signalling*, *GSM 900 Signalling* etc.) can be displayed and selected with the roll-key after an *Address n* field is activated.

The network and the test (signalling) mode are addressed in the remote-control commands in the form of the associated *secondary address*, see Chapter 5, *Setting the Device Addresses,* and Chapter 7, *Program Examples*.

Remote control

```
SYSTem:REMote:ADDRess:SECondary  1 to 29,<FgrpName> | NONE
```

Local ➠ Remote Transition

Defines the behavior of the CMU in a local to remote transition. The command is valid for all function groups and test modes, however, its effect depends on the test mode *(Signalling* or *Non Signalling* tests, see e.g. *GSMxxx-MS* manual):

Disconnection on (box checked) In *Signalling* mode, the connection or call is dropped and the CMU returns to its default signalling state (e.g. *SOFF* in the *GSMxxx-MS* function groups). In *Non Signalling* mode, all generators are switched off.

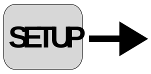
Disconnection off In *Signalling* mode, all signalling states are maintained. This makes it possible to switch the instrument to remote control without dropping a call or connection. In *Non Signalling* mode, the current operating state of all generators is maintained.

Remote control

```
SYSTem:GTRMode:COMPatible ON | OFF
```

Serial Interfaces (Setup – Comm.)

The interface menu *(Setup Comm.)* defines the transmission parameters of the serial outputs COM 1 and COM 2.



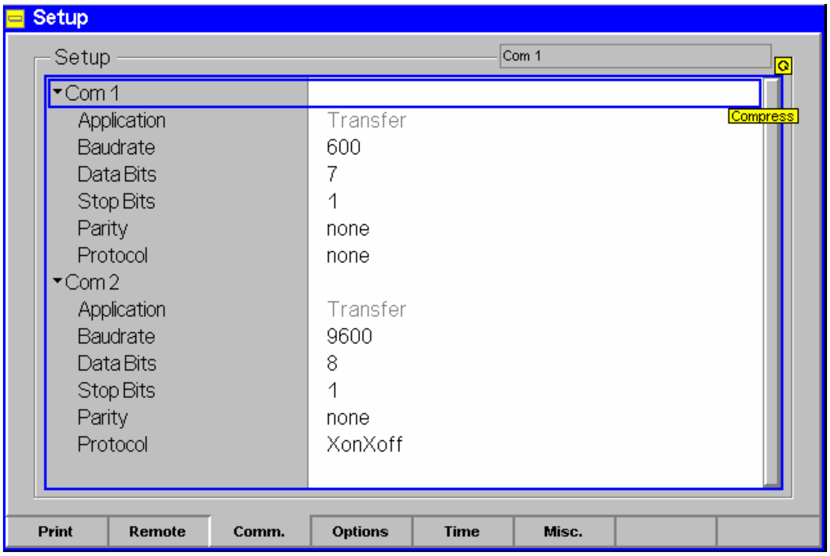


Fig. 4-8 Interface menu

COM 1

The COM 1 section defines the transmission parameters for the serial interface COM 1.

If required, the transmission parameters must be set such as to comply with the parameters of the addressed device (PC etc.). The interface characteristics are explained in detail in Chapter 8, *Hardware Interfaces*. The individual parameters are presented in *Table 4-1* below.

The *Application* field indicates whether the serial port is used as a printer connector *(Printer,* if COM 1 was selected as printer port in the *Print* tab; see p. 4.9) or for data transfer to the controller *(Transfer*, default setting). This parameter can not be changed in the *Comm.* tab.

Remote control
`SYSTem:COMMunicate:SERial1:APPLication`
`SYSTem:COMMunicate:SERial1:TRANsmit:PACE... etc.`

Table 4-1 Transmission parameters of the serial interfaces

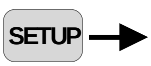
Parameter	**Meaning**	**Value range**
Application	Addressed device	Transfer | Printer (fixed setting)
Baud Rate	Data transmission rate	110 |300 | 600 | 1200 | 2400 | 4800 | 9600 | 19200 | 38400 | 57600 | 115200
Data Bits	Number of data bits	7 | 8
Stop Bits	Number of stop bits	1 | 2
Parity	Number of parity bits	none | odd | even
Protocol	Transmission protocol	none | XonXoff | CtsRts

COM 2 The COM 2 section defines the transmission parameters for the serial interface COM 2. The parameters are analogous to the COM 1 parameters.

Remote control
`SYSTem:COMMunicate:SERial2:APPLication`
`SYSTem:COMMunicate:SERial2:TRANsmit:PACE... etc.`

Enabling Options (Setup – Options)

The option menu *(Setup Options)* provides information on the type of instrument and the installed options, equipment and firmware versions *(Software Options, Hardware Options, Hardware Equipment, Firmware Versions)*. New software options purchased can be enabled in this menu using a code number.



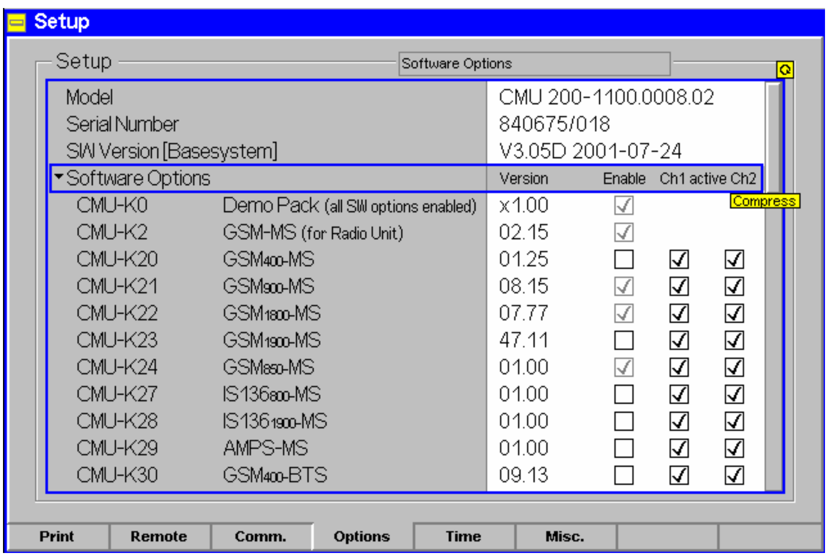


Fig. 4-9 Options menu

Info section: The three lines above the *Software Options* section contain the following information on the instrument.

Model	Instrument model
Serial No.	Serial number of the instrument
SW Version [Basesystem]	Installed base system firmware with date of release

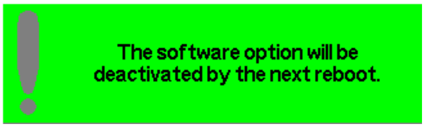
Remote control
`SYSTem:OPTions:INFO?`
addition information about the installed firmware options can be queried via
`SYSTem:OPTions:INFO:CURRent?` in all function groups and test modes.

Software Options

The *Software Options* section contains a list of all software options for the CMU. The check boxes behind each software option determine the system configuration:

Enable Enable (box checked) or disable software option. Options purchased with a new unit are already enabled. Software options purchased later must be explicitly enabled with a key code to be functional; see below.

Ch1 active Ch2 Activate (box checked) or deactivate software option on the next reboot. After deactivating an option by unchecking one of the boxes, the CMU displays the following message:



Deactivating software options that are temporarily not needed improves the system performance, especially during the start-up process when all active firmware options must be loaded. An enabled but deactivated option can be re-activated any time without any key code or other additional input.

Note: *Some options, e.g. options CMU-K39 to CMU-K43, are supplementary options extending the GSM-BTS and GSM-MS options. The supplementary options must be enabled with a key code but can not be deactivated. No* Ch1 active Ch2 *boxes are provided.*

Enabled options are active by default. Disabled options are inactive and can not be activated.

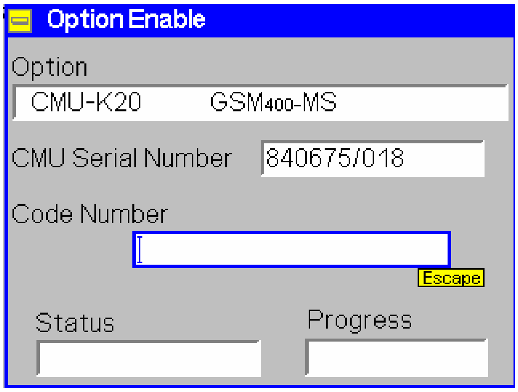
Remote control
`SYSTem:OPTions?`
`*OPT?`

Enabling software options

Software options can be enabled or disabled in the *Enable* check boxes of the *Software Options* table. As all software options are already included in the firmware, enabling does not require any re-installation, but only a key code which is supplied with the option.

- Select the respective line in the list of software options (in the example of *Fig. 4-9* the line *CMU-K20 GSM400-MS)*,
- Press the *Enter* key.

The popup window *Option Enable* appears on the screen:



The *Option Enable* window contains the following fields:

Option	Short designation and name of option
CMU Serial Number	Serial number of the CMU basic instrument

Code Number	Code number of the option to be installed
Status	Indication of the next operating step to perform
Progress	Progress of the enabling procedure

Of the five fields, only the *Code Number* can be edited. The name of the option being enabled and the serial number of the CMU are automatically entered into the corresponding fields.

- ➢ Enter the code number of the option in the input field *Code Number*.
- ➢ Confirm the entry using *Enter*.

The option is automatically enabled.

Remote control
–

Hardware Options / Hardware Equipment / Firmware Versions

The *Hardware Options* section lists all hardware options for the current CMU model (CMU200 or CMU300). Additional hardware accessories are listed in the *Hardware Equipment* section. The table shows the product index or *not installed*, if the CMU is not equipped with the hardware option or equipment.

Note: *An comprehensive list of the hardware equipment of the instrument is provided in the Info menu; see p. 4.18.*

The FW version for RXTX Board 1 (uP1) and RXTX Board 2 (uP2) is displayed in the *Firmware Versions* section. This information is mainly intended for service purposes.

Further information on the options can be found in the data sheet. Installation and removal of hardware options is described in Chapter 4 of the CMU service manual.

Note on Front Module controller

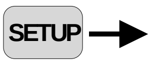
The version of the Front Module controller has an impact on the shut down process of the instrument; see Chapter 1, section Switching off the Instrument. *When operating instruments equipped with an FMR 6 in remote control mode, it is recommended to disable the nonvolatile RAM, see command* `SYSTem:NONVolatile:DISable` *in Chapter 6.*

Remote control
`SYSTem:OPTions?`
`*OPT?`

Time Settings (Setup – Time)

The *Setup Time* tab shows and permits to change the following settings:

- The (current) time zone, time and time convention *(Time)*
- The (current) date *(Date)*



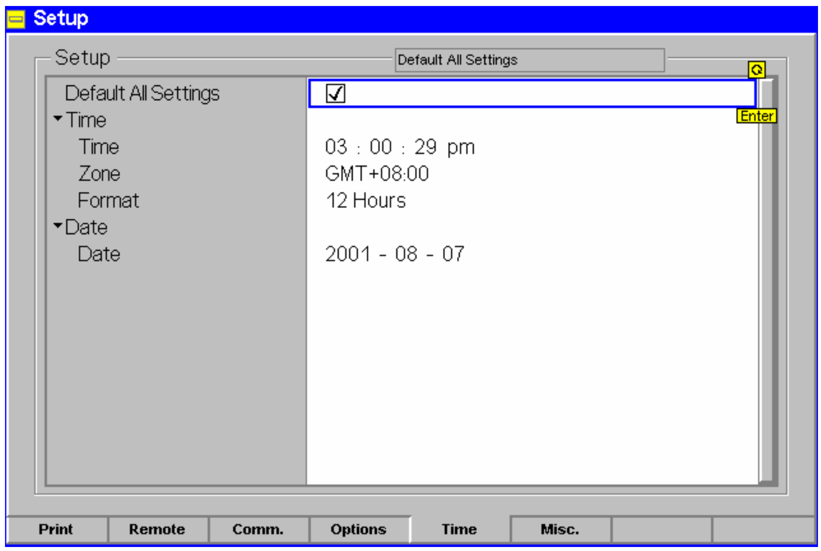


Fig. 4-10 Time menu

Default Settings The *Default All Settings* switch assigns default values to all settings in the *Time* tab (the default values are quoted in the command description in chapter 6 of this manual).

Remote Control
–

Time The *Time* table section sets the current time and its display format:

hh:mm:ss.	Time in the format hours:minutes:seconds	
Zone	Selection of the time zone, Middle European time (Greenwich mean time (GMT) + 1 h) is set by default	
Format	12 Hours:	12:00:00 am ... 11:59:59 am 12:00:00 pm ... 11:59:59 pm
	24 Hours	0:00:00 ... 23:59:59

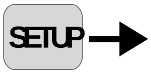
Remote control
`SYSTem:TIME:TIME`
`SYSTem:TIME:TZONe`

Date The *Date* section defines the current date in the format yyyy-mm-dd (year-month-day).

Remote control
`SYSTem:DATe`

Acoustic Signal and Keyboard (Setup – Misc.)

The *Setup Misc.* menu activates the acoustic signal *(key beep)* and selects the keyboard assignment *(Keyboard).*



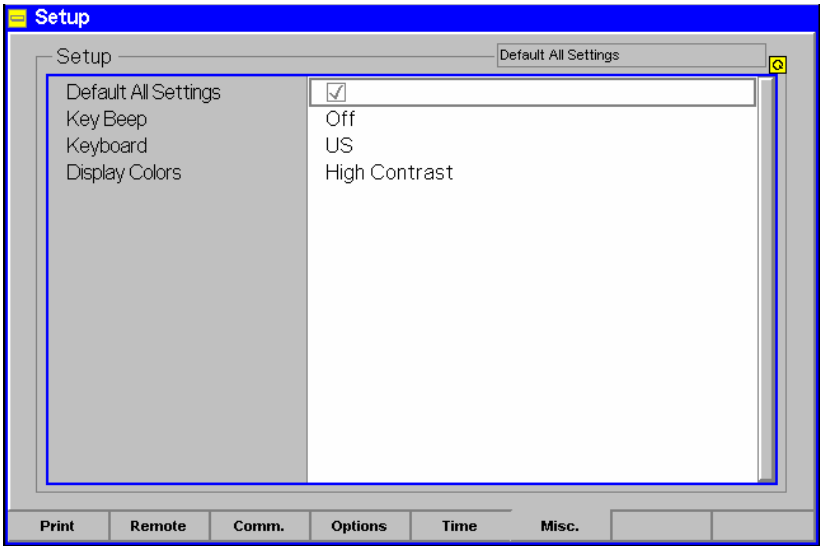


Fig. 4-11 Setup – Misc. menu

Key Beep *Key Beep* switches the acoustic signal of the CMU on or off. If the key beep is *On* the CMU sends a discreet acoustic signal whenever a key is pressed. The default setting is *Off*.

Remote control
`SYSTem:MISC:KBEep`

Keyboard *Keyboard* selects the keyboard assignment *(German* or *US* keyboard).

Remote control
`SYSTem:MISC:KEYBoard`

Display Colors *Display Colors* selects the brightness of the CMU's LC display. In the *High Contrast* setting, the display is darker; the contrasts are enhanced.

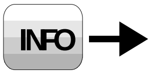
Remote control
No command, screen configuration only.

System Information (Info)

The *Info* popup menu, which is opened by pressing the *INFO* key, displays comprehensive information on the instrument and its components and provides a number of selftests.

Hardware Equipment

The *Hardware Equipment* tab of the *Info* menu lists all hardware equipment of the instrument. Part of the information is also displayed in the *Options* tab of the *Setup* menu; see p. 4.13 ff.



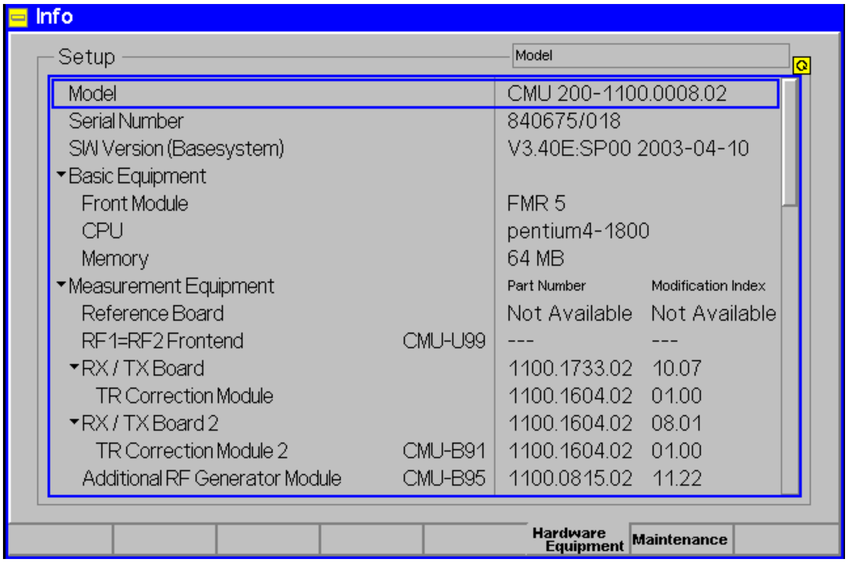


Fig. 4-12 Info – Hardware Equipment

Selftest (Info – Maintenance)

The *Maintenance* tab of the *Info* menu provides a number of selftests, primarily intended for service purposes.

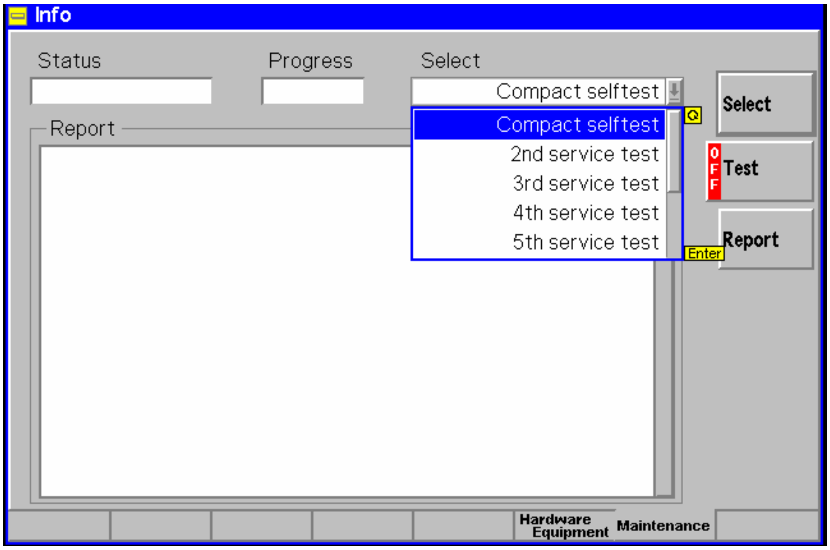


Fig. 4-13 Info – Maintenance menu

Select

The Select softkey selects the type of selftest to be carried out. If a test is selected and the *Test* softkey is pressed (see below), the selftest is started and the results are displayed in the *Report* window.

The tests are to retrieve diagnosis voltages and configuration info about different hardware modules, primarily for service purposes. The information is obtained as explained for *System Info.*

Remote control
–

Test

The *Test* softkey initiates the selftest selected via the *Select* softkey and displays it in the Report table.

The status of the selftest *(RUN, OFF, HLT;* the *RUN* state usually last only for a very short time) is indicated – like any other measurement status – on the left side of the softkey. It can be changed after softkey selection (press once) by means of the *ON/OFF* key.

A short description of the current test appears in the *Status* output field; its progress is shown in the *Progress* bar.

Remote control
–

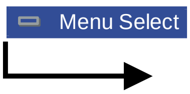
Report

The *Report* softkey activates the *Report* table, e.g. for scrolling.

Remote control
–

Selftest (Maintenance)

The *Maintenance* popup menu, which is accessible via the *BASE* function group in the *Menu Select* menu, complements the *Info* menu (see p. 4.18 above) in providing service information, selftests and correction procedures that are aimed to improve particular measurements. The selftests are primarily intended for production and service purposes and therefore not needed during normal operation of the instrument. The following description serves as a general overview.



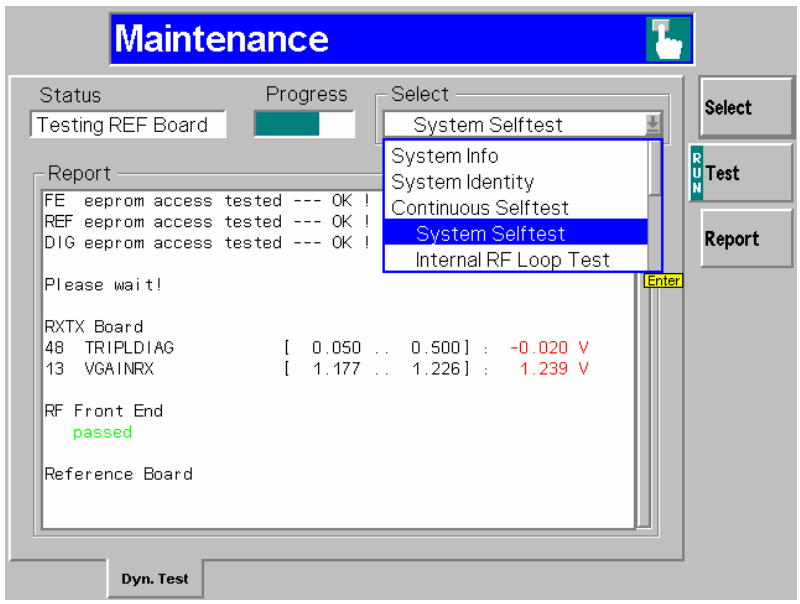


Fig. 4-14 Selftest – Maintenance menu

Select

The *Select* softkey selects the type of selftest or correction procedure to be performed.

Note: *The Select drop-down list always contains all entries listed below. If the selftest is started for a board that is not available in the unit, a message “<Board_Name> board is not available” is displayed.*

System Info Provides information on the system memory and the hardware and software configuration. If *System Info* is selected and the *Test* activated (see below), the CMU lists all deliverable hardware and software options in the report table and indicates whether they are available on your CMU.

System Identity Scans all modules and stores the part numbers and production data to file c:\identity.dat. In addition the available software versions are written to the log file C:\INTERNAL\LOG\VERSION.LOG.

Continuous Selftest	Continuous combined *System Selftest* and *Internal RF Loop* selftest. The continuous selftest is repeated until it is explicitly switched off.
System Selftest	Tests all modules one after another and displays a pass/fail message.
Internal RF Loop Test	Test of frequencies and levels at connectors RF1 and RF2 using the CMU's internal RF generator and analyzer with internal RF coupling.
1->4/3->2 RF Loop T.	Test of frequencies and levels for the RF path between the connectors RF1 –> RF4 IN and RF3 OUT –> RF2. For this test, special external N coax cables (included in service kit CMU-Z3) must be used to close the RF path.

The remaining tests are selftests for individual modules, e.g. Front End, Reference Board, Digital Board, RXTX Board 1, Audio Board, I/Q-IF Board (Option CMU-B17), Aux Tx Board (Option CMU-B95). Besides, the following correction procedures are available:

Audio Board Calib.	Improves the accuracy of Audio measurements (with option CMU-B41; see section *Audio Generator and Analyzer)*.
FM Modulation Calib.	Improves the accuracy of measurements on FM-modulated signals (e.g. for *Bluetooth* (CMU-K53), AMPS (CMU-K29)).
Correction Filter Cal.	Improves the accuracy of WCDMA modulation measurements (only with options CMU-K65/…/-K69 (CMU200) or CMU-K75/-K76 (CMU300) and CMU-Z6, see operating instructions for CMU-Z6, stock no. 1150.0199.12).
L1CoPro TX Calib.	Improves the level accuracy of the downlink WCDMA generator (option CMU-K66).
Internal Aux Tx Loop Test	Same as *Internal RF Loop Test,* but for the Aux Tx signal (option CMU-B99).

Remote control
–

Test

The *Test* softkey controls the selftest of the type selected via the *Select* softkey and displays the results in the *Report* table.

The status of the selftest *(RUN, OFF, HLT)* is indicated on the left side of the softkey. It can be changed after softkey selection (press once) by means of the *ON/OFF* key.

A short description of the current test appears in the *Status* output field; its progress is shown in the *Progress* bar.

Remote control
–

Report

The *Report* softkey activates the *Report* table, e.g. for scrolling.

Remote control
–

Data Handling (Data)

The *Data* popup menu, which is opened by pressing the *DATA* key, saves and recalls configuration files, handles log files for GSM layer 3 messages and manages the files in the internal and external memories that can be used for mass storage.

Saving Configurations (Data – Save)

The *Save* tab in the *Data* popup menu stores the current instrument settings to a configuration file. Configuration files have the extension *.SAV and contain the following information:

- All user-defined settings of a particular function group and test mode comprising all measurement settings (defined in the measurement configuration menus) and all general settings (defined in the *Connection Control* menu)
- For *Signalling* test mode, all settings concerning signalling (connection setup etc.)
- For the *Base* system, the current function group, test mode and measurement menu.

The configuration of several function groups and test modes can be written to a common configuration file. The configuration of the current session is automatically stored in the non volatile RAM before a session is terminated and re-activated when the CMU is started next time; see also Chapter 1, section *CMU VersionManager.*

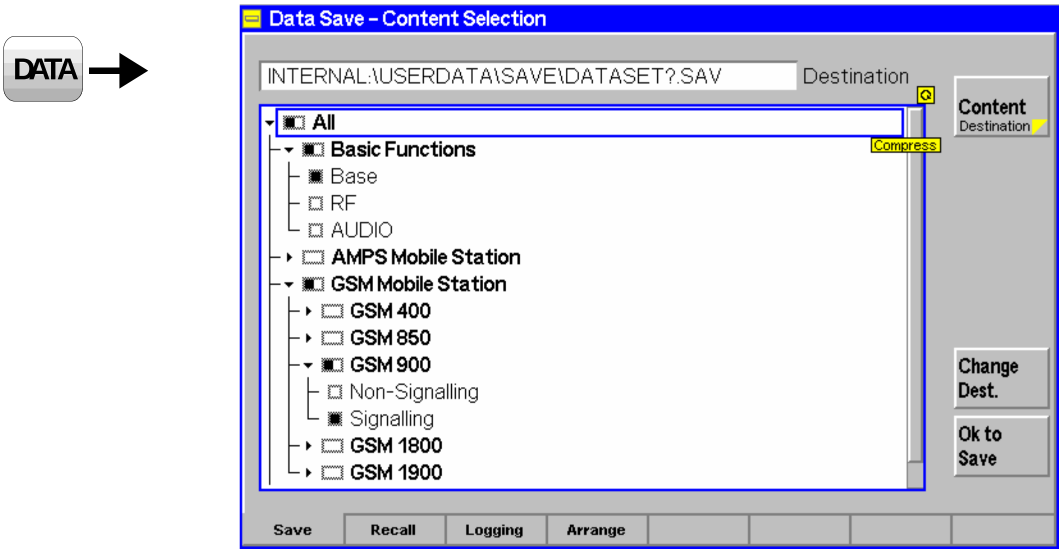


Fig. 4-15 Data – Save menu

Selection of function groups

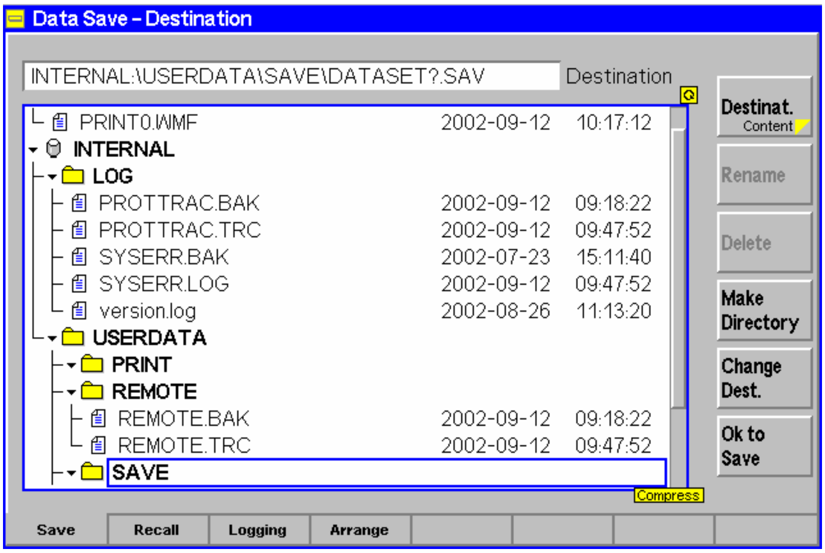
All function groups and test modes available on the instrument are arranged in a tree view showing the function groups and test modes to be saved to a configuration file. When the popup is opened, the configuration tree is expanded and the active function group and test mode is selected. The tree view is identical to the tree in the *Reset* menu (see section *Reset of Instrument Settings (RESET Key)* on p. 4.3 ff.).

The *Base* system is part of every software configuration and therefore selected by default irrespective of the current function group and mode. It is possible though to exclude the base system settings from the configuration file by deselecting the *Base* node.

Note: *If the base system is excluded from the configuration, the current function group, test mode and measurement menu are not stored to* *the configuration file. In this case it can be useful to write this information to the file comment; see Change Dest. softkey below.*

Content
Destination

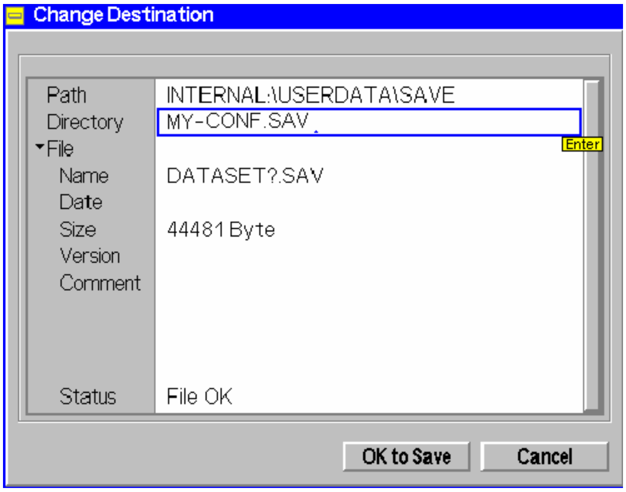
Content/Destination toggles between the configuration tree (see *Fig. 4-15 above*) and a view of the directories available for storing the configuration file (*.SAV). The *Destination* view is analogous to the *Arrange* tab; see section *File Manager (Data – Arrange)* on p. 4.29 ff.



Remote control
–

Change
Dest.

The *Change Dest.* softkey opens a dialog to specify the name and path of the created configuration file and enter a *Comment* to be stored with the file. See also *View Info/Rename* softkey on p. 4.30.



Editing the *Change Destination* dialog is optional: By default, the CMU stores configuration files to the directory *INTERNAL\USERDATA\SAVE* and uses the file names DATASET?.SAV where the question mark is replaced by current numbers that are automatically incremented, starting with zero (auto-increment function). To create more than 10 different configuration files, another name or destination must be specified. The information stored in a configuration file can not be edited.

Selecting *OK to Save* closes the dialog window and stores the inputs made. Pressing *Cancel* or *Change Dest.* again without selecting *OK to Rename* closes the dialog box, discarding all inputs made.

Remote control
The path, directory, file name and comment of an existing configuration file can be changed using the `MMEMory` commands; see section *File Manager (Data – Arrange)* on p. 4.29 ff.

OK to Save

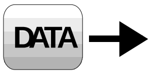
OK to Save saves the current configuration in all function groups and test modes selected in the configuration tree to the configuration file specified via *Change Dest.*

Note: *Saving only the configuration of the active function group is faster because no additional software modules must be loaded.*

Remote control
```
MMEMory:SAVE:CURRent <FileName> [,<msus>]
MMEMory:SAVE[:ALL] <FileName> [,<msus>]
```

Loading Saved Configurations (Data – Recall)

The *Recall* tab in the *Data* popup menu recalls and activates a configuration previously stored with the *Save* tab; see section current instrument settings to a configuration file (*.SAV); see section *Saving Configurations (Data – Save)* on p. 4.22 ff.



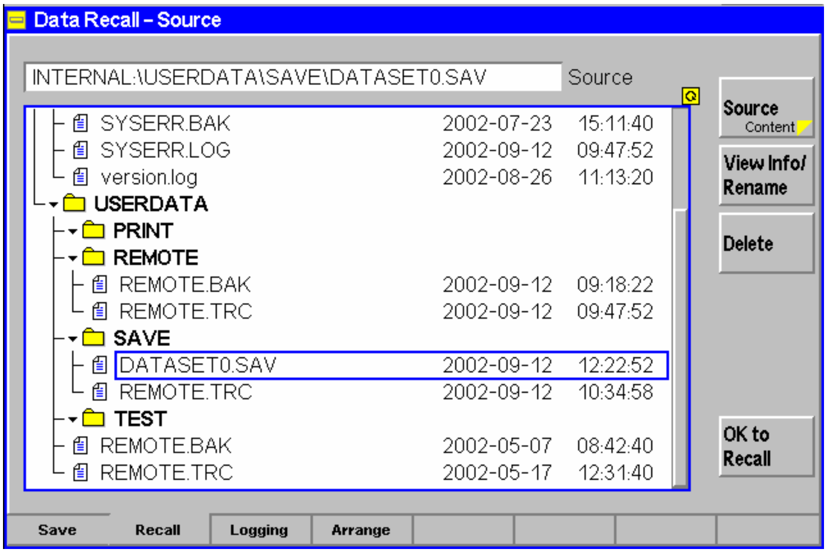


Fig. 4-16 Data – Recall menu

The *View Info/Rename* and *Delete* softkeys are equivalent to the softkeys of the same name in the *Arrange tab;* see section *File Manager (Data – Arrange)* on p. 4.29*.*

File selection

The stored files can be selected from a tree view in the center of the menu. The tree can be expanded and compressed using the roll-key and the *ON/OFF* key (see Chapter 3, *Expanding menu tables*). By default, configuration files are stored in the directory *INTERNAL\USERDATA\SAVE* and with the file names DATASET?.SAV, where the question mark is replaced by a current number.

Source Content

Source/Content toggles between the directory view (see *Fig. 4-16 above*) and the overview of function groups and test modes contained in a configuration file (configuration tree); see *Dir. View/Content* softkey on p. 4.30.

The configuration tree can be used for a partial recall of instrument settings: On recalling a configuration file, only the settings in the function groups and test modes selected in the configuration tree are overwritten. By default all function groups and test modes stored in the configuration file are selected.

Remote control
–

OK to Recall

OK to Recall recalls the selected configuration file and activates the stored settings for the function groups and test modes selected in the configuration tree.

The active function group, test mode and measurement menu is stored with the *Base* system settings when a configuration file is created. As a consequence the behavior of the CMU after a recall depends on whether or not the *Base* system settings are also recalled:

- After a recall including the base system settings the CMU enters the function group, test mode and measurement menu stored in the configuration file.
- After a recall excluding the base system (or a recall of a configuration file without base system information) the CMU returns to its current function group.

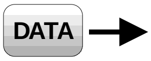
Note: *Recalling only a configuration of the active function group is faster because no additional software modules must be loaded.*

Before recalling and activating a configuration file, the instrument checks whether the settings are compatible with its current hardware configuration and software versions. If an incompatibility is detected, the configuration file is not recalled and an error message is generated. Configuration files are upward compatible and can be re-used in later firmware versions.

Remote control
```
MMEMory:RECall:CURRent <FileName> [,<msus>]
MMEMory:RECall[:ALL] <FileName> [,<msus>]
```

Layer 3 Message Log (Data – Logging)

The *Logging* tab in the *Data* popup menu activates recording of the layer 3 messages transferred during a GSM-MS Signalling session and selects a destination file for this information.



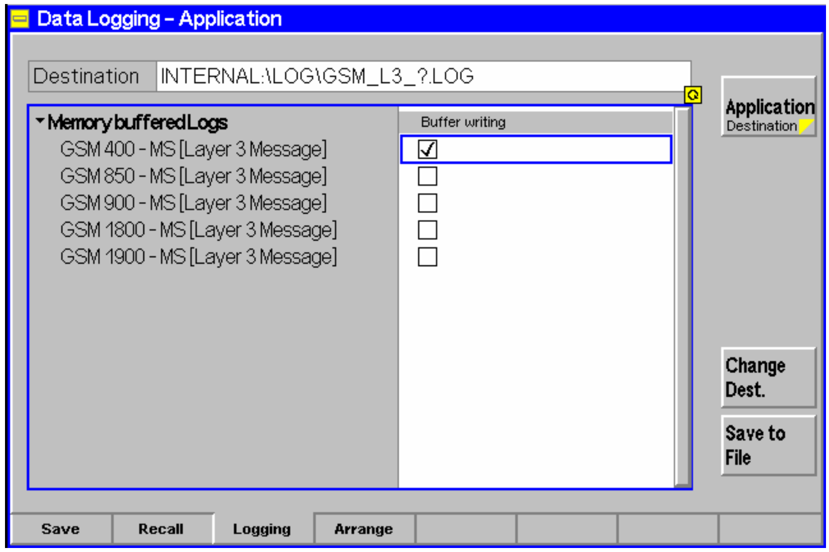
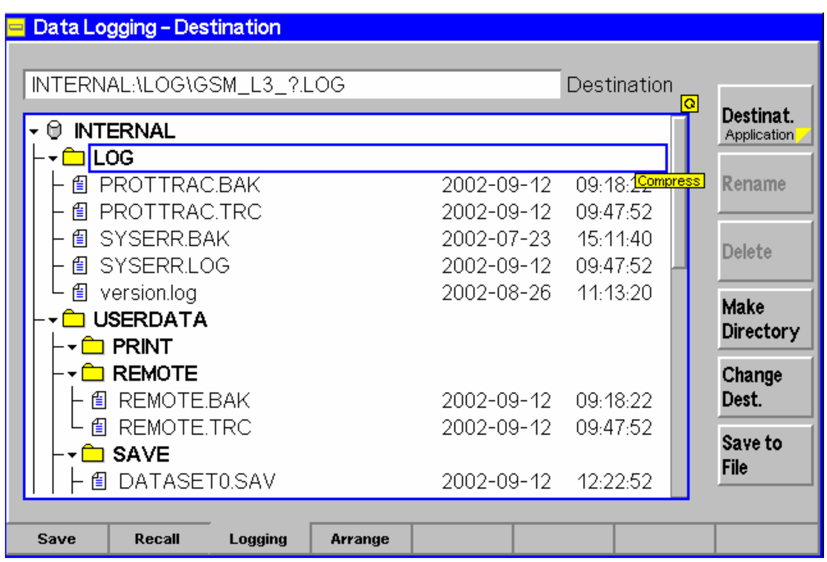


Fig. 4-17 Data – Logging menu

Application
Destination

Application/Destination toggles between the overview of available GSM networks (see *Fig. 4-17 above*) and a view of the directories available for storing the log file (*.LOG). The *Destination* view is analogous to the *Arrange* tab; see section *File Manager (Data – Arrange)* on p. 4.29 ff.



Remote control
–

Buffer Writing

The checkboxes in the *Buffer Writing* column control data recording in the five different GSM networks supported by the instrument.

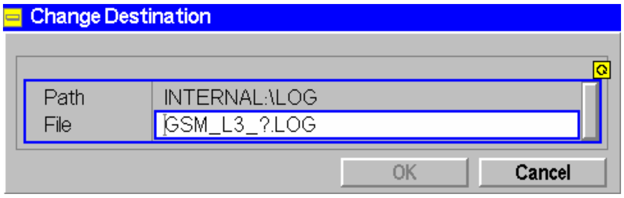
If buffer writing is enabled for a particular GSM network (box checked), the GSM layer 3 uplink and downlink messages transferred during a *GSM-MS Signalling* test session are stored in a ring buffer. The buffer size corresponds to approx. 3200 messages. Message types that are connected with information displayed in the CMU measurement menus, e.g. the MS receiver reports, are not recorded. Recording is continued even after a handover or a change of the network.

The contents of the ring buffer can be written to a binary file any time (even while *Buffer Writing* is enabled); see *Save to File* softkey below. Saving the buffer contents clears the buffer. On the other hand the buffer is not cleared when *Buffer Writing* is enabled.

Remote control:
The commands for the layer 3 message log belong to the *GSMxxx-MS Signalling* function groups:
`MMEMory:L3Msg:BWRiting ON | OFF`

Change Dest.

The *Change Dest.* softkey opens a dialog to specify the name and path of the created log file.



Editing the *Change Destination* dialog is optional: By default, the CMU stores log files to the directory *INTERNAL\LOG* and uses the file names GSM_L3_?.LOG where the question mark is replaced by current numbers that are automatically incremented, starting with zero (auto-increment function). To create more than 10 different log files, another name or destination must be specified.

Selecting *OK to Save* closes the dialog window and stores the inputs made. Pressing *Cancel* or *Change Dest.* again without selecting *OK to Rename* closes the dialog box, discarding all inputs made.

Remote control
The commands for the layer 3 message log belong to the *GSMxxx-MS Signalling* function groups:
`MMEMory:L3Msg:CDEStination <FileName> [,<msus>]`

Save to File

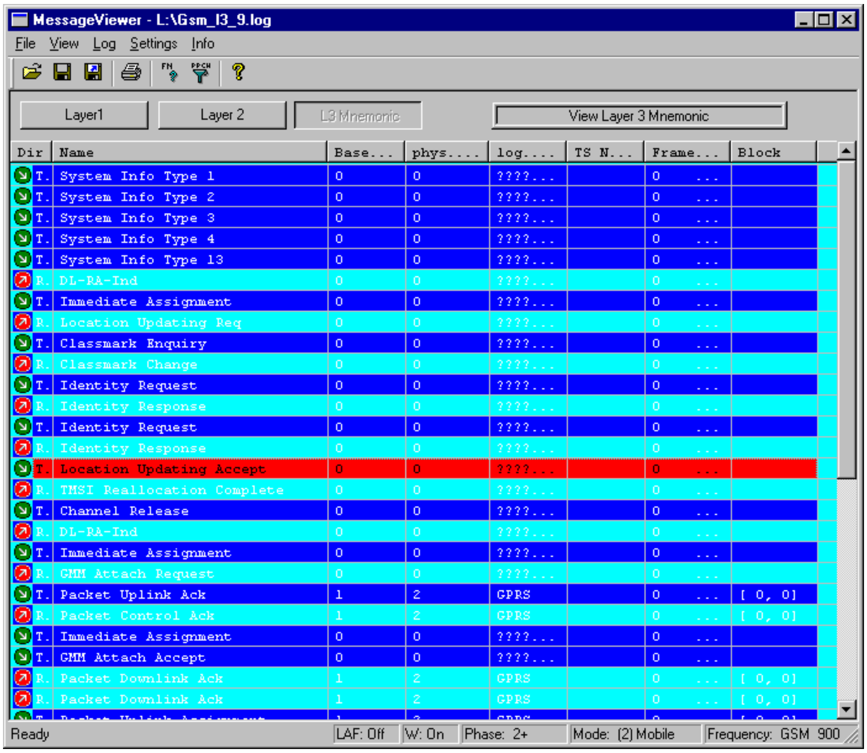
Save to File saves the current ring buffer content to the log file specified via *Change Dest.* and clears the ring buffer.

Note: *The contents of the ring buffer are also saved when the instrument is shut down, i.e. after pressing Alt+F4 on instruments equipped with a FMR 5 or during the normal shutdown process (ON/STANDBY key; "Shutdown in progress...") on instruments equipped with a FMR 6. To distinguish files created during shutdown from ordinary log files they are named GSM_L3_?.SAV where the ? is auto-incremented.*

Remote control
The commands for the layer 3 message log belong to the *GSMxxx-MS Signalling* function groups:
```
MMEMory:L3Msg:SAVe <FileName> [,<msus>]
MMEMory:L3Msg:BEMPty?
```

Transfer and Evaluation of Log Files

A log file can be transferred to a PC using the functions of the *Arrange* tab (see section *File Manager (Data – Arrange)* on p. 4.29 ff.) or via GPIB bus using the `MMEMory:DATA` command. Rohde & Schwarz provides an evaluation software tool for log files, the *Message Viewer* (option R&S CMU-Z49; the extended version R&S CRTU GP01, stock no. 1139.7590.02, allows to edit layer 3 messages). After loading the log file into the *Message Viewer,* the information can be evaluated as shown in the following examples. For more information please refer to the operating manual or help for the *Message Viewer.*



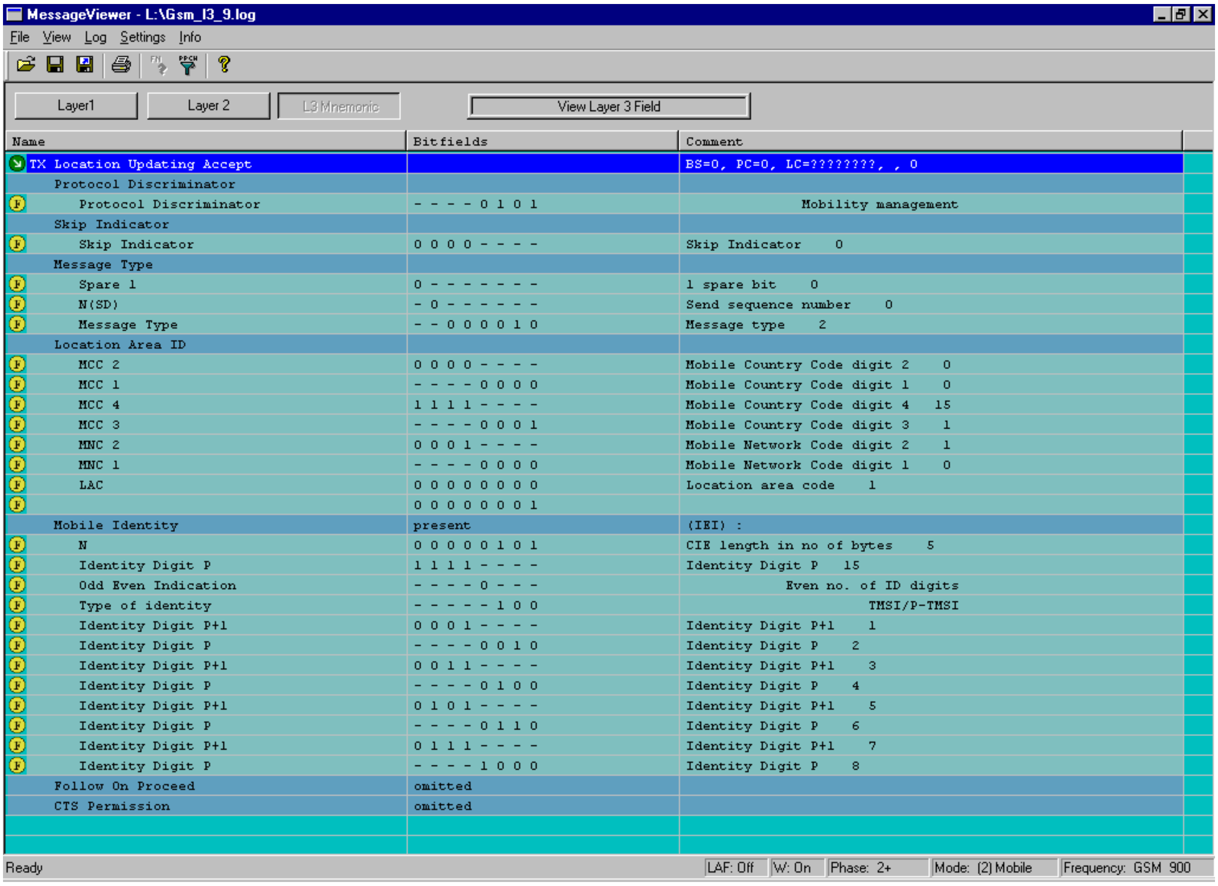


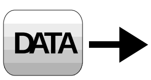
Fig. 4-18 Evaluation of log files

File Manager (Data – Arrange)

The *Arrange* tab in the *Data* popup menu manages the files in the internal and external memories that can be used for mass storage. The menu is particularly useful for handling files containing user data such as:

- Screenshots (*.wmf or printer format, see section *Print Menu (PRINT Menu)* on p. 4.4 f.)
- Log files (special binary *.log format, see section *Layer 3 Message Log (Data – Logging)* on p. 4.25 ff.)
- Remote report files (ASCii text files, see description of the remote screen in Chapter 5)

An extended file management functionality is available in remote control; see `MMEMory` system in Chapter 6.



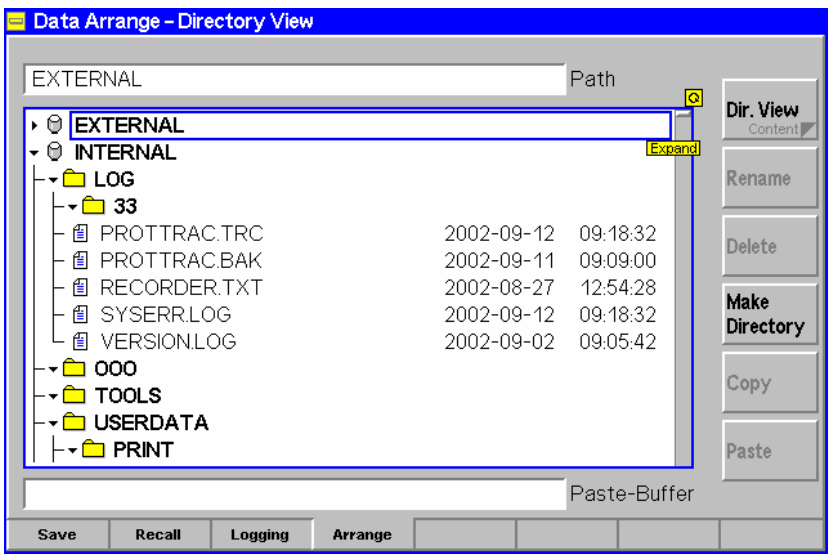
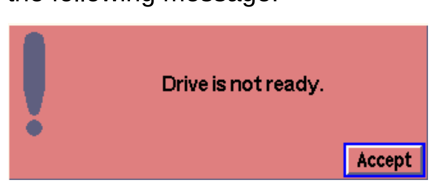


Fig. 4-19 Data – Arrange menu

File selection

The stored files can be selected from a tree view in the center of the menu. The tree can be expanded and compressed using the roll-key and the *ON/OFF* key (see Chapter 3, *Expanding menu tables*). It starts from the nodes for the *EXTERNAL* and *INTERNAL* mass storage devices:

EXTERNAL Root directory of the external storage device. Depending on the instrument configuration, this can be a floppy disk or a PCMCIA memory card, inserted in slot 0 (right side) of the PCMCIA interface. The *Data* menu does not discriminate between the two slots. If an attempt is made to expand the *EXTERNAL* directory while no external storage device is present, the CMU displays the following message:



➢ *Accept* the message, insert a suitable storage device and try again to expand the *EXTERNAL* directory and view its contents.

INTERNAL Root directory of the section on the internal hard disk that is reserved for mass storage.

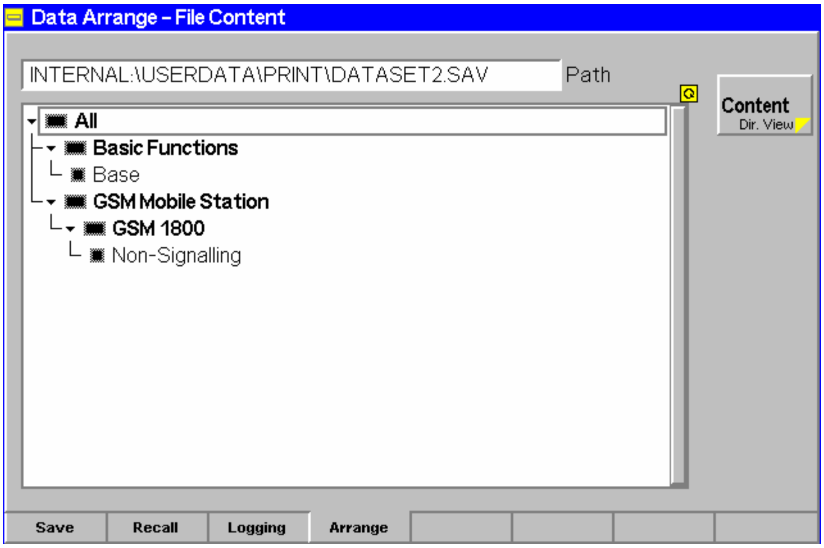
File indication / Paste Buffer

The output field above the tree view shows the path and name of the selected file. The *Paste Buffer* field below the tree view shows the path and name of a file that has been cut or copied to be pasted into another directory.

Remote control
`MMEMory:MSIS INTernal | EXTernal`

Dir. View Content

Dir. View/Content toggles between the directory view (see *Fig. 4-19 above*) and the overview of function groups and test modes contained in a configuration file (*.SAV). The *Content* view is available for configuration files only:



The *Content* view shows the path and name of the configuration file and all function groups and test modes contained in the file. The tree view is for information only. It is analogous to the trees in the *Reset* menu (see section *Reset of Instrument Settings (RESET Key)* on p. 4.3 ff.) and in the *Save* and *Recall* tabs of the *Data* menu, however, it only shows the function groups and test modes actually contained in the configuration file so that all rectangular symbols are black.

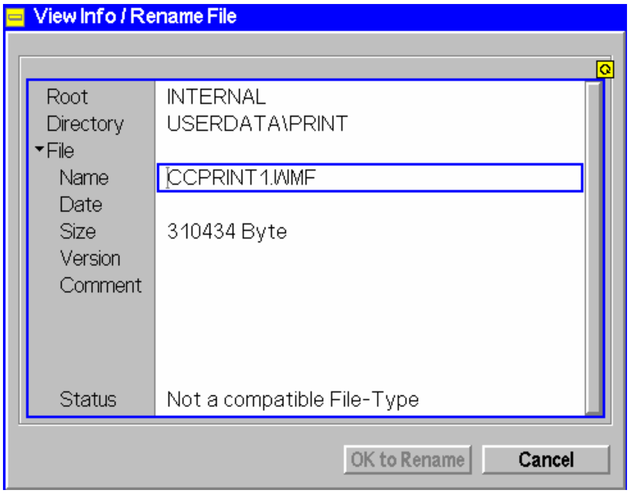
Remote control
–

View Info Rename

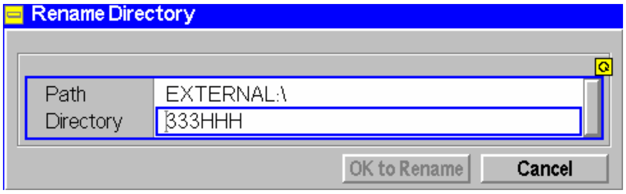
The *View Info/Rename* softkey opens a dialog to display and edit file information or assign a new name to the selected file or to a subdirectory.

The labeling of the softkey and its function depends on the selected node in the directory view:

- If a file is selected the softkey reads *View Info/Rename.* It opens a popup window showing the *Root* directory, the *Directory* plus other file information. The file *Name* and a *Comment* to be stored with the file can be edited. This can be done with the *DATA* keys on the front panel and the auxiliary editor (see Chapter 3) or even more conveniently using an external keyboard. The *Status* shows either *File OK* (for configuration files *.SAV) or *Not a compatible file type* (for all other file types).



- If a directory is selected, no particular information is needed so the softkey reads *Rename.* It opens a popup window to rename and move the directory by editing the *Path* and the *Directory* name. The path can be entered according to DOS conventions, if so desired. *Rename* is disabled (grayed) while the *EXTERNAL* and *INTERNAL* root directories or the reserved directories *Log, Userdata, Print, Remote, Save* are selected (the reserved directories are used internally to store important info files). Moreover, the maximum number of directory levels below the *EXTERNAL* and *INTERNAL* root directories is 5.

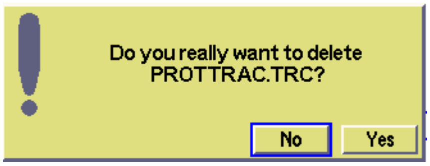


Selecting *OK to Rename* closes the dialog windows and renames the file or directory. Pressing *Cancel* or *View Info/Rename* again without selecting *OK to Rename* closes the dialog box without renaming the file.

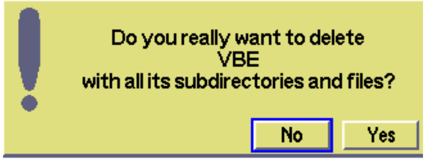
Remote control
```
MMEMory:INFO? <FileName> [,<msus>]
MMEMory:MOVE <FileSource>[,<msus1>], <FileDest> [,<msus2>]
```

Delete

The *Delete* softkey deletes the selected file or directory. Before an individual file is deleted, the CMU generates a warning:



Before a directory is deleted, the CMU generates a similar warning:



Selecting *Yes* deletes the file or directory; selecting *No* closes the warning messages without deleting.

Remote control
`MMEMory:DELete <FileName>, [INTernal | EXTernal]`
`MMEMory:RMDir <DirName>, [INTernal | EXTernal]`

Make Directory

The *Make Directory* softkey creates a new directory. The name and path of the new directory are entered into a *Make Directory* dialog box; see *Rename Directory* above.

Remote control
`MMEMory:MKDir <Dir_Name>[,<msus>]`

Copy

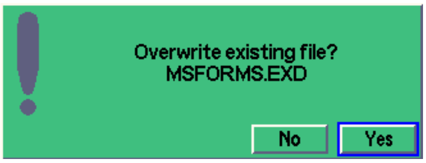
The *Copy* softkey stores the selected file or directory into the *Paste Buffer* so it can be copied to other directories or storage devices (see *Paste* softkey below). The original file or directory is not deleted, so the *Copy* function duplicates a file or a directory with all its contents.

Remote control
No direct equivalent. To replace the Copy/Paste mechanism use the command
`MMEMory:COPY <FileSource>[,<msus1>], <FileDest> [,<msus2>]`

Paste

- The *Paste* softkey stores the file or directory copied into the *Paste Buffer* to the current directory. It is disabled (grayed) if the *Paste Buffer* is empty. A copied file can be stored several times to different directories and storage devices. Pasting the file does not affect the *Paste Buffer.*

If the current directory contains a file or subdirectory with the same name; a warning is generated:



Selecting *Yes* overwrites the existing file or directory; selecting *No* closes the warning message without pasting the content of the buffer.

Remote control
No direct equivalent. To replace the Copy/Paste mechanism use the command
`MMEMory:COPY <FileSource>[,<msus1>], <FileDest> [,<msus2>]`

4 Functions

RF Measurements (RF)

This section describes the measurement and configuration menus of function group *RF*. It is organized as follows:

- Configuration of the RF output signal and RF analyzer settings *(Analyzer/Generator).*
- Measurement menus *(Power* and *Spectrum):* Measurement menus, results, configuration menus.
- General configurations *(Connection Control).*

The most important menus of the *RF* function group are shown in an overview at the end of chapter 3 in the present CMU manual.

Analyzer/Generator Menu

The main menu *Analyzer/Generator* configures the RF generator and analyzer and displays the power of the received RF signal.

The measurement control softkey *Analyzer Power* changes to *Power Meter Freq. Sel.,* depending on the application selected. This softkey controls the measurement, indicates its status *(RUN | HLT | OFF)* and opens the configuration menu *Analyzer/Generator Configuration*. The hotkeys associated to the measurement control softkey define the scope of the *Analyzer/Generator* measurement.

The other softkeys on the right side are combined with various hotkeys (e.g. the hotkeys *Frequency* and *RBW* belong to the softkey *Analyzer Settings).* The softkey/hotkey combinations provide test settings and switch over between different measurements.

The *RF* function group provides different types of power measurements. All power measurements are performed at fixed frequency. They differ in their measurement principle and filter settings, in the statistical evaluation and the display of results.

Analyzer Power

Analyzer Power is an application in the *Analyzer/Generator* menu. The measurement yields the average power of an RF input signal over a sweep; see section *Measurement Results* on p. 4.37 ff.

A wide range of measurement filters including a wideband filter is available. The accuracy of the *Analyzer Power* (including the wideband power) measurement is enhanced if the center frequency of the analyzer matches the frequency of the measured signal. The characteristics of the *Analyzer Power* measurement makes it particularly suitable for the analysis of CW signals where no measurement curves are needed.

Power Meter Freq. Sel.

Power Meter Freq. Sel. is the second application in the *Analyzer/Generator* menu. The measurement yields the average, minimum and maximum power of an RF input signal over a sweep plus a statistical evaluation over several consecutive sweeps; see section *Measurement Results* on p. 4.37 ff.

A wide range of measurement filters including the filters specified for TDMA and CDMA conformance tests is available. The measurement is always frequency selective; no wideband filter is provided. The measurement time depends on the filter bandwidth but never exceeds the order of magnitude of 100 ms for a single sweep. The frequency of the RF signal is also measured, provided that is close enough to the selected measurement frequency.

The characteristics of the *Power Meter Freq. Sel* measurement makes it particularly suitable for the analysis of CW signals where no measurement curves are needed.

Pow. Meter Wideband

Pow. Meter Wideband is displayed in the *RF* connector tab of the *Connection Control* menu. The 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 modulated RF signals, the result of the wideband power measurement depends on the modulation characteristics.

The main purpose of the measurement is to indicate whether an input signal is available and whether it is advisable to change the *Max Level* settings.

Power vs. Time The *Power vs. Time* measurement yields the power of the RF input signal over a variable time range. The result is displayed in a graphical diagram; see section *Power* on p. 4.40 ff.

The measurement is performed at fixed frequency. A wide range of Gaussian measurement filters is available. The *Power vs. Time* measurement can be used to analyze an RF signal with variable power, e.g. a burst signal.

Types of settings

The purpose of the *Analyzer/Generator* menu is to provide quick access to the most common RF analyzer and generator settings and to present the basic power results at a glance. Two measurement applications *Analyzer Power* or *Power Meter Freq. Sel.* 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 the RF function group. 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. 4.58 ff.). Examples of general settings are the *RF Max. Level* and the 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. 4.58 ff.). Examples of specific settings are the *Repetition* mode (to be set independently for all applications) and *Statistic Count* (not relevant for the *Analyzer Power* application).

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. 4.37 f.

The results displayed in the *Analyzer/Generator* menu represent only a small fraction of the power results that the CMU is able to acquire. More results are displayed in the *Power* and *Spectrum* measurement menus; see sections *Power* on p. 4.40 ff. and *Spectrum* on p. 4.48 ff. In particular, the *Power* and *Spectrum* menus show the results as a function of time and frequency.

The main menu *Analyzer/Generator* is opened from the main menu *Menu Select* (with associated key at front of instrument). It can also be accessed from the other measurement menus of the function group *RF* via the *Ana./Gen.* hotkey.

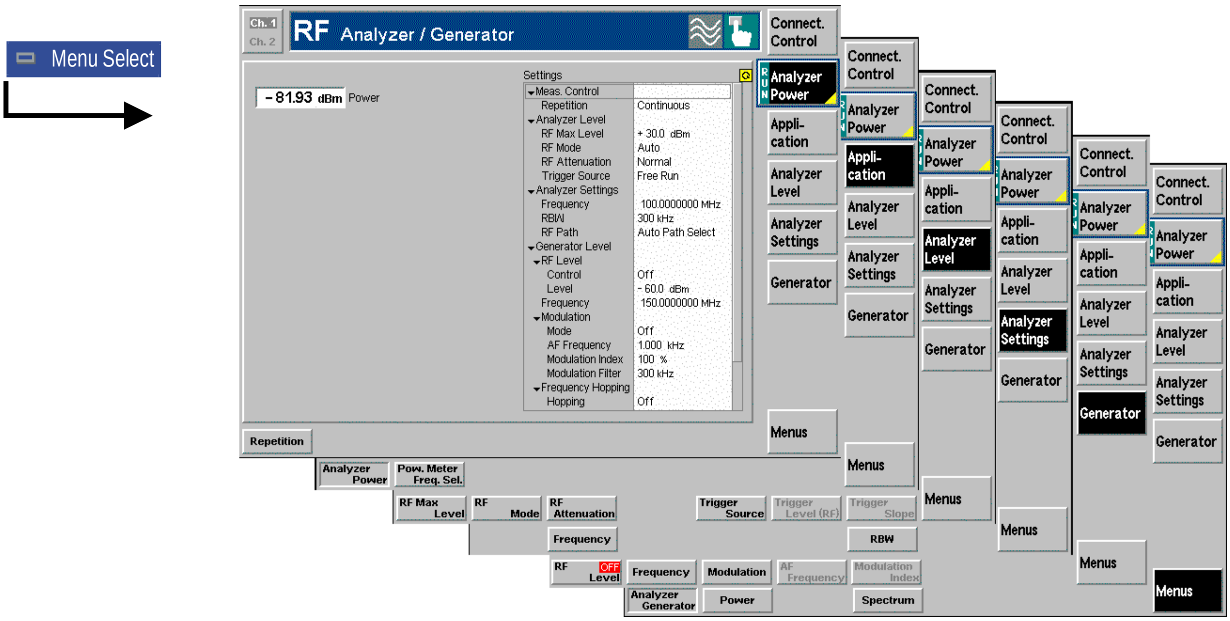


Fig. 4-19 Measurement menu Analyzer / Generator

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.

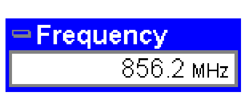
Example:

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)

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

Analyzer Power

The *Analyzer Power* softkey (which changes to *Power Meter Freq. Sel.,* depending on the application selected) controls the measurement application and indicates its state *(RUN | HLT | OFF)*. This state can be changed after softkey selection (pressing once) by means of the *ON/OFF* key or the *CONT/HALT* key. The state can be set independently for all three applications.

Remote control

```
INITiate:RFANalyzer
ABORt:RFANalyzer
STOP:RFANalyzer
CONTinue:RFANalyzer
FETCh:RFANalyzer:STATus?
FETCh[:SCALar]:RFANalyzer:POWer[:RESult]? etc.
```

Measurement configuration

The configuration menus for the RF analyzer and generator are directly accessible from the *Analyzer/Generator* menu: Pressing the *Analyzer Power* softkey twice opens the popup menu *Analyzer/Generator Configuration* (see page 4.38 ff.).

Besides a number of hotkeys defining the scope of the measurement are associated to the *Analyzer Power* softkey. The corresponding settings are specific to the *Analyzer/Generator* menu and also provided in the *Control* tab of the *Analyzer/Generator Configuration* menu; see section *Analyzer/Generator Configuration* on p. 4.38 ff.

Application

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. Details about the measurements and the results are explained in section *Measurement Results* on p. 4.37 f.

Analyzer Power

The *Analyzer Power* hotkey selects the measurement of the peak power using a filter with variable bandwidth or a wideband filter. In this application no statistical evaluation of the results is provided.

Remote control
The *Analyzer Power* application corresponds to the `RFANalyzer` subsystem.

Pow. Meter Freq. Sel.

The *Pow. Meter Freq. Sel.* hotkey selects the measurement of the peak and average power using a wide selection of narrow-band (and therefore frequency selective) filters. In this application a statistical evaluation of the results is provided.

Remote control
The *Pow. Meter Freq. Sel.* application corresponds to the `NPOWer` subsystem.

Analyzer Level

The *Analyzer Level* softkey controls the level in the RF input signal path and provides the trigger settings for the current measurement.

The input level and trigger settings are general settings and therefore also provided in the *Connection Control* menu. They are described in more detail in sections *Analyzer Settings – Table-Oriented Version* on page 4.59 and *Trigger (Connection Control – Trigger)* on p. 4.72 ff.

Analyzer Settings

The *Analyzer Settings* softkey determines the center frequency of the RF analyzer and the resolution bandwidth of the measurement filter. The settings are specific to the *Analyzer/Generator* menu and also provided in the *Control* tab of the *Analyzer/Generator Configuration* menu; see section *Analyzer/Generator Configuration* on p. 4.38 ff.

Generator
Tx Aux Tx

The *Generator* softkey configures the RF signals generated. The generator settings are general settings and therefore also provided in the *Connection Control* menu. They are described in more detail in section *Generator Settings (Connection Control – Generator)* on p. 4.61 ff.

The *RF Level* hotkey is also used to switch the RF generator on and off.

If option R&S CMU-B95, *Second RF Generator,* is fitted, the *Generator* softkey toggles between the primary RF signal *(Tx)* and the auxiliary RF signal *(Aux Tx)* settings. The properties of the *Aux Tx* signal are also described in section *Generator Settings (Connection Control – Generator)* on p. 4.61 ff

Settings table

The *Settings* 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 rotary knob scrolls and expands the *Settings* table.

Measurement Results

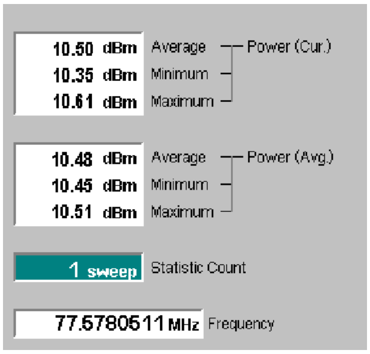
The results displayed in the *Analyzer/Generator* menu depend on the selected application. All results are obtained at a definite frequency and resolution bandwidth; see *Analyzer Settings* softkey on p. 4.36.

Analyzer Level:

The result for the *Analyzer Level* application appears in a single output field.

The indicated *Power* is the power of the RF input signal measured at the selected frequency and RBW and averaged over a basic evaluation period/sweep of 4096 samples. The result is updated after each sweep.

Pow. Meter Freq. Sel.:



The results for the frequency selective power meter *(Pow. Meter Freq. Sel.)* application are displayed in several groups of output fields. All results are obtained at the selected frequency and RBW. The statistical evaluation is based on a basic evaluation period/sweep of 4096 samples and on the statistics cycle *(Statistic Count)* defined in the configuration menu (see section *Analyzer/Generator Configuration* on p. 4.38 ff.; for a general description of statistical evaluations in the CMU refer to Chapter 3, section *General Settings)*.

Power (Curr.)	Average, minimum and maximum power of the RF input signal in the current sweep
Power (Avg.)	Average, minimum and maximum of the *Power (Curr.)* values: The *Maximum (Minimum)* value is the largest (smallest) power ever measured in the current measurement. *Average* is the average over all *Average – Power (Curr.)* values in the current measurement, obtained according to the averaging rules described in Chapter 3, section *General Settings.*
Statistic Count	Number of sweeps per statistics cycle. The colored bar indicates the relative measurement progress in the statistics cycle
Frequency	Frequency of the RF input signal. The frequency can be measured with an accuracy of 0.1 Hz.

Analyzer/Generator Configuration

The popup menu *Analyzer/Generator Configuration* configures the RF analyzer measurements. It is opened by pressing the *Analyzer Power* measurement control softkey in the Analyzer/Generator menu twice.

In the *Control* tab of the *Analyzer/Generator Configuration* menu both power measurement applications of the *Analyzer/Generator* menu can be configured independently. The tab defines:
The center *Frequency* of the RF analyzer

The Repetition mode

The *Statistic Count* for the measurement (for the *Power Meter Freq. Sel.* measurement only)

The *Resolution Bandwidth* of the measurement filter

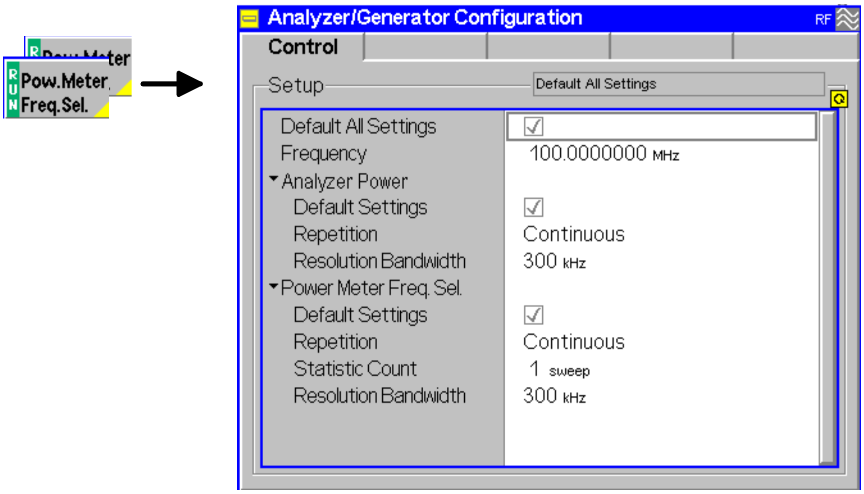


Fig. 4-20 Analyzer/Generator Configuration – Control

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 applications are provided.

Remote control
–

Frequency *Frequency* defines the center frequency of the RF analyzer. This setting is valid for both *Analyzer/Generator* measurement applications.

Remote control
`[SENSe:]RFANalyzer:FREQuency <Frequency>`

Resolution Bandwidth *Resolution Bandwidth* defines the resolution bandwidth of the analyzer. The nominal resolution bandwidth is the 3-dB bandwidth of the measurement filter. The bandwidths available depend on the measurement application:
For both applications, a list of Gaussian filters with discrete bandwidths between 10 Hz and 1 MHz is available. The frequencies in the list are given by $1x10^n$ Hz, $2x10^n$ Hz, $3x10^n$ Hz, $5x10^n$ Hz where n=1 to 5. In addition the value 1 MHz is provided.

The *Analyzer Power* measurement can be performed with a *WIDE* resolution bandwidth (denoting measurement at the front end with no restriction of the analyzer frequency and level). The wide-band measurement is most accurate if the correct center frequency is set.

The *Pow. Meter Freq. Sel.* measurement can be performed with the root-raised cosine filter specified in standard TIA/EIA-136.xxx *(TDMA* filter) or with an 1.4 MHz bandpass filter specified for CDMA measurements *(CDMA* filter).

Resolution bandwidths for the *Power* and *Spectrum* measurements can be set independently (pp. 4.40, 4.49).

Remote control
```
[SENSe:]RFANalyzer:BWIDth[:RESolution] <Bandwidth>
[SENSe:]NPOWer:BWIDth[:RESolution] <Bandwidth>
```

Repetition

Repetition determines the repetition mode. Repetition modes for the applications *Analyzer Power* and *Power Meter Freq. Sel.* can be set independently.

Single Shot Single-shot measurement: the measurement is stopped after one sweep comprising 4096 samples. A stopped measurement is indicated by the status display *HLT* in the *Power* softkey.

Continuous Continuous measurement: The CMU measures continuously until the measurement is explicitly stopped via the measurement control softkey in the graphical measurement menu (see *Analyzer Power* softkey on p. 4.35). The measurement results are valid after one sweep; however, the measurement is continued, and the output is continuously updated. An ongoing measurement is indicated by the status display *RUN* in the *Power* softkey.

Single shot should always 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 repetition mode with a defined number of measurement cycles to be performed, see chapter 6 of this manual.*

Remote control
```
CONFigure:RFANalyzer:CONTrol:REPetition
     CONTinuous | SINGleshot | 1 ... 10000,NONE,<Stepmode>
CONFigure:NPOWer:CONTrol:REPetition
     CONTinuous | SINGleshot | 1 ... 10000,NONE,<Stepmode>
```

Statistic Count

Statistic Count defines how many sweeps are combined to form one statistics cycle. Each sweep consists of 4096 samples. This setting is available for the *Power Meter Freq. Sel.* application; for *Analyzer Power* measurements the *Statistic Count* is always equal to one.

1 to 1000 sweeps Number of sweeps per statistics cycle

The settings *1* and *OFF* (press *ON/OFF* key) are equivalent. A statistics cycle determines the duration of single-shot measurements *(*see Chapter 3, section *General Settings*).

Remote control
```
CONFigure:NPOWer:CONTrol:STATistics  1 ... 1000 | NONE
```

Power vs. Time Measurement

The menu group *Power* is designed to measure the RF signal power as a function of time (oscillographic representation measured at a specific frequency, e.g. for burst analysis). The popup menu *Power Configuration* is used for configuration of the measurements; the measurement results are displayed in the graphical measurement menu *Power*.

Note: *The RF function group provides a wide selection of power measurements. For an overview see section Analyzer/Generator on p. 4.33 ff.*

Measurement Menu (Power)

The graphical measurement menu *Power* displays the results of the power measurement in the time domain.

The main softkey *Power* controls the measurement, indicates its status *(RUN | HLT | OFF)* and opens the configuration menu *Power Configuration.* The hotkey associated to the main 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 *Frequency* and *RBW* belong to the softkey *Analyzer Settings).* The softkey/hotkey combinations provide test settings and display configurations.

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 *Power* hotkey.

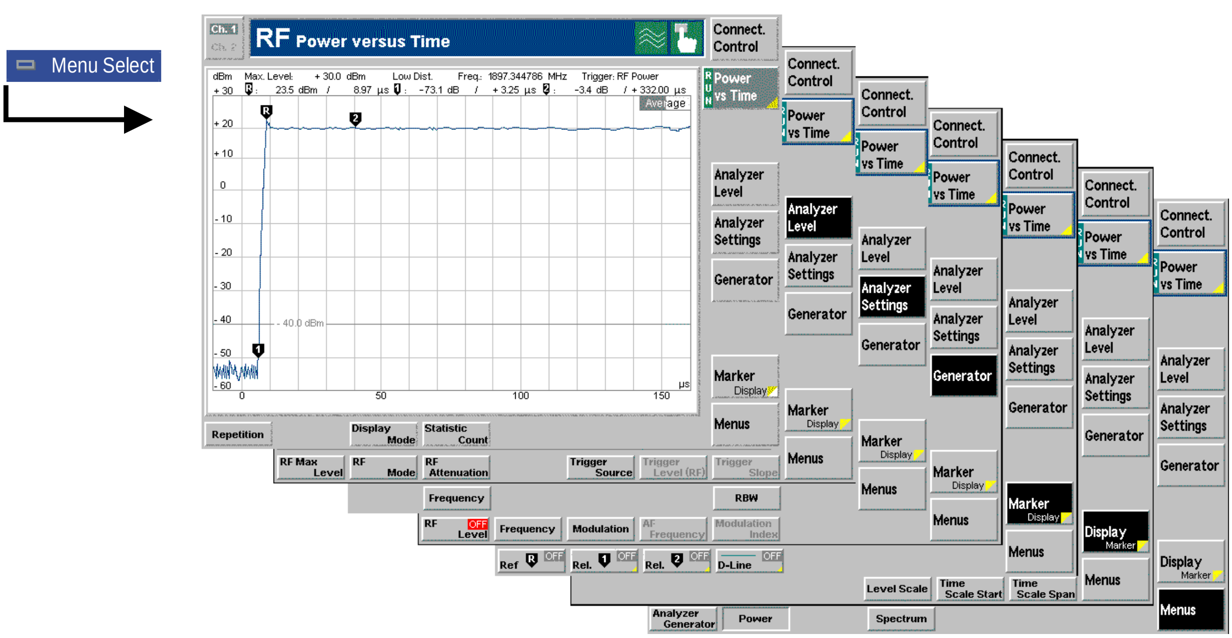


Fig. 4-21 Measurement menu Power

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 p. 4.35 ff.

Some of the basic settings are also accessible from the *Power Configuration* popup menu. They are explained in more detail in the *Measurement Configurations (Power Configuration)* section on page 4.45 ff.

Power vs Time

The *Power vs Time* softkey controls the power 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.

Remote control
```
INITiate:POWer; ABORt:POWer; STOP:POWer; CONTINUE:POWer
FETCh:POWer:STATus?
```

Measurement configuration

Pressing the *Power vs Time* softkey twice opens the popup menus *Power Configuration* (see page 4.45). 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 Configurations (Power Configuration)* section on page 4.45 ff.

Analyzer Level

The *Analyzer Level* softkey controls the level in the RF input signal path and provides the trigger settings for the current measurement.

The input level and trigger settings are general settings and therefore also provided in the *Connection Control* menu. They are described in more detail in sections *Analyzer Settings – Table-Oriented Version* on page 4.59 and *Trigger (Connection Control – Trigger)* on p. 4.72 ff.

Analyzer Settings

The *Analyzer Settings* softkey determines the center frequency of the RF analyzer and the resolution bandwidth of the measurement filter. The settings are specific to the *Power* menu and also provided in the *Control* tab of the *Power Configuration* menu; see section *Measurement Configurations (Power Configuration)* section on page 4.45 ff.

Generator Tx Aux Tx

The Generator softkey configures the RF signals generated. The generator settings are general settings and therefore also provided in the Connection Control menu. They are described in more detail in section *Generator Settings (Connection Control – Generator)* on p. 4.61 ff.

The RF Level hotkey is also used to switch the RF generator on and off.

If option R&S CMU-B95, *Second RF Generator*, is fitted, the *Generator* softkey toggles between the primary RF signal *(Tx)* and the auxiliary RF signal *(Aux Tx)* settings. The properties of the *Aux Tx* signal are also described in section *Generator Settings (Connection Control – Generator)* on p. 4.61 ff

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 bits), 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 to mark and read out an arbitrary level in the test diagram.

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 rotary knob.

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 RF 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.

Level Scale

The *Level Scale* hotkey defines the level range of the *Power* test diagram (ordinate scale). The scale can be adjusted in 0.1 dB steps. Note that, in contrast to the reference level, the range selection doesn't have any impact on the measurement.

The ordinate scale is calculated from the maximum level defined in the *Connection Control* menu (see section *Analyzer Settings – Table-Oriented Version* on page 4.59) and the range such that

- The *Max Level* defines the upper edge of the diagram.
- The difference *Max Level – Level Scale* defines the lower edge of the diagram.
- The number of horizontal grid lines (corresponding to 10, 15, or 16 cells) and the ordinate labeling is adapted to the range.

Remote control
`[SENSe:]POWer:LEVel:RANGe <Range>`

Time Scale Start

The *Time Scale Start* hotkey defines the left edge of the *Power* test diagram (abscissa scale). The time scale of the diagram is derived from the *Time Scale Start* and the *Time Scale Span* assuming a constant number of 10 horizontal cells:

- *Time Scale Start* defines the left edge of the diagram.
- *Time Scale Start* + *Time Scale Span* defines the right edge of the diagram.
- The abscissa labeling is adapted to the defined time scale.

Time Scale Start is defined relative to the trigger time (delay). The permissible range of start times depends on the span (see below) and on the resolution bandwidth of the power measurement. As a general rule, larger values are allowed if the span is increased and the resolution bandwidth decreased.

Remote control
`[SENSe:]POWer:TIME:DELay <Delay>`

Time Scale Span

The *Time Scale Span* hotkey defines the time range of the *Power* test diagram (abscissa scale). The span is equal to the total measurement range of the *Power* measurement.

The time scale of the diagram is derived from the *Time Scale Start* and the *Time Scale Span* as explained above.

Remote control
`[SENSe:]POWer:TIME:SPAN <Span>`

Menus

The Menus softkey displays the hotkey bar for switching over to the other measurement menus.

Measurement Results

The values represented in the measurement menu *Power* can be divided into three groups:
Setting values

Scalar measurement results (marker values)

The trace plotted as a function of time

These values are indicated in two parameter lines and the test diagram:

Parameter line 1/2

Test diagram with reference marker, delta marker 1 and 2 and D-line.

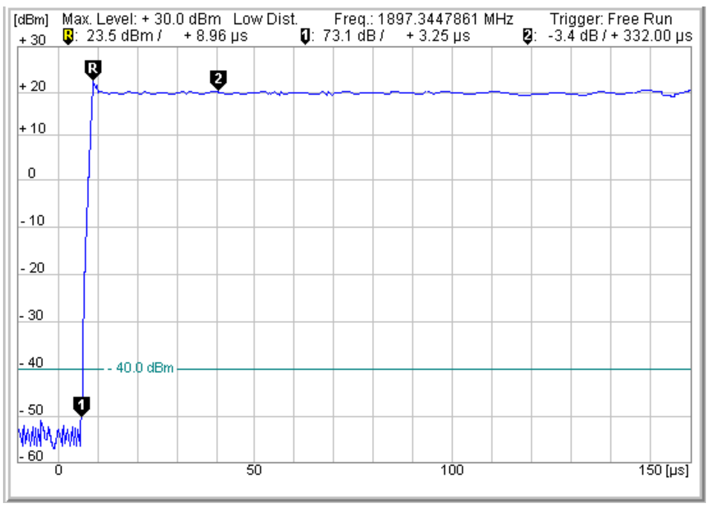


Fig. 4-22 Display of measurement results (Power menu)

Settings/ scalar measurement results	Settings and scalar measurement results are indicated in the two parameter lines above the test diagram
1st parameter line	The first parameter line contains the following settings:
	RF Max. Level — Maximum value of input level as set in the *Connection Control* menu (see section *Analyzer Settings* – *Table-Oriented Version* on page 4.59).
	RF Attenuation — Setting for the attenuation of the input level *(Normal, Low Noise, Low Distortion)* as set in the *Connection Control* menu (see section *Analyzer Settings* – *Table-Oriented Version* on page 4.59).
	Freq. — Center frequency of the RF signal analyzed
	Trigger — Trigger mode *(Free Run, RF Power, IF Power* or *External)*
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*) or difference from reference marker (setting *relative*)
	2 — Level and time of delta marker 2 (setting *absolute*) or difference from reference marker (setting *relative*)
Remote control	Settings are read out using the query corresponding to the setting command (setting command with appended question mark). To obtain the measurement value at a single point on the trace the whole trace must be read, see below.

Measurement curves (arrays)

The measurement curve is displayed as a continuous trace in the test diagram together with the limit lines, markers and the D-line, if defined.

The measurement curve in the *Power* measurement menu shows the measured power of the received RF signal (in dBm) as a function of time (in µs). The diagram scale, which is equal to the measurement range, and the displayed result depend 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.

Remote control
```
READ:ARRay:POWer[:RESult]...?
FETCh:ARRay:POWer[:RESult]...?
SAMPle:ARRay:POWer[:RESult]...?
```

Measurement Configurations (Power Configuration)

The popup menu *Power Configuration* determines the parameters of the power measurement. It is activated by pressing the softkey *Power* in the graphical measurement menu *Power* twice.

The *Power Configuration* menu controls the power measurement. It defines:
The Repetition mode

The type of measurement curve to be displayed *(Display Mode)*

The *Statistic Count* for the measurement

The center *Frequency* of the RF analyzer

The *Resolution Bandwidth* of the measurement filter

Besides, it influences the power display by adding or removing the *Grid*.

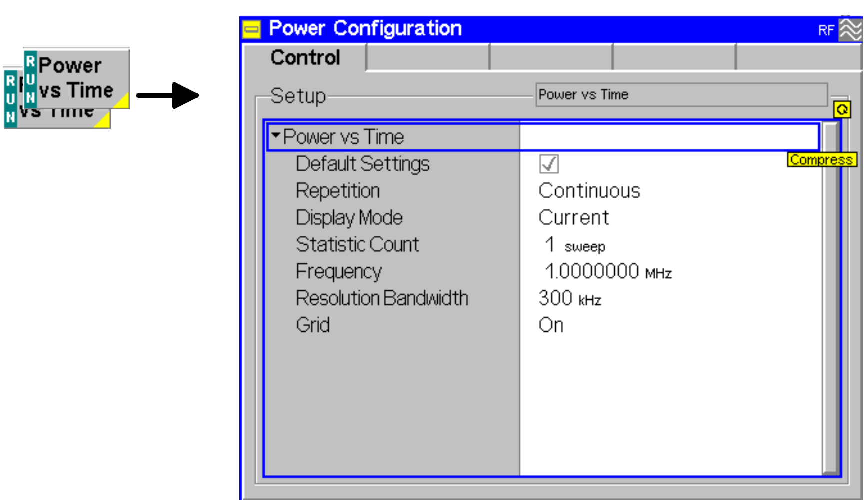


Fig. 4-23 Power Configuration – Control

Default Settings

The *Default 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).

Remote Control
–

Repetition

The *Repetition* field determines the repetition mode. The basic evaluation period (statistics cycle) corresponds to the evaluation of the trace over the entire time range.

For more information see section *Analyzer/Generator Configuration* on p. 4.38 ff. and section *General Settings* in Chapter 3.

Remote control
```
CONFigure:POWer:CONTrol:REPetition
     CONTinuous | SINGleshot | 1 ... 10000,NONE,<Stepmode>
```

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 a number of bursts
Maximum	Maximum over a number of 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[:CURRent]? FETCh:ARRAy:POWer:MINimum? FETCh:ARRAy:POWer:MAXimum? FETCh:ARRAy:POWer:AVERage?` etc.

Statistic Count

Statistic Count defines how many sweeps are combined to form one statistics cycle. Each sweep corresponds to the evaluation of the trace over the entire time range.

1 to 1000 sweeps	Number of sweeps per statistics cycle

The settings *1* and *OFF* (press *ON/OFF* key) are equivalent. A statistics cycle determines the duration of single-shot measurements (see Chapter 3, section *General Settings*).

Remote control
```
CONFigure:POWer:CONTrol:STATistics  1 ... 1000 | NONE
```

Frequency

Frequency. defines the center input frequency for the measurement in MHz.

Remote control
```
[SENSe:]POWer:FREQuency:CENTer <Frequency>
```

Resolution Bandwidth

Resolution Bandwidth defines the resolution bandwidth of the measurement filter. The nominal resolution bandwidth is the 3-dB bandwidth of the Gaussian measurement filter. From a list discrete bandwidths between 10 Hz and 1 MHz can be selected. The frequencies in the list are given by $1x10^n$ Hz, $2x10^n$ Hz, $3x10^n$ Hz, $5x10^n$ Hz where n=1 to 5. In addition the value 1 MHz can be selected.

Resolution bandwidths for the analyzer and the *Spectrum* measurement can be set independently (see also p. 4.49).

Remote control
`[SENSe:]POWer:FREQuency:BANDwidth[:RESolution] <Bandwidth>`
`[SENSe:]POWer:FREQuency:BWIDth[:RESolution] <Bandwidth>`

Grid

The *Grid* checkbox switches The grid in the graphical test diagram on or off.

Remote control
–

Spectrum Measurement

The menu group *Spectrum* measures the signal power as a function of the frequency (spectrum analysis). The popup menu *Spectrum Configuration* is used for configuration of the measurements; the results (i.e. the spectrum) are displayed in the graphical measurement menu *Spectrum*.

Measurement Menu (Spectrum)

The graphical measurement menu *Spectrum* displays the results of the spectrum analysis (measurement of signal power as a function of the frequency).

The main softkey *Spectrum* controls the measurement, indicates its status *(RUN | HLT | OFF)* and opens the configuration menu *Spectrum Configuration* (press twice)*.* The hotkey associated to the main softkey defines the scope of the *Spectrum* measurement.

The other softkeys to the right of the test diagram are combined with various hotkeys. If a softkey is selected and an associated hotkey pressed, a popup window will appear which indicates the current setting and enables an entry (see section *Measurement Menu (Power)* on page 4.40).

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

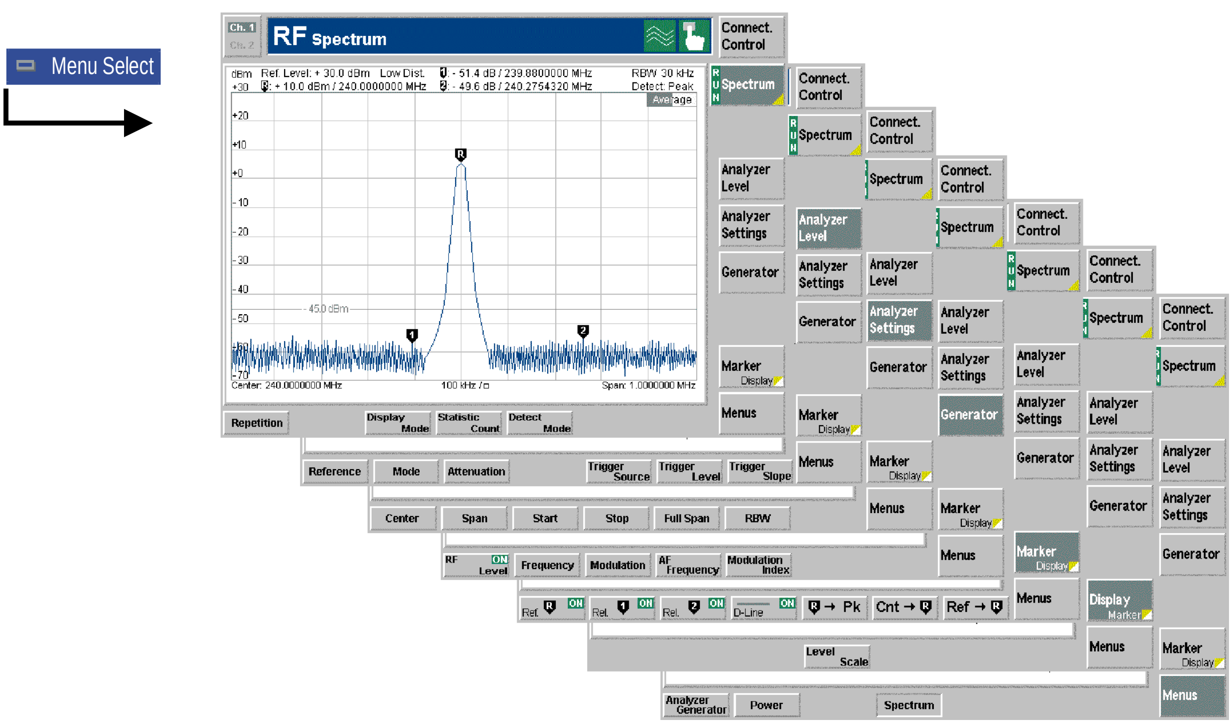


Fig. 4-24 Measurement menu Spectrum

Test settings

The basic settings for the *Spectrum* measurement are directly accessible from the measurement menu via softkey/hotkey combinations. The entry of values is described in section *Test Settings* on p. 4.35 ff.

Some of the basic settings are also accessible from the *Spectrum Configuration* popup menu. They are explained in more detail in section *Measurement Configurations (Spectrum Configuration)* on page 4.54 ff.

Spectrum

The *Spectrum* softkey controls the spectrum 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.

Remote control
```
INITiate:SPECtrum; ABORt:SPECtrum
STOP:SPECtrum; CONTinue:SPECtrum
FETCh:SPECtrum:STATus?
```

Measurement configuration

Pressing the *Spectrum* softkey twice opens the popup menus *Spectrum Configuration* (see page 4.54 ff). 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 Configurations (Spectrum Configuration)* on page 4.54 ff.

Analyzer Level

The *Analyzer Level* softkey controls the level in the RF input signal path and provides the trigger settings for the current measurement.

The input level and trigger settings are general settings and therefore also provided in the *Connection Control* menu. They are described in more detail in sections *Analyzer Settings – Table-Oriented Version* on page 4.59 and *Trigger (Connection Control – Trigger)* on p. 4.72 ff.

Reference Level

The *Reference Level* hotkey defines the reference level.

The reference level defines the upper edge of the diagram. It is generally different from the maximum input level set in the *Connection Control* menu, see section *Analyzer Settings – Table-Oriented Version* on page 4.59.

Remote control
```
[SENSe:]LEVel:REFerence  <LEVel>
```

Analyzer Settings

The *Analyzer Settings* softkey determines the frequency range that is measured and displayed and the resolution bandwidth of the spectrum analyzer.

The settings are specific to the Spectrum menu. Some of them are also provided in the Control tab of the Spectrum Configuration menu; see section *Measurement Configurations (Spectrum Configuration)* on page 4.54 ff.

A single measurement of the signal power over the whole frequency range (span, sweep width) by means of a spectrum analyzer is called a sweep. Typically, the minimum sweep time T_{min} is linked to the resolution bandwidth B of the analyzer and the frequency range F by the relation $T_{min} \sim F/B^2$. This means that a compromise between a high resolution, wide frequency range and high measurement speed must be reached.

The frequency range can be set in three different ways:

- By defining the center frequency f_c and the span Δf. The start and stop frequencies are thus given by $f_{start} = f_c - \Delta f/2$ and $f_{stop} = f_c + \Delta f/2$. This mode is convenient if the spectrum is to be analyzed in the vicinity of a known frequency which can be used as the center frequency of the diagram.
- By defining the start frequency f_{start} and the stop frequency f_{stop}. The center frequency and span are thus given by $f_c = (f_{start} + f_{stop})/2$ and $\Delta f = f_{stop} - f_{start}$.
- By selecting *Full Span* the default frequency range is displayed, i.e. the default start and stop frequencies are selected.

The number of vertical grid lines (i.e. the number of cells in horizontal direction) can be variable (depending on the frequency span) or fixed, see *Spectrum Configuration* menu on page 4.54.

Center

The *Center* hotkey defines the center frequency of the sweep range in MHz or in another frequency unit selected via the unit keys. The center frequency is identical with the *Frequency* set in the *Spectrum Configuration* menu.

Remote control
`[SENSe:]SPECtrum:FREQuency:CENTer <Frequency>`

Span

The *Span* hotkey defines the sweep span.

Remote control
`[SENSe:]SPECtrum:FREQuency:SPAN <Frequency>`

Start

The *Start* hotkey defines the start frequency of the sweep.

Remote control
`[SENSe:]SPECtrum:FREQuency:STARt <Frequency>`

Stop

The *Stop* hotkey defines the stop frequency of the sweep.

Remote control
`[SENSe:]SPECtrum:FREQuency:STOP <Frequency>`

Full Span

The *Full Span* hotkey sets the default sweep span.

On pressing the *Full Span* hotkey the abscissa of the spectrum diagram is changed, and the resolution bandwidth is set to *Auto*. However, the previous scaling parameters and resolution bandwidth are stored and the inscription of the *Full Span* hotkey changes to Last Span. The *Last Span* hotkey allows the previous scaling parameters and resolution bandwidth to be recalled and the previous diagram to be restored.

Remote control
Set *Start* and *Stop* to their default values. Resolution bandwidth see below.

RBW

The *RBW* hotkey defines the resolution bandwidth for the *Spectrum* measurement. The setting is also provided in the *Control* tab of the *Spectrum Configuration* menu; see section *Measurement Configurations (Spectrum Configuration)* on page 4.54 ff.

Remote control
```
[SENSe:]SPECtrum:FREQuency:BANDwidth[:RESolution] <Bandwidth>
[SENSe:]SPECtrum:FREQuency:BWIDth[:RESolution] <Bandwidth>
```

Generator
Tx **Aux Tx**

The Generator softkey configures the RF signals generated. The generator settings are general settings and therefore also provided in the Connection Control menu. They are described in more detail in section *Generator Settings (Connection Control – Generator)* on p. 4.61 ff.

The RF Level hotkey is also used to switch the RF generator on and off.

If option R&S CMU-B95, *Second RF Generator*, is fitted, the *Generator* softkey toggles between the primary RF signal *(Tx)* and the auxiliary RF signal *(Aux Tx)* settings. The properties of the *Aux Tx* signal are also described in section *Generator Settings (Connection Control – Generator)* on p. 4.61 ff

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 bits), 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 to mark and read out an arbitrary level in the test diagram.

Ref. R

The hotkey *Ref. R* switches the reference marker on or off.

The reference marker is represented by the symbol R in the test diagram. The marker position (abscissa) is determined in the input field *Ref. Marker R*. The marker can be positioned to arbitrary frequency 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 by default. The marker level is given by the trace at the marker position.

The position of all markers can be varied using the rotary knob.

Remote control
No command, screen configuration only

Rel. 1

The *Rel. 1* hotkey switches the delta marker 1 on or off.

The delta marker 1 is represented by the symbol 1 in the test diagram. The marker position (abscissa) is determined in the input field *Rel. Marker 1*. The marker can be positioned to arbitrary frequency values. If its position is outside the diagram area it will be invisible and its coordinates will be "- - - / <ab-scissa_value>". The marker is switched off by default. The marker level is given by the trace at the marker position.

The toggle switch *Delta Config.1* is opened by pressing *Rel. 1* twice and defines whether the second parameter line shows the absolute position of the delta marker (*absolute*, in dBm and time units) or its distance to the reference marker (*relative*, in dB and time units). If *absolute* is selected the inscription of the *Rel. 1* hotkey changes to *Abs. 1*.

Remote control
No command, screen configuration only

Rel. 2

The *Rel. 2* hotkey switches the delta marker 2 on or off. Its functionality is 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 RF Max. Level (in dB, setting relative).

Remote control
No command, only screen configuration

R → Pk

The hotkey *R to Pk* places the reference marker to the maximum of the trace.

Cnt→ R

The hotkey *Cnt to R* centers the diagram to the frequency of the reference marker.

Ref→ R

The hotkey *Ref to R* sets the reference level to the current marker position. It is recommended to use the three softkeys *R to Pk, Cnt to R* and Ref to R in succession to obtain a standard scale for the diagram.

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.

Level Scale

The *Level Scale* hotkey defines the total level range of the *Spectrum* test diagram (ordinate scale). The ordinate scale is calculated from the *Reference* level (see above) and the *Level Scale* such that

- The *Reference* level defines the upper edge of the diagram.
- The difference *Reference* level – *Level Scale* defines the lower edge of the diagram.
- The number of horizontal grid lines (corresponding to 10, 15, or 16 cells) and the ordinate labeling is adapted to the range.

Remote control
`[SENSe:]POWer:LEVel:RANGe <Range>`

Menus

The Menus softkey displays the hotkey bar for switching over to the other measurement menus.

Measurement Results

The values represented in the measurement menu *Spectrum* can be divided into three groups:
Setting values

Scalar measurement results (marker values)

The trace plotted as a function of time

These values are indicated in two parameter lines and the test diagram:

Parameter line 1/2

Test diagram with reference marker, delta marker 1 and 2 and D-line.

Abscissa labels

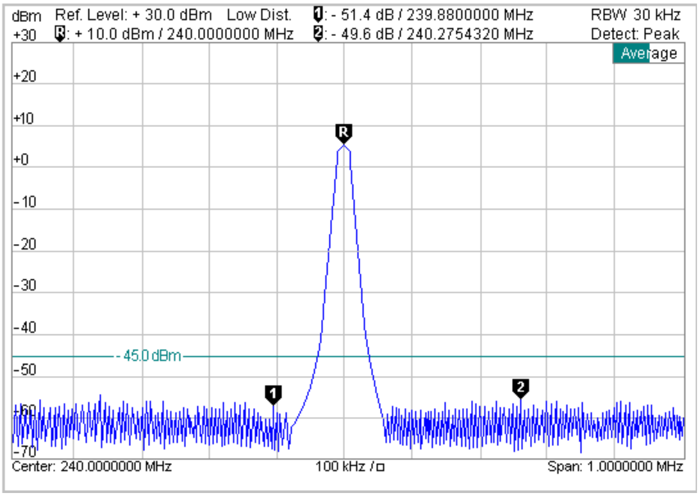


Fig. 4-25 Display of measurement results (Spectrum menu)

Settings/ scalar measurement results

Settings and scalar measurement results are indicated in the two parameter lines above the test diagram

1st parameter line

The first parameter line contains the following settings:

Ref. Level	Reference level; upper edge of the diagram as set with the *Analyzer Level – Ref. Level* hotkey
1	Level and time of delta marker 1 (setting *absolute*) or difference from reference marker (setting *relative*)
RBW	Resolution bandwidth *(Auto* or numeric value)

2nd parameter line

The second parameter line contains the following marker values:

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

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

To obtain the measurement value at a single point on the trace the whole trace must be read, see below.

Measurement curves (arrays)

The continuous curve in the test diagram shows the measured power (in dBm) as a function of the frequency (in MHz). The curve depends on the display mode *(Current, Max./Min., Average)* that can be set in the configuration menu (see section *Measurement Configurations (Spectrum Configuration)* on page 4.54 ff.). The display mode is indicated in the upper right corner of the diagram.

The measurement curve extends over the frequency range *(Span)* indicated below the diagram and is interpolated from 560 points, each corresponding to one pixel of the CMU's LC display. The number of measurement values is actually larger than 560; the coordinates of the pixels defining the curve can be calculated according to the peak or RMS *Detect Mode* described in section *Measurement Configurations (Spectrum Configuration)* on page 4.54 ff.

Remote control
```
READ:ARRay:SPECtrum[:RESult][:CURRent]?
FETCh:ARRay:SPECtrum[:RESult][:CURRent]?
SAMPle:ARRay:SPECtrum[:RESult][:CURRent]?
READ:SUBarrays:SPECtrum[:RESult][:CURRent]?
READ:SUBarrays:SPECtrum[:RESult]:AVERage? etc.
```

Measurement Configurations (Spectrum Configuration)

The popup menu *Spectrum Configuration* determines statistical and display parameters for the spectrum analysis. It is activated by pressing the softkey *Spectrum* in the graphical measurement menu *Spectrum* twice. In the *Control* tab, the configuration menu defines:
The repetition mode *(Repetition)*

The type of measurement curve to be displayed *(Display Mode)*

The number of sweeps forming a statistics cycle *(Statistic Count)*

The format of the grid *(Scaling Mode)*

The prescription for calculating the curve from the entire set of measurement points *(Detect Mode)*

The center *Frequency* of the spectrum measurement

The *Resolution Bandwidth* of the measurement filter

Besides, it influences the spectrum display by adding or removing a *Grid* with configurable cells.

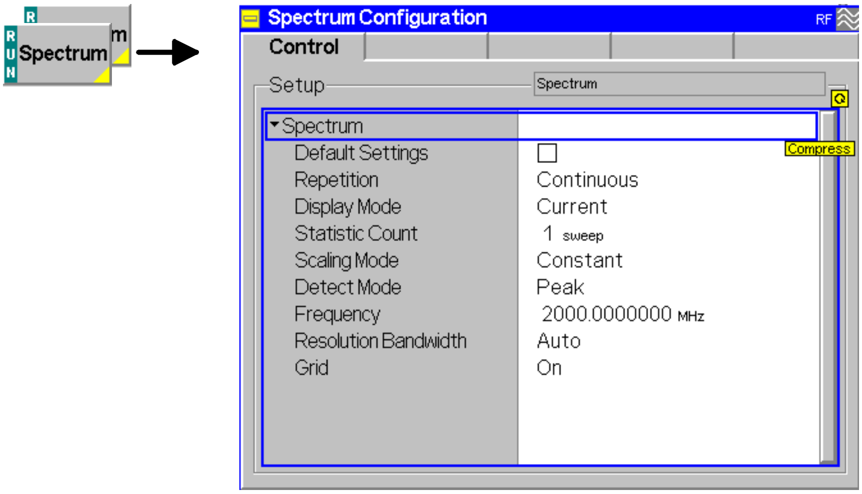


Fig. 4-26 Spectrum Configuration – Control

Many functions of this menu comply with those of the *Control* tab of the *Power Configuration* menu (see page 4.45 f.). In the remote-control commands, the keyword `POWer` is to be replaced by `SPECtrum`.

Default Settings The *Default* 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).

Remote Control
–

Repetition *Repetition* determines the repetition mode, see chapter 3 and explanations given on page 4.46 for the *Power* measurement.

Remote control
```
CONFigure:SPECtrum:CONTrol:REPetition
      CONTinuous | SINGleshot | 1 ... 10000,NONE,<Stepmode>
```

Display Mode *Display Mode* defines which of the four measured and calculated measurement curves is displayed. The measurement curves differ in the way the RF signal power *p(t)* at a fixed point in time *t* is calculated if the measurement is repeated several times:

Current	Measured value for current sweep
Minimum	Minimum over a number of sweeps
Maximum	Maximum over a number of sweeps
Average	Average value over a number of sweeps

One sweep corresponds to the evaluation of the trace over the whole measurement range. The number of sweeps for calculation of the statistical values *Minimum, Maximum* and *Average* – and thus the result – depends on the repetition mode set (see page 4.46). In detail, this implies:

Single shot	Display of minimum, maximum and average value from the performed statistics cycle (see *Statistic Count* definition below).
Continuous	Display of minimum and maximum from all sweeps already measured. The **average value**, however, is calculated according to the prescription in Chapter 3, section *General Settings*.

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

```
FETCh:SUBarrays:SPECtrum[:CURRent]?
FETCh:SUBarrays:SPECtrum:MINimum?
FETCh:SUBarrays:SPECtrum:MAXimum?
FETCh:SUBarrays:SPECtrum:AVERage? etc.
```

Statistic Count

Statistic Count defines how many sweeps are combined to form one statistics cycle.

1 to 1000 sweeps Number of sweeps per statistics cycle

The settings *1* and *OFF* (press *ON/OFF* key) are equivalent. A statistics cycle determines the duration of single-shot measurements (see Chapter 3, section *General Settings*).

Remote control
`CONFigure:POWer:CONTrol <MODE>,1 ... 1000 | NONE`

Grid / Scaling Mode

Grid switches on or off the grid in the graphical test diagram. In addition the *Scaling Mode*, i.e. the number of grid cells in horizontal direction (frequency axis) can be selected:

Variable The number of horizontal grid cells is adapted to the sweep span of the *Spectrum* measurement, see page 4.50,

Constant The diagram consists of a constant number of 10 horizontal grid cells.

Remote control
`DISPlay:SPECtrum:CONTrol:GRID ON | OFF`

Detect Mode

Detect Mode defines how the measurement curve is calculated from the entire set of measurement points. The curve is interpolated from 560 points, each corresponding to one pixel of the CMU's LC display. The number of measurement values is actually larger than 560; the coordinates of the pixels defining the curve can be calculated in two alternative ways:

Peak The y-coordinate (power) of each pixel is equal to the maximum of all measurement values falling inside the pixel range.

RMS The y-coordinate of each pixel is equal to the RMS average of all measurement values falling inside the pixel range.

The two settings yield different curves, especially in domains where the signal shows strong power variations (e.g. in the noise floor around a distinct spectral lobe). RMS averaging tends to smooth out the spectral curve and to suppress the noise. On the other hand, very narrow peaks may be underestimated if RMS *Detect Mode* is set.

Remote control
`[SENSe:]SPECtrum:DETector PEAK | RMS`

Frequency

Frequency defines the center frequency of the measurement range in MHz or in another frequency unit selected via the unit keys. The center frequency is identical with the *Center* frequency set with the *Analyzer Settings* softkey.

Remote control
`[SENSe:]SPECtrum:FREQuency:CENTer <Frequency>`

Resolution Bandwidth

Resolution Bandwidth defines the resolution bandwidth for the *Spectrum* measurement. The resolution bandwidth is identical with the *RBW* set with the *Analyzer Settings* softkey.

The nominal resolution bandwidth is the 3-dB bandwidth of the measurement filter. From a list discrete bandwidths between 10 Hz and 1 MHz can be selected. The frequencies in the list are given by $1x10^n$ Hz, $2x10^n$ Hz, $3x10^n$ Hz, $5x10^n$ Hz where n=1 to 5. In addition the two values 1 MHz and *Auto* can be selected.

With the *Auto* setting the resolution bandwidth is automatically adapted to

bandwidth = span/50

(if this value is inside the allowed range).

Resolution bandwidths for the analyzer and the *Power* measurement can be set independently (see also p.SEITENREFFORMATVERBINDEN 4.40).

Remote control

```
[SENSe:]SPECtrum:FREQuency:BANDwidth[:RESolution] <Bandwidth>
[SENSe:]SPECtrum:FREQuency:BWIDth[:RESolution] <Bandwidth>
```

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 *RF* function group 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, RF*, *Sync., Trigger, I/Q-IF)* can be accessed via the hotkey bar at the lower edge of the screen.

Analyzer Settings (Connection Control – Analyzer)

The *Analyzer* tab adjusts the RF input path to the expected input power *(RF Max. Level)* and sets the center frequency of the RF analyzer. 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 *(RF Max. Level)*, the way this level is defined *(RF Mode)* and the attenuation of the RF input path *(RF Atten.)*. All settings of this menu are also provided in the table-oriented version of the *Analyzer* tab; see section *Table-Oriented Version* on p. 4.59 ff.

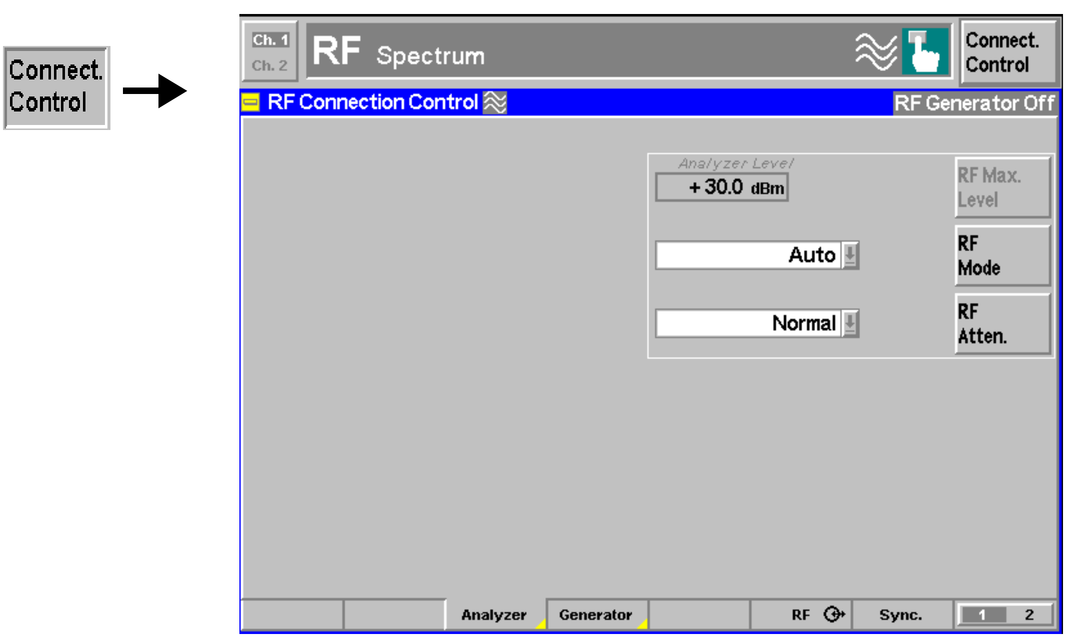


Fig. 4-27 Connection Control – RF analyzer settings (softkey)

Table-Oriented Version

The table-oriented version of the *Analyzer* tab determines:
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 *Frequency* and the resolution *Bandwidth* of the RF analyzer *(Analyzer Settings)*

The *RF Path* for the analyzed signal

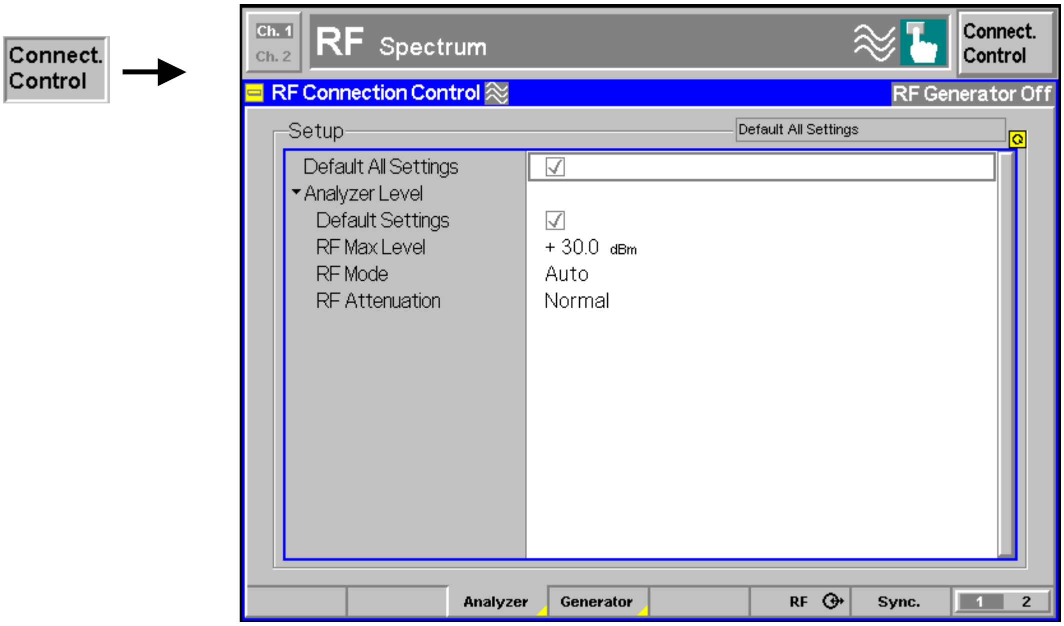


Fig. 4-28 Connection Control – RF analyzer settings (table)

Default Settings *Default All Settings* 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). Additional default switches are provided for the *Analyzer Level* and *Analyzer Settings* table sections.

Remote Control
`[SENSe:]LEVel:DEFault`

RF Max. Level *RF Max. Level* determines the maximum permissible input level (overload level). The maximum input level determines the upper edge of the diagram in the graphical menu *Power* and is also displayed next to the softkey *RF Max. Level* in the main menu *Analyzer/Generator* (see page 4.33). The upper edge of the *Spectrum* diagram is set independently via the *Reference* hotkey, see section *Test settings* on page 4.49.

RF Mode *RF Mode* determines how the maximum input level is set:

Manual	Manual input of maximum input level
Auto	Automatic setting of maximum input level (autoranging) according to the power of the applied signal.

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

The value range depends on the selected RF input (see section *Generator Settings (Connection Control – Generator)* on page 4.61):

External attenuation

If an external input attenuation is reported to the instrument (see section *RF Connectors (Connection Control – RF)* on page 4.65), 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.

Input levels exceeding the *RF Max. Level* can not be measured; the corresponding measurement result fields indicate invalid results "– – –".

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 permissible 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>`

RF Attenuation

*RF Attenuation*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 both *Power* and *Spectrum* measurements)
Low distortion	Mixer level reduced by –10 dB (high intermodulation spacing)

The *RF 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`

Generator Settings (Connection Control – Generator)

The *Generator* tab configures the RF generator, in particular by defining the output level *(RF Level)*, the *Frequency, Modulation*, and *Frequency Hopping*. The CMU provides 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 *Generator* tab controls and configures the RF generator. The CMU provides two independent RF signals *Tx* and *Aux Tx* (with option CMU-B95, *Additional RF Generator),* which can be configured as follows:

Level and frequency settings *(RF Level, Frequency)*

Selection of an offset frequency or amplitude modulation *(Modulation, SSB Frequency, Modulation Index)*

All settings of this menu are also provided in the softkey-oriented version of the *Generator* tab; see section *Table Oriented Version* on p. 4.61 ff.

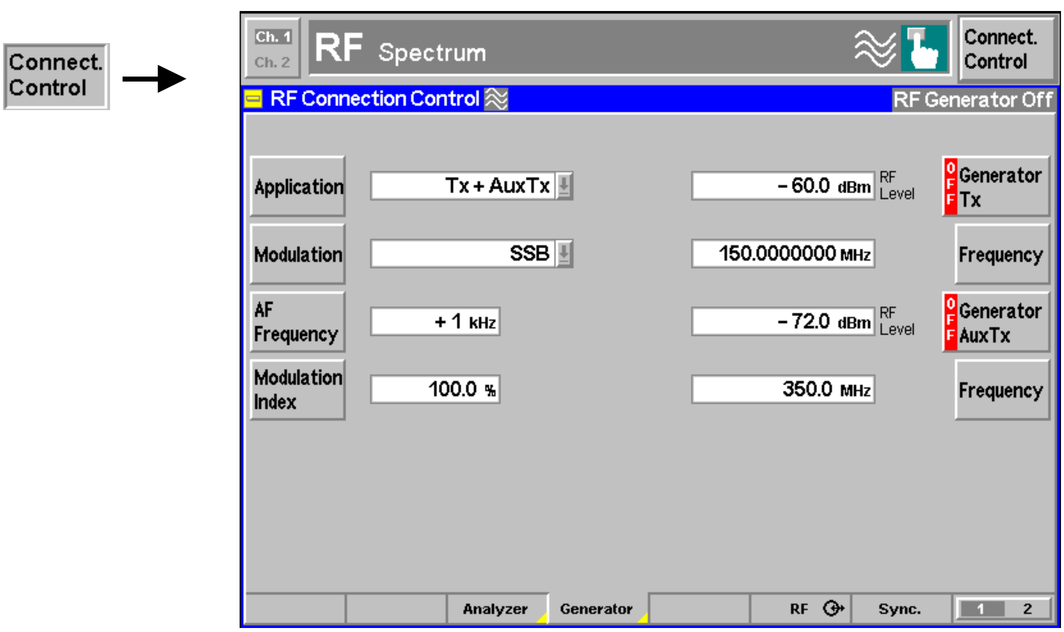


Fig. 4-29 Connection Control – RF generator settings (softkey)

Table Oriented Version

The table-oriented version of the *Generator* tab configures the two independent sine wave signals *Tx* and *Aux Tx*: It defines:

Level, Frequency and *Modulation* of the signals

Switchover between two frequencies *(Frequency Hopping,* for Tx signal only)

Time dependence of the signal power *(Ramping,* for Tx signal only)

Aux Tx signal:

If option CMU-B95, *Additional RF Generator,* is fitted, the CMU provides a second RF signal AuxTx 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 *RF Connectors (Connection Control – RF)* on p. 4.65 ff.). Moreover, it is possible to assign independent external attenuation factors to both signals.

AuxTx is generated with the modulation settings of the primary Tx signal (`...RFGenerator:MODulation...`) but with no frequency hopping or ramping. Option CMU-B95 extends the functionality of the GSM-MS measurements, see operating manual for options R&S CMU-K20/…/K24.

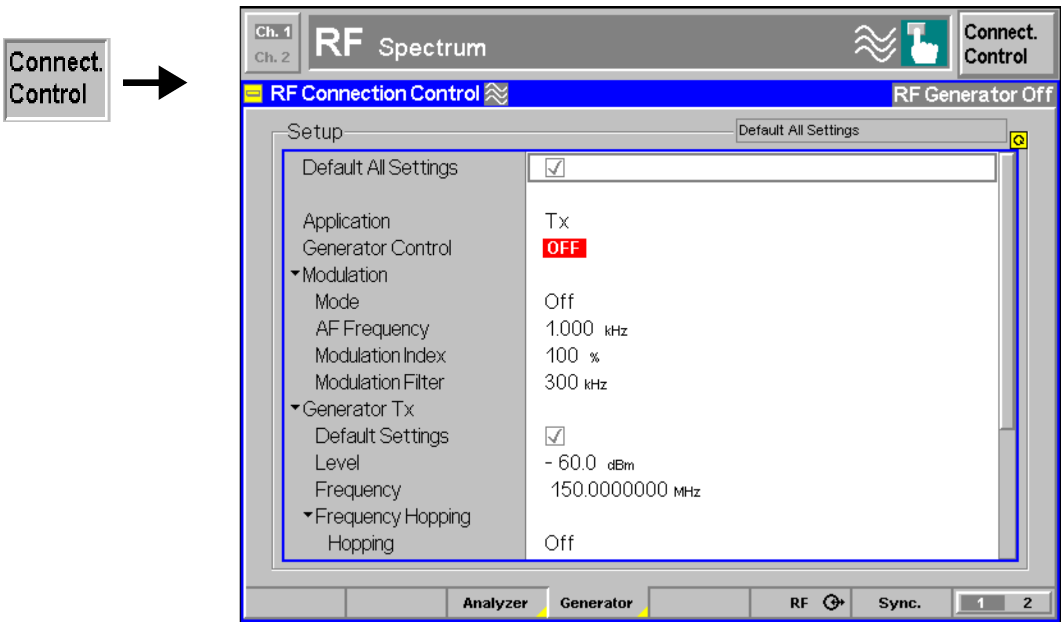


Fig. 4-30 Connection Control – RF generator settings (table)

Default Settings *Default All Settings* assigns default values to all settings in the *Generator* tab (the default values are quoted in the command description in chapter 6 of this manual). Additional default switches are provided for the individual signals *Tx* and *Aux Tx*.

Remote Control
`DEFault:RFGenerator`

Application *Application* selects one of the following RF generator signal configurations:

Tx	The primary RF signal *Tx* is generated according to the settings in the *Generator* tab. The additional signal *Aux Tx* is always switched off.
Aux Tx	The additional signal *Aux Tx* is generated according to the settings in the *Generator* tab. The primary signal *Tx* is always switched off.
Tx + Aux Tx	Both the primary signal *Tx* and the additional signal *Aux Tx* can be generated.

Selecting an application does not automatically switch on the RF generator; see *Generator Control* below.

Remote Control
`CONFigure:RFGenerator:APPLication RX | AUXT | TXAT`

Generator Control

Generator Control controls the RF generator and indicates its operating state *(ON | OFF)*.

This function depends on the selected *Application* (see above):

In the default setting *(Application = Tx), Generator Control* switches the primary signal *Tx* on or off. All *Aux Tx* generator settings are ignored.

If the additional signal *Aux Tx* is selected *(Application = Aux Tx)*, *Generator Control* switches the additional signal *Aux Tx* on or off. All *Tx* generator settings are ignored.

If both signals are selected *(Application = Tx + Aux Tx)*, *Generator Control* switches both signals on or off.

Remote Control
```
INITiate:RFGenerator
ABORt:RFGenerator
FETCh:RFGenerator:STATus?
```

The following modulation settings are valid for both the *Tx* and the *Aux Tx* signal.

Modulation – Mode

Modulation – Mode selects the modulation scheme of the RF signal.

OFF	Unmodulated (CW) RF carrier signal
SSB	RF carrier is shifted by a constant AF offset frequency defined with the AF Frequency softkey (Single Side Band modulation).
AM	RF carrier is amplitude-modulated by means of AF signal with constant frequency and modulation index set with the AF Frequency and Modulation Index softkeys.

Note: *The AM setting shifts the level ranges of all three RF outputs by –6 dB.*

Remote control
```
SOURce:RFGenerator:MODulation OFF | SSB | AM
```

AF Frequency

AF Frequency defines an AF frequency which is used for SSB or AM modulation; see Modulation softkey above.

If SSB modulation is set, the frequency of the RF carrier signal is shifted by the AF frequency, which can be either positive or negative. If AM modulation is set, the RF signal is amplitude-modulated with the AF frequency (which has to be positive) and with a given modulation index (see softkey *Modulation Index* below). An application for SSB modulation is given in chapter 7.

Remote control
```
SOURce:RFGenerator:MODulation:SSB:FREQuency <Frequency>
```

Modulation Index

Modulation Index defines the modulation index for AM modulation, i.e. the amplitude ratio of the modulating AM signal to the RF carrier signal in percent.

The modulation index is in the range of 0% (no amplitude modulation) to 100%. Overmodulation is excluded.

Remote control
```
SOURce:RFGenerator:MODulation:AM:INDex <Mod_Index>
```

Modulation Filter

Modulation Filter defines the resolution bandwidth of the modulation filter. The bandwidths 30 kHz, 300 kHz or *Off* (corresponding to a broadband modulation filter) can be selected.

In a *Spectrum* measurement a modulation filter suppresses the signals located to the right and to the left of the center frequency.

Remote control
```
SOURce:RFGenerator:BANDwidth[:RESolution] <Bandwidth>
```

The following settings are provided separately for the *Tx* and for the *Aux Tx* signal.

Level

Level defines the total level of the generated RF signals in dBm. The value range depends on the selected RF output (RF 1, RF 2 or RF 3 OUT).

External attenuation

If an external gain or attenuation is used and reported to the instrument (see softkey *Ext. Att. Output* in the menu *RF* on page 4.65) the RF generator level is adjusted to maintain the commanded power after the attenuation or gain. As a consequence, all levels indicated are referenced to the input of the DUT and no longer correspond to the actual level at the output connectors of the CMU. 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 entered generator 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 Level,
Re-edit	RF Level is entered once again,
Cancel	The last valid input value is maintained.

When switching over to another output, the current value of RF Level is automatically adapted, if required:

- Towards lower values to the maximum permissible value of the new output,
- Towards upper values to the minimum value of the new output.

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

Frequency

Frequency defines the frequency of the generated RF signals.

Remote control
```
SOURCe:RFGenerator:FREQuency <Frequency>
SOURCe:RFGenerator:AUXTx:FREQuency <Frequency>
```

The following settings are provided for the *Tx* signal only.

Frequency Hopping

Frequency Hopping defines whether *Tx* is a signal with a single, constant basic frequency (frequency hopping *Off*) or a signal with two alternating frequencies (frequency hopping *On)* .

The basic frequency is the *Frequency* set in the *RF Analyzer/Generator* menu. The second (hopping) frequency can be entered in the *Hopping Frequency* input field. Two definitions of the hopping frequency are provided:

Absolute The absolute value of the hopping frequency is entered.

Relative The difference between the hopping frequency and the basic frequency is entered. The resulting absolute frequency, i.e. $f_{abs} = f_{rel} + f_{base}$ must lie in the allowed range for the CMU (see data sheet).

If frequency hopping is selected the RF signal frequency changes after every 4.615 ms: the dwell time at a frequency is as for GSM signals.

Remote control
```
SOURce:RFGenerator:FHOPping:STATe <ON | OFF>
SOURce:RFGenerator:FHOPping:FREQuency <Frequency>
SOURce:RFGenerator:FHOPping:FREQuency:MODE
                                 <ABSolute | RELative>
```

Ramping The *Ramping* parameter defines whether the *Tx* is a continuous, unmodulated signal (CW signal, Ramping is *Off)* or a series of pulses (Ramping is *On)*.

If ramping is *On* the CMU generates rectangular, GSM-like pulses with a duration of 577 µs.

Remote control
```
SOURce:RFGenerator:PULSe:STATe <ON | OFF>
```

RF Connectors (Connection Control – RF)

The tab *RF* configures the connectors for the two RF signals *Tx* and *Aux Tx* (with option CMU-B95, *Additional RF Generator;* see section *Generator Settings (Connection Control – Generator)* on p. 4.61 ff.). This includes:
Selection of the RF signal *(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)*

Besides, the tab controls the *Wideband* power meter and displays the result.

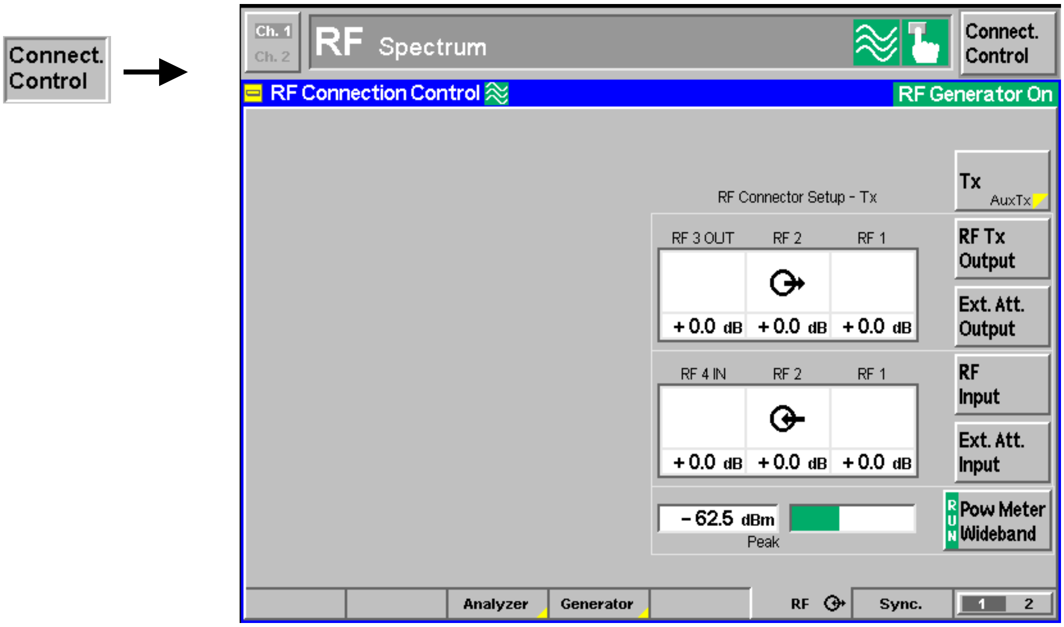


Fig. 4-31 Connection Control – RF connectors

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 Tx Output* changes to *RF Aux Tx Output,* and the input softkeys are hidden.

Remote control
```
OUTPut[:STATe] RF1 | RF2 | RF3
```

RF Tx
Output

The RF Tx 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. The selected RF output is indicated by a symbol.

If the additional RF signal *Aux Tx* is selected (see above), the softkey is labeled *RF Aux Tx Output* and selects the output connector for *AuxTx.*

Note: *Input and output connectors can be combined at will. 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“ (light) if the output level is switched on.

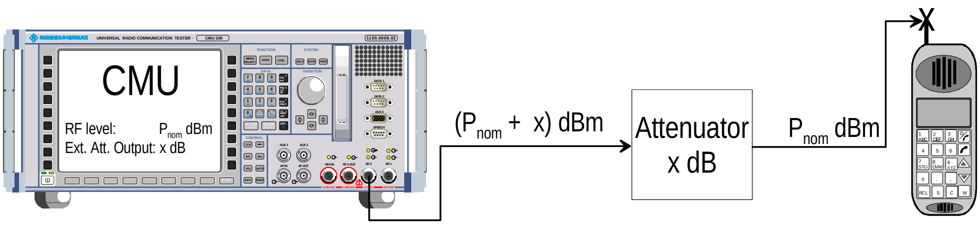
Remote control
```
OUTPut[:TX][:STATe] RF1 | RF2 | RF3
OUTPut:AUXTx[:STATe] RF1 | RF2
```

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, e.g., a path attenuation (cable) is included in the test setup, which is to be compensated for by an increased signal level.

If an external attenuation is defined, the output signal level is referenced to the input of the DUT, the generator level is therefore shifted with respect to the actual level at the input 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.



Note: RF User Correction

In addition to the static external output attenuation setting, the CMU provides a systematic correction of the generated RF power by means of user-defined, frequency and level-dependent correction tables; see section RF User Correction *in Chapter 1.*

Remote control
```
[SENSe:]CORRection:LOSS:OUTPut<nr>[:TX][:MAGNitude] <Loss>
SOURce:CORRection:LOSS:OUTPut<nr>[:TX][:MAGNitude] <Loss>
[SENSe:]CORRection:LOSS:OUTPut<nr>:AUXTx[:MAGNitude] <Loss>
SOURce:CORRection:LOSS:OUTPut<nr>:AUXTx[: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. The selected RF output is indicated by a ⊖ symbol. Input and output connectors can be arbitrarily combined.

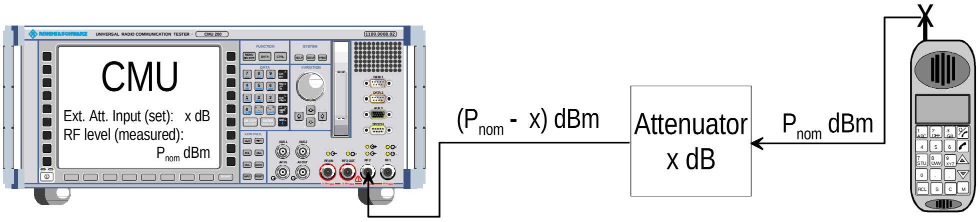
Remote control
```
INPut[:STATe] RF1 | RF2 | RF4
```

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" (light) if the measurement is active.*

Note: RF User Correction

In addition to the static external input attenuation setting, the CMU provides a systematic correction of the measured RF power by means of user-defined, frequency and level-dependent correction tables; see section RF User Correction in Chapter 1.

Remote control
```
[SENSe:]CORRection:LOSS:INPut<nr>[:MAGNitude]
SOURce:CORRection:LOSS:INPut<nr>[:MAGNitude] <Loss>
```

Pow. Meter Wideband

The *Pow. Meter Wideband* 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 soft-key shows the measured power relative to the total measurement range (see Chapter 6).

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 modulated RF signals, the result of the wideband power measurement depends on the modulation 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: *The RF function group provides a wide selection of power measurements. For an overview see section Analyzer/Generator on p. 4.33 ff.*

Remote control
```
INITiate:WPOWer
FETCh:WPOWer:STATus?
READ[:SCALar]:WPOWer?
FETCh[:SCALar]:WPOWer?
SAMPle[:SCALar]:WPOWer?
```

Reference Frequency (Connection Control – Synch.)

The tab *Synch.* determines 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)*.

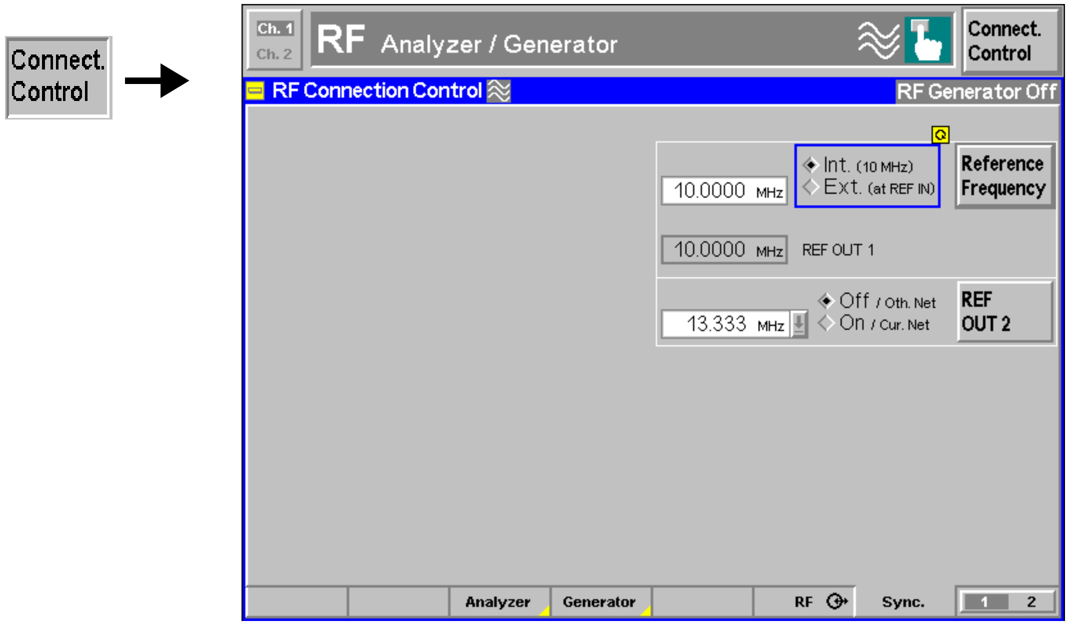


Fig. 4-32 Connection Control – Synchronization

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 reference signal used is also routed to output *REF OUT 1* so that it can be fed to other instruments as well.

Note:

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`.

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 with the input signal.

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:

```
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 clock frequency can be used to synchronize other instruments to the CMU.

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 40 MHz one of the following clock frequencies may be selected:

40.000 MHz,	20,000 MHz,	13.334 MHz,	10.000 MHz,	8.000 MHz,	6.667 MHz,	5.715 MHz,
5.000 MHz,	4.445 MHz,	4.000 MHz,	3.637 MHz,	3.334 MHz,	3.077 MHz,	2.858 MHz,
2.667 MHz,	2.500 MHz,	2.353 MHz,	2.223 MHz,	2.106 MHz,	2.000 MHz,	1.905 MHz,
1.819 MHz,	1.740 MHz,	1.667 MHz,	1.600 MHz,	1.539 MHz,	1.482 MHz,	1.429 MHz,
1.380 MHz,	1.334 MHz,	1.291 MHz,	1.250 MHz			

(The values are calculated according to the formula $F_{\text{out }0}= 40.000\ MHz / n$ where $n = 1, ..., 32$.)

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.

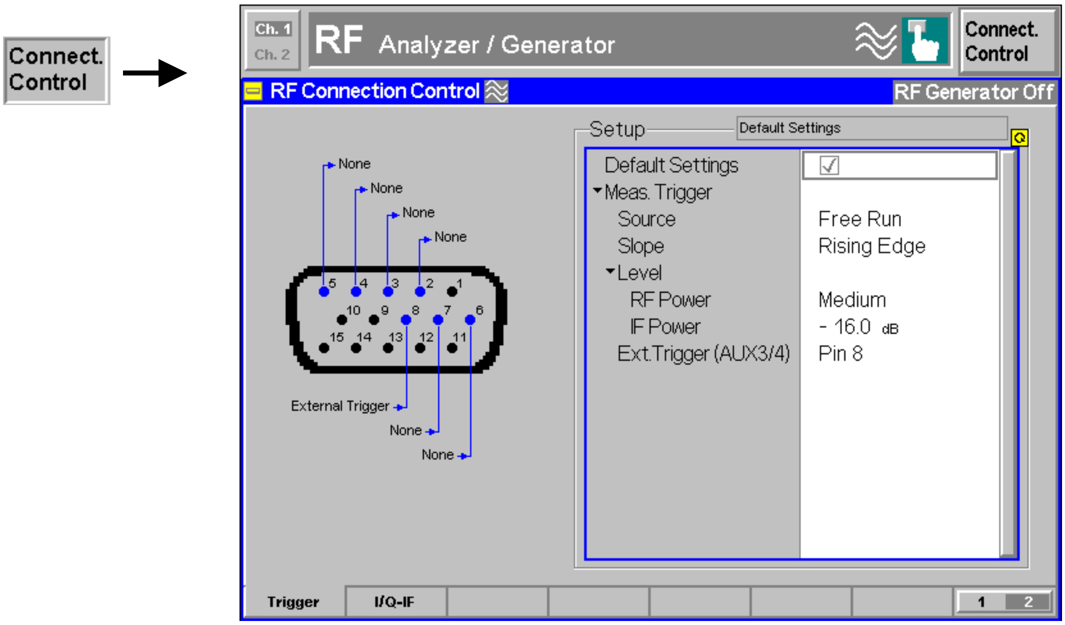


Fig. 4-1 Connection Control – Trigger

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	Free-run mode, the measurement is carried out continuously, it is not related to the input signal
RF Power	The measurement is triggered by the level (rising or falling edge; see *Slope* setting below) of the RF signal to be measured
IF Power	The measurement is triggered by the level of the IF signal
Extern	External trigger signal fed in via connector AUX3 (pin no. 8)

For the *RF Power* and *IF Power* trigger the trigger level is specified via the *Level* parameters. *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
                     IMMediate | RFPower | IFPower | EXTern
```

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 *RF Max. Level* softkey on p. 4.59). 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. 4.68) 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]:SLOPe: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 section *I/Q and IF Interface (Option CMU-B17)* on p. 4.97 ff.

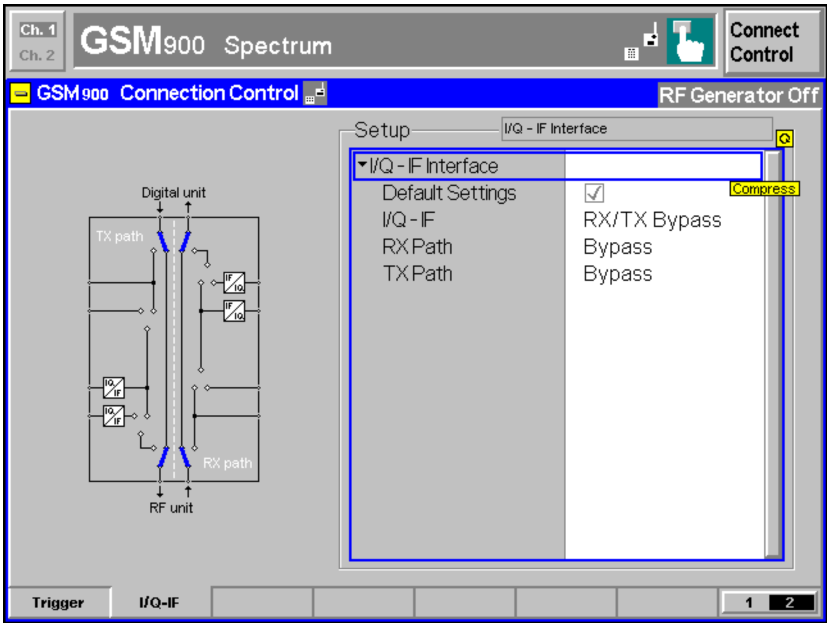


Fig. 4-2 Connection Control – I/Q-IF

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 4-1 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
```

TX 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 4-1 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

Options and Extensions

The function groups described in this section require the installation of hardware options; for a complete list of deliverable options refer to the data sheet. Software options for digital and analog network tests are described in separate operating manuals; for a list refer to the *Manuals* section before tabbed divider no. 1 of this manual.

Audio Generator and Analyzer (Option CMU-B41)

Option CMU-B41, *Audio Generator and Analyzer*, provides an additional *Audio* function group comprising the functions for generating and measuring audio signals. It can be accessed either from the *Menu Select* menu (standalone audio measurements) or by switching over from any of the *GSM-MS, Bluetooth, cdmaOne (IS 95)-MS, CDMA2000,* or *TDMA (IS 136)-MS* measurement menus. In the latter case, the audio circuit of a mobile station can be tested without releasing a call connection or changing the signalling state of the CMU.

Standalone *audio* measurements are performed with default connector settings, the audio signals being applied to the connectors *AF IN/AUX 1* (input) and *AF OUT/AUX 2* (output) on the front panel of the instrument (see Chapter 1). If *Audio* is used in the context of the network tests *(Signalling* test mode), the *AF/RF* tab of the associated *Connect. Control* menu allows to select the input source of the CMU speech encoder and the output destination of its speech decoder (for more information refer to the relevant network operating manuals).

Analyzer/Generator Menu

The main menu *Analyzer/Generator* defines the DC or sinusoidal AC signals generated by the two audio generators and displays the voltage of the two measured audio signals.

The measurement control softkey *Analyzer 1,* which changes to *Analyzer 2,* depending on the audio measurement application selected) controls the measurement, indicates its status *(RUN | HLT | OFF)* and opens the configuration menu *Audio Configuration*. The hotkeys associated to the measurement control softkey define the scope of the *Audio* measurement.

The other softkeys to the right of the test diagram are combined with various hotkeys (e.g. the hotkeys *AF Max. Level* and *AF Mode* belong to the softkey *Analyzer Level).* The softkey/hotkey combinations provide test settings and switch over between different measurements.

The *Analyzer/Generator* menu is opened from the main menu *Menu Select* (with associated key at front of instrument) or via the *Audio* hotkey which is available in all *GSM-MS, Bluetooth, cdmaOne (IS 95)-MS, CDMA2000,* or *TDMA (IS 136)-MS* measurement menus. Compared to the standalone case, the network audio option offers an extended functionality (see *Fig. 4-33* below):

The *Connect. Control* softkey from the previous (calling) GSM function group is also available in *Audio.* The corresponding menu is described in the relevant operating manuals; see overview of CMU documentation at the beginning of the present CMU manual.

A symbol indicating the GSM test mode is displayed in the menu header.

A hotkey switching back to the GSM function group shows at the bottom of the menu.

The actual *Audio* functionality is identical in the standalone and network modes.

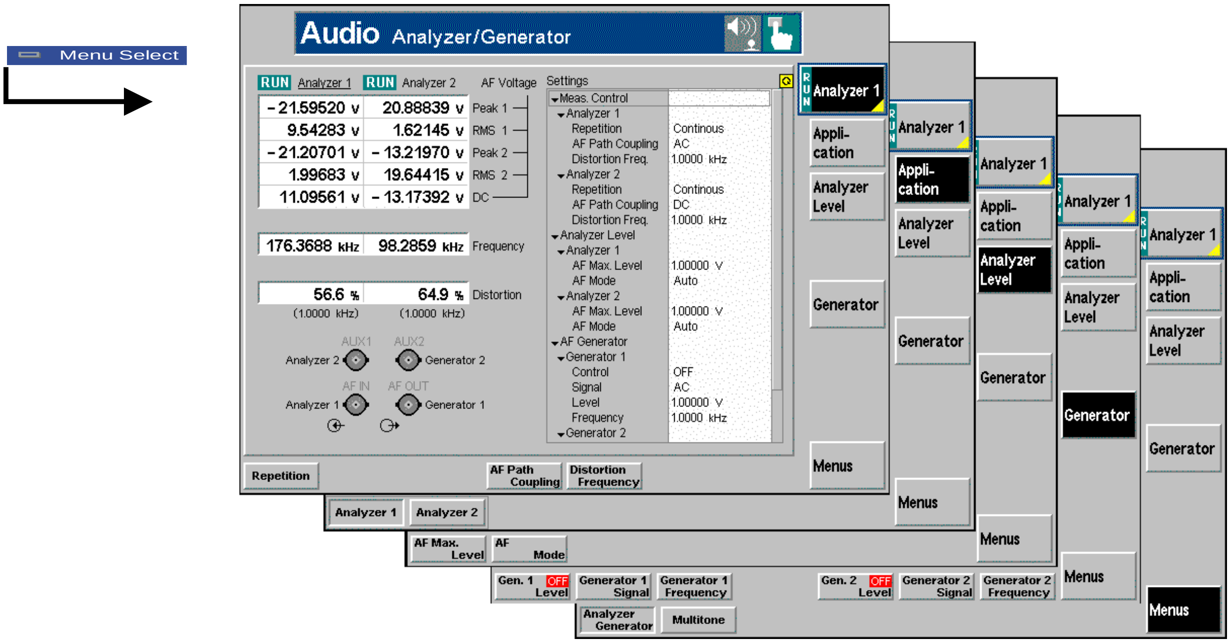


Fig. 4-33 Measurement menu Analyzer/Generator (Audio)

Test Settings

The basic settings for the *Audio* measurement are directly accessible from the measurement menu via softkey/hotkey combinations. The entry of values is described in section *Test settings* on p. 4.40 ff.

Many of the basic settings are also accessible from the *Analyzer Configuration* popup menu. They are explained in more detail in section *Measurement Configurations (Analyzer Configuration)* on p. 4.81 ff.

Analyzer 1

The *Analyzer 1/2* softkey (which changes to Analyzer 2, depending on the application selected) controls the audio measurement (RUN / HLT / OFF) and indicates its status. 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 Audio applications.

Remote control

```
INITiate:AFANalyzer:<Applic>
STOP:AFANalyzer:<Applic>
ABORt:AFANalyzer:<Applic>
CONTinue:AFANalyzer:<Applic>

FETCh:AFANalyzer:<Applic>:STATus?
```

Measurement configuration

Pressing the *Analyzer* softkey twice opens the popup menu *Analyzer Configuration*; see p. 4.81 ff. 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 (Analyzer Configuration – Control)* on p. 4.81 ff.

Appli-cation

The Application softkey selects the audio measurement application.

The results of both applications *Analyzer 1* and *Analyzer 2* are indicated in the corresponding columns of the output tables; see section *Measurement Results* on p. 4.79 ff. The *Settings* table shows the measurement configurations for both applications. On the other hand, all softkeys and hotkeys in the measurement menu belong to the current application.

Analyzer 1

Analyzer 1 selects the primary audio circuit where the audio signals are applied to the connectors AF OUT (output, AF generator signal) and AF IN (input) on the CMU front panel.

Remote control:
The *Analyzer 1* application is selected by the keyword `[:PRIMary]` in the 3rd level of the analyzer commands, e.g. `INITiate:AFANalyzer[:PRIMary]`.

Analyzer 2

Analyzer 2 selects the secondary audio circuit where the audio signals are applied to the connectors AUX 2 (output, AF generator signal) and AUX 1 (input) on the CMU front panel.

Remote control:
The *Analyzer 2* application is selected by the keyword `:SECondary` in the 3rd level of the analyzer commands, e.g. `INITiate:AFANalyzer:SECondary`.

Analyzer Level

The *Analyzer Level* softkey controls the level in the AF input signal path.

AF Max. Level

The *AF Max. Level* hotkey sets the maximum expected AF input level. Levels exceeding this value can not be measured.

Remote control
`[SENSe:]AFLEVel:MAXimum <Level>`

Error messages

If the value set for *Manual 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 maximum input level.
Re-edit	The *Manual Level* is entered once again.
Cancel	The last valid input value is maintained.

AF Mode

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

Manual	Manual input of maximum input level via *Manual Level* (in mV).
Auto	Automatic setting of maximum input level *(autoranging)* according to average power of applied AF signal (plus an appropriate overload margin).

Note1: *A maximum input level can be entered even if automatic level setting (autoranging) is selected. It serves as a start value for the autoranging algorithm and is important to ensure safe switchover to manual setting.*

Note2: *The AF Max. Level and AF Mode settings supersede the corresponding settings in the Multitone menu (Analyzer 1/2); see hotkeys* *AF Max. Level on p. 4.86 and AF Mode on p. 4.87.*

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

Generator

The *Generator* softkey controls the audio generator and defines the properties of the generated DC or sinusoidal AC signal. The three hotkeys for the primary and secondary audio circuit *(Gen. 1/Gen. 2)* are analogous.

The generator settings are also provided in the *Analyzer Configuration* menu; see section *Generator Settings (Analyzer Configuration – Generator)* on p. 4.82 ff.

GSM 900 –MS Sign.

The hotkey switches back to the previous GSM function group.

This hotkey is available if the *Analyzer/Generator* menu is opened from a GSM function group. The hotkey is labeled with the calling function group and test mode, which is also displayed in the menu header.

Remote control
All function groups for network tests are referenced by their secondary addresses; see Chapter 5.

Measurement Results

The test settings of the current *Audio* measurement and the results are displayed in the tables in the center of the menu.

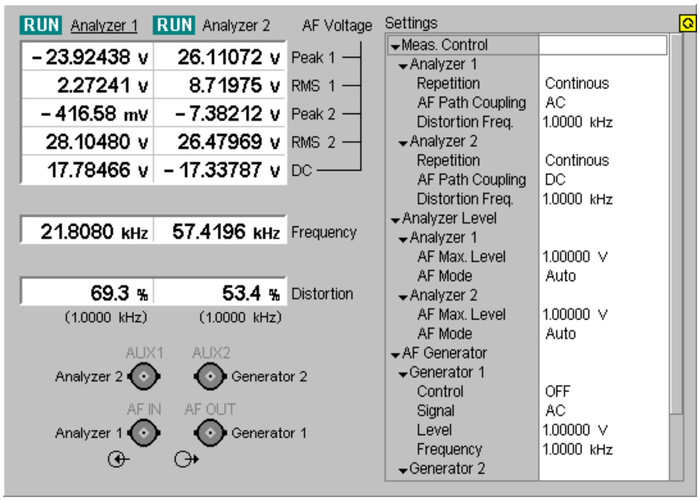


Fig. 4-34 Display of test settings and measurement results (Audio)

Results

The table and output fields in the left half of the table show the results for both audio circuits (applications *Analyzer 1* and *Analyzer 2).* If an analyzer is switched off (see measurement control softkey *Analyzer 1* on p. 4.77), *OFF* is indicated above the corresponding output column and the output fields show invalid results ("---").

The values in the *AF Voltage* table represent the measured voltages of the AF signals:

Peak 1/2	Peak value of the AC component of the measured AF signal in V. The numbers 1 and 2 denote two different input paths for AF signals with different filter configuration; see *Fig. 4-37* on p. 4.83.
RMS 1/2	Effective (RMS-averaged) value of the AC component of the measured AF signal in V.
DC	DC component of the measured AF signal in V
Frequency	Frequency of the measured AC signal
Distortion	Ratio of the measured AF signal with a notched-out reference frequency to the complete measured AF signal in percent. The reference frequency of the distortion measurement set in the Distortion tab of the configuration menu (see p. 4.82) is indicated in brackets below the output field. If the reference frequency is equal to the fundamental frequency of the AF signal, the Distortion value corresponds to the Total Harmonic Distortion and Noise. To avoid suppression of the first harmonic, the bandwidth of the notch filter is automatically adjusted to be smaller than the reference frequency.

Remote control

```
READ[:SCALar]:AFANalyzer:<Applic>[:RESult]?
FETCh[:SCALar]:AFANalyzer:<Applic>[:RESult]?
SAMPle[:SCALar]:AFANalyzer:<Applic>[:RESult]?
```

AF Connector Overview

The figure below the result table 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.

For standalone audio measurements and network tests in *Non Signalling* mode 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).

If network tests are performed in *Signalling* mode and a speech codec is available, the routing of input and output signals is is a function of the *Speech Decoder* output destination. For more information refer to the network test manuals.

Settings

The *Settings* table gives an overview of the configuration of the current measurements. This includes the settings made via the softkeys and hotkeys of the *Audio* menu.

Remote control

Settings are read out using the query corresponding to the setting command (setting command with appended question mark). See section *Test Settings* on p. 4.77 ff..

Measurement Configurations (Analyzer Configuration)

The popup menu *Analyzer Configuration* contains three tabs to determine the parameters of the *Audio* measurement. It is opened by pressing the softkey *Analyzer* in the measurement menu *Analyzer/Generator* twice. It is possible to change between the tabs by pressing the associated hotkeys.

The popup menu *Analyzer 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 (Analyzer Configuration – Control)

The *Control* tab determines:
The *Repetition* mode,

The *AF Path Coupling* of the audio measurement.

The reference frequency of the distortion measurement *(Distortion Frequency)*.

The settings can be defined independently for the applications *Analyzer 1* and *Analyzer 2*.

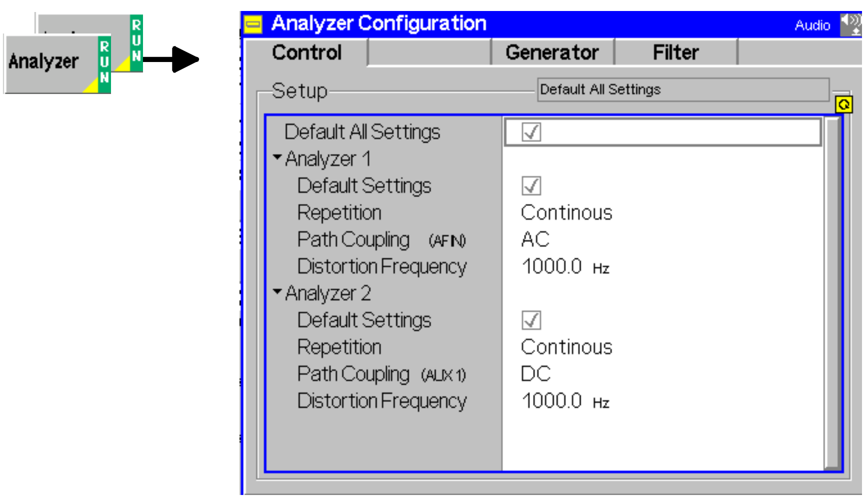


Fig. 4-35 Analyzer Configuration – Control

Default Settings The *Default* 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 applications are provided.

Remote Control
–

Repetition The *Repetition* field determines the repetition mode, see chapter 3 and explanations given on page 4.46 for the *Power* measurement. In *Audio,* one statistics cycle is terminated when the system has settled and a valid result is available.

Remote control
```
CONFigure:AFANalyzer:<Applic>:CONTrol:REPetition
      CONTinuous | SINGleshot | 1 ... 10000,NONE,<Stepmode>
```

Path Coupling

Path Coupling sets the input path for measurement of the AC or AC and DC component of the AF signal:

AC DC component of the measured AF signal (including a possible DC offset of the input amplifier) blocked. This ensures accurate measurement of the AC component. The DC component, however, can not be measured.

DC Measurement of the complete AF input signal (DC plus AC components).

Note: *The path coupling has an impact on the allowed filter settings; see section Input Path Configuration (Analyzer Configuration – Filter) on p. 4.82 f.*

Remote control
`CONFigure:AFANalyzer:<Applic>:CONTrol:COUPling AC | DC`

Distortion Frequency

Distortion Frequency defines the reference frequency of the distortion measurement. If the reference frequency is set to the fundamental frequency of the AF signal, the *Distortion* value corresponds to the Total Harmonic Distortion and Noise.

Remote control
`CONFigure:AFANalyzer:<Applic>:CONTrol:DISTortion:FREQuency`

Generator Settings (Analyzer Configuration – Generator)

The *Generator* tab defines the properties of the generated AF signals. The settings can be defined independently for the two AF generators.

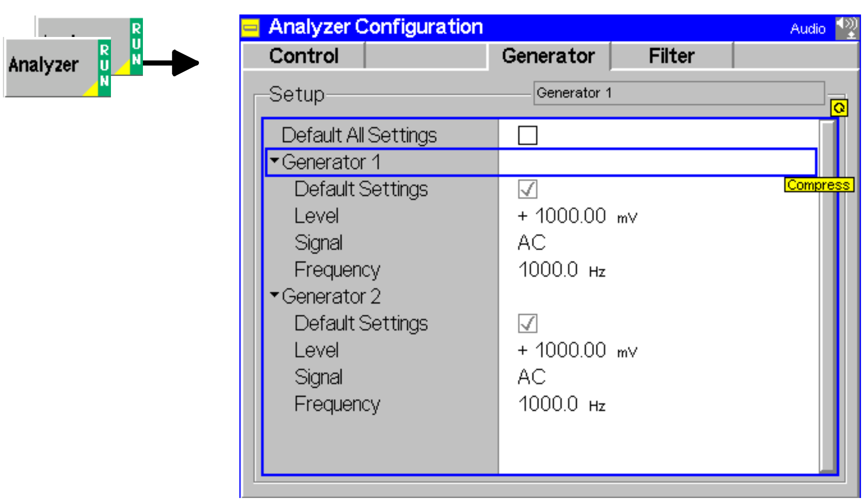


Fig. 4-36 Analyzer Configuration – Generator

Default Settings

The *Default Settings* switch assigns default values to all settings in the *Generator* tab (the default values are quoted in the command description in chapter 6 of this manual). In addition, default switches for the two independent generators are provided.

Remote Control
–

Level *Level* defines the generator level in mV. The meaning of the entered level depends on the generator signal type (see *Signal* below):
If the generated signal is an AC signal, *Level* denotes the effective (RMS averaged) voltage.

If the generated signal is an DC signal, *Level* denotes the constant DC voltage.

Remote control
`SOURce:AFGenerator:<Applic>:LEVel <Level>`

Signal *Signal* qualifies whether the generated audio signal is a DC or an AC signal.

Remote control
`SOURce:AFGenerator:<Applic>:SMODe DC | AC`

Frequency *Frequency* sets the frequency of the generated AF audio signal in Hz. The hotkey is disabled if the generated signal is a DC signal.

Remote control
`SOURce:AFGenerator:<Applic>:FREQuency <Frequency>`

Input Path Configuration (Analyzer Configuration – Filter)

The *Filter* tab configures the different filter stages for the AF analyzer. The input path for measuring the AC component of the AF signal is as shown below:

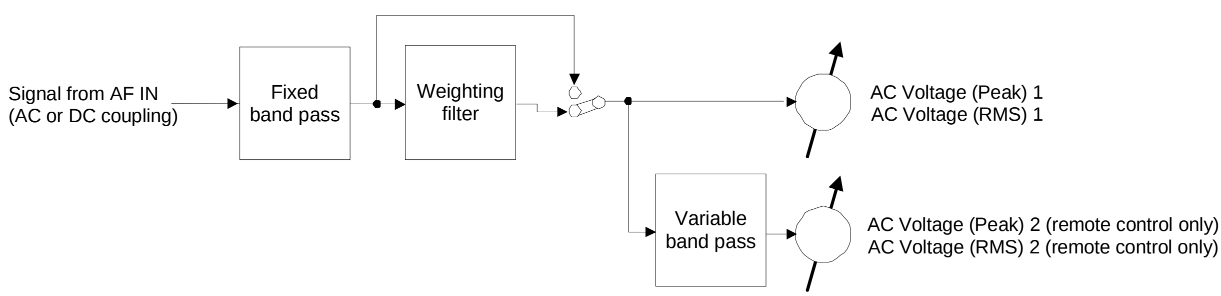


Fig. 4-37 AF analyzer input path configuration

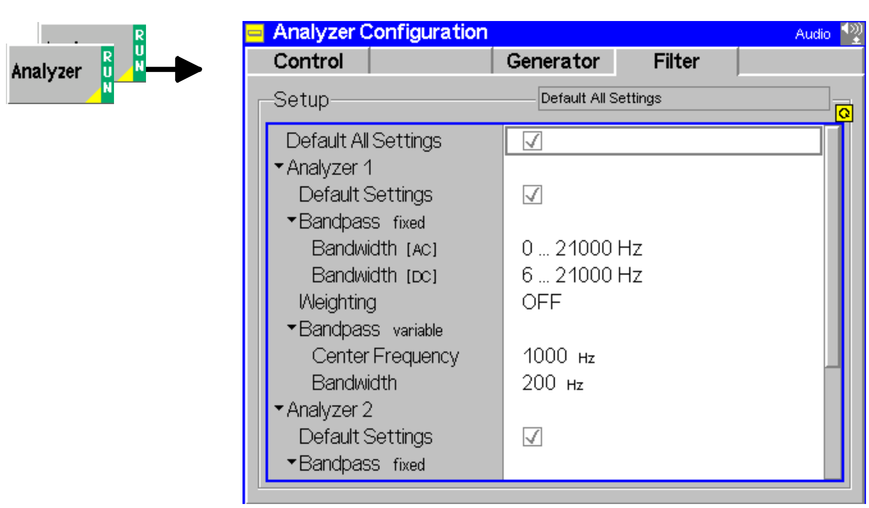


Fig. 4-38 Analyzer Configuration – Filter

Default Settings The *Default Settings* switch assigns default values to all settings in the *Filter* tab (the default values are quoted in the command description in chapter 6 of this manual).

Remote Control
–

Bandpass The *Bandpass* section sets the bandwidth of the fixed band pass (see *Fig. 4-37 above*).

Bandwidth (AC Coup.) Bandwidth to be used if the AF path coupling is set to AC (see *Path Coupling* on page 4.82)

Bandwidth (DC Coup.) Bandwidth to be used if the AF path coupling is set to DC

The CMU provides a broad selection of bandwidths with lower cutoff frequencies between 0 Hz and 300 Hz and upper cutoff frequencies between 250 Hz and 21 kHz (see command description in Chapter 6).

Note: *If the AF Path Coupling is set to DC, the audio analyzer receives the complete AF input signal including a possible DC component. To avoid measurement inaccuracies, band pass filters with a lower cutoff ≥ 6 Hz are available only.*

Remote control
`CONFigure:AFANalyzer:<Applic>:FILTer:BPASs:ACCoupling`
`CONFigure:AFANalyzer:<Applic>:FILTer:BPASs:DCCoupling`

Weighting The *Weighting* section selects a weighting filter to be switched into the AF signal path after the fixed band pass (see *Fig. 4-37 above*).

C-Message Swith on C-message weighted filter

CCITT Swith on CCITT weighting filter

Off No weighting filter

Remote control
`CONFigure:AFANalyzer:<Applic>:FILTer:WEIGhting`

Bandpass (variable) The *Bandpass (variable)* section sets the center frequency and the bandwidth of the variable band pass.

Note: *The variable band pass settings affect the results for AC Voltage (Peak) 2 and AC Voltage (RMS) 2 only (see Fig. 4-37 above). These quantities are available in remote control but not displayed in the Analyzer/Generator menu.*

Remote control
`CONFigure:AFANalyzer:<Applic>:FILTer:VBPass:CFRequency`
`CONFigure:AFANalyzer:<Applic>:FILTer:VBPass:BWIDth`

Multitone Measurement

The graphical measurement menu *Multitone* shows the results of the multitone audio measurement.

To perform an *Multitone* measurement, the CMU generates a composite audio signal that represents the superposition of up to 20 individual fixed-frequency tones with configurable frequency and level. An audio signal containing the same tones can be analyzed in a single measurement and displayed in a bar chart.

The *Multitone* measurement is thus a fast method to determine the level of up to 20 different tones at known frequencies and to perform a limit check for all results. Possible applications are also frequency response and intermodulation measurements.

The main softkey *AF Chan. One,* which changes to *AF Chan. Two* if the corresponding application is selected, controls the *Multitone* measurement, indicates its status *(RUN | HLT | OFF)* and opens the configuration menu *Multitone Configuration* (press twice). The hotkeys associated to the main softkey define the scope of the *Multitone* measurement.

The other softkeys to the right of the test diagram are combined with various hotkeys (e.g. the hotkeys *AF Max. Level* and *AF Mode* belong to the softkey *Analyzer Level)*. 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 (for an example, see section *Test settings* on page 4.40 ff.).

The measurement menu *Multitone* is opened via the main menu *Menu Select* (with the associated key at the front of the instrument) or from the *Analyzer/Generator* menu using the *Multitone* hotkey.

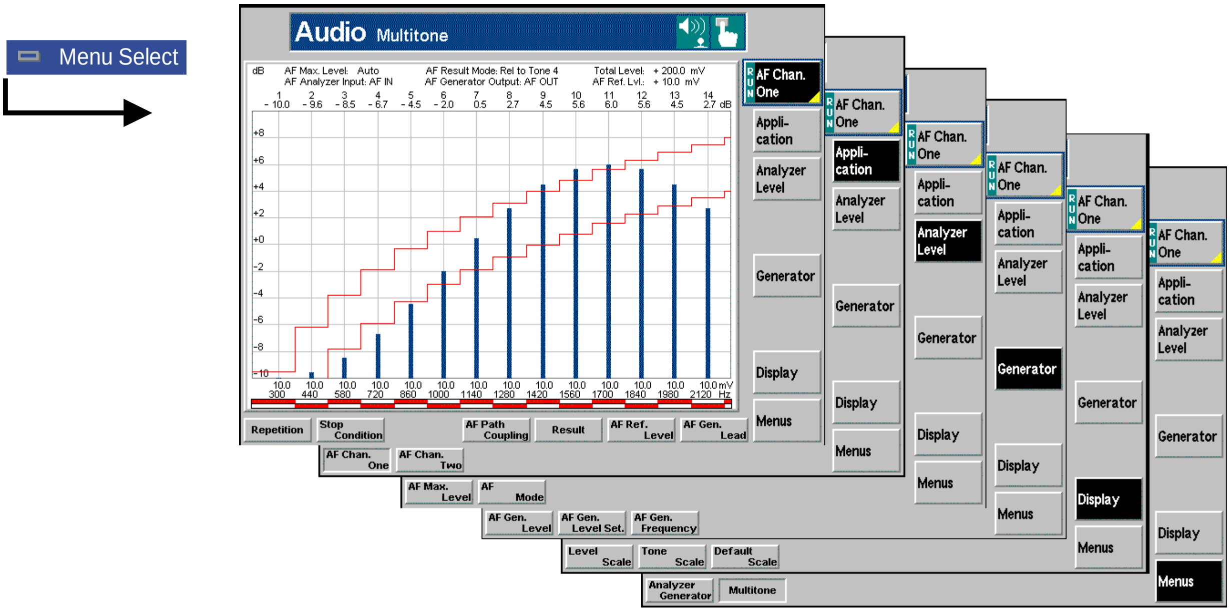


Fig. 4-39 Measurement menu Multitone

Test Settings

The *Multitone* measurement can be configured by means of the softkeys and hotkeys in the graphical measurement menu.

AF Chan. One

The *AF Chan. One* softkey controls the *Multitone* 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.

AF Chan. One changes to *AF Chan. Two* if the corresponding application is selected.

Remote control
`INITiate:MULTitone:AFxChannel; ABORt:MULTitone:AFxChannel;`
`STOP:MULTitone:AFxChannel; CONTINUE:MULTitone:AFxChannel`
`FETCh:MULTitone:AFxChannel:STATus? (x = 1,2)`

Measurement configuration

Pressing the *AF Chan. One* softkey twice opens the popup menus *Multitone Configuration* (see page 4.89). Besides, a number of hotkeys defining the scope of the measurement are associated to the *AF Chan. One* softkey. All settings are also provided in the *Control* tab of the *Multitone Configuration* menu; see section *Measurement Control (Multitone Configuration – Control)* on page 4.89.

Application

The *Application* softkey activates one of the applications of the *Multitone* measurement. The two applications represent two independent audio circuits. Both circuits are identical except for the input and output connectors. Configurations such as the input path *(Analyzer Level)* can be set independently. Changing the application will also change the measurement control softkey *AF Chan. One / AF Chan. Two.*

AF Chan. One

The *AF Chan. One* hotkey selects the *Multitone* measurement on channel one. This means that the audio signals are applied to the connectors AF IN (CMU input) and AF OUT (CMU output) on the front panel.

Remote control
Audio channel no. one is identified by the third-level keyword `AF1Channel`.

AF Chan. Two

The *AF Chan. Two* hotkey selects the *Multitone* measurement on channel two. This means that the audio signals are applied to the connectors AUX 1 (CMU input) and AUX 2 (CMU output) on the CMU front panel.

Remote control
Audio channel no. two is identified by the third-level keyword `AF2Channel`.

Analyzer Level

The *Analyzer Level* softkey controls the level in the AF input signal path for both applications of the *Multitone* measurement.

AF Max. Level

The *AF Max. Level* hotkey sets the maximum expected input level in mV. Two independent values can be set for the two applications AF Chan. One *(Analyzer 1)* and AF Chan. Two *(Analyzer 2)*. The setting is applied if the *AF Mode* (see softkey below) is set to *Manual*.

Note: *The AF Max. Level setting supersedes the corresponding level set in the Control tab of the Analyzer Configuration menu; see section Measurement Control (Analyzer Configuration – Control) on p. 4.81 f.*

Remote control
```
[SENSE:]AFLevel:<Applic>:MAXimum <Level>
[SENSE:]AFLevel:SECondary:MAXimum <Level>
```

AF Mode

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

Manual	Manual input via *AF Max. Level* hotkey
Auto	Automatic setting according to the average power of the applied AF signal.

Two independent values can be set for the two applications AF Chan. One *(Analyzer 1)* and AF Chan. Two *(Analyzer 2)*.

Note: *The AF Mode setting supersedes the corresponding setting in the Control tab of the Analyzer Configuration menu; see section Measurement Control (Analyzer Configuration – Control) on p. 4.81 f.*

Remote control
```
[SENSE:]AFLevel:<Applic>:MODE  MANual | AUTomatic
[SENSE:]AFLevel:SECondary:MODE  MANual | AUTomatic
```

Generator Level

The *Generator Level* softkey defines the level of the AF multitone signal.

The generator level settings are described in more detail in section *Test Tones (Multitone Configuration – Tone Def.)* on page 4.93 ff.

Display

The *Display* softkey scales or shifts the graphical display.

Level Scale

The *Level Scale* hotkey defines the level scale of the *Multitone* test diagram (ordinate scale). The level scale merely represents a display configuration that doesn't have any impact on the measurement or on the input signal path.

The level scale is calculated from a maximum value *(Max.)* and a *Span:*

- The *Max* value defines the upper edge of the diagram.
- The difference *Max – Span* defines the lower edge of the diagram.
- The number of horizontal grid lines (corresponding to 10, 15, or 16 cells) and the ordinate labeling is adapted to the range.

Remote control
no remote control command; screen configuration only

Tone Scale

The *Tone Scale* hotkey selects the display range (abscissa scale) of the test diagram. The range comprises 14 test tones which must be in consecutive order. This condition leaves the following options:

Tone 1 to 14	Display all results between tone 1 and tone 14
...	
Tone 7 to 20	Display all results between tone 7 and tone 20

If a tone is within the selected range but disabled in the *Tone Def.* tab of the configuration menu (see section *Test Tones (Multitone Configuration – Tone Def.)* on page 4.93 ff.), the corresponding result is not indicated, i.e. the bar is omitted and a gap occurs in the test diagram.

Remote control
no remote control command; screen configuration only

Default Scale

The *Default Scale* hotkey cancels all display configurations made and activates the default settings.

Remote control
no remote control command; screen configuration only

Menus

The *Menus* softkey displays the hotkey bar for switching over to the other measurement menus.

Measurement Results

The *Multitone* measurement menu displays the individual levels at up to 14 out of 20 different test tones, corresponding to 20 (not necessarily distinct) audio input frequencies. The results and the test settings are indicated in two parameter lines and the actual test diagram (bar graph) with its axis labels:

Parameter lines

Test tone no. and frequency response

Bar graph with upper and lower limit lines

Test tone voltage and frequency

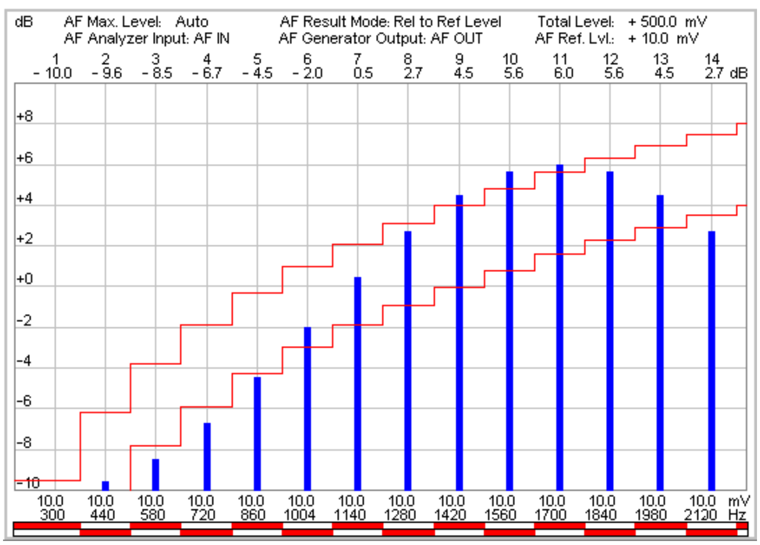


Fig. 4-40 Display of measurement results (Multitone)

Parameter lines

The first parameter line contains the following settings and results:

AF Max. Level	Maximum AF input level in mV as set by means of the *AF Max. Level* softkey described on p. 4.86.
AF Result Mode	Reference value for all levels as set in the configuration menu (see section *Measurement Control (Multitone Configuration – Control)* on p. 4.89 ff.)
Total Level	Sum of the individual levels of all test tones measured in mV.

The second parameter line contains the following settings:

AF Analyzer Input	Input connector used for the Multitone measurement. In the AF Chan. One application, AF IN is used.
AF Generator Output	Output connector used for the Multitone measurement. In the AF Chan. One application, AF OUT is used.
AF Ref. Lvl	0-dB line in the test diagram as set in the configuration menu (see section *Measurement Control (Multitone Configuration – Control)* on p. 4.89 ff.).

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

Bar graph The bar graph shows the AF level in dB at a maximum of 14 out of 20 different audio frequencies corresponding to a continuous range of test tones configured in the *Tone Def.* tab of the configuration menu (see p. 4.93 ff.). If a test tone is disabled in the configuration menu, the corresponding bar is omitted.

Frequency axis (abscissa) The range of test tones (no. 1 to 14, 2 to 15 etc.) to be viewed can be selected via the *Display* – *Tone Scale* hotkey (see p. 4.87). The bars representing the level of the different tones are equidistantly distributed over the whole diagram width. This optimizes the readability of the diagram but implies that the abscissa scale is not necessarily linear. Therefore, the frequency and voltage of every single test tone is displayed below the frequency axis.

Frequency response axis (ordinate) The ordinate can be arbitrarily scaled by setting a maximum and minimum value (both in dB). With a fixed ordinate, the adjustable 0 dB reference line (see *Level Scale* hotkey on p. 4.87) allows to shift the whole diagram vertically.

Remote control
`READ:ARRay:MULTitone:AFxChannel?` etc.
`READ[:SCALar]:MULTitone:AFxChannel:TONE<nr>?` etc. `(x = 1,2)`

Limit Check The upper and lower limit lines for each test point defined in the *Limit Lines* tab of the configuration menu (see p. 4.92) correspond to the two red step functions in the diagram. If the result at a particular test point exceeds the upper limit (falls below the lower limit), the corresponding section of the upper (lower) bar across the bottom of the diagram turns red.

Remote control
```
CALCulate:ARRay:MULTitone:AFxChannel:MATChing:LIMit?
CALCulate[:SCALar]:MULTitone:AFxChannel:TONE<nr>:MATChing:
      LIMit?
CALCulate[:SCALar]:MULTitone:AFxChannel:MATChing:LIMit?
                  (x = 1,2)
```

Measurement Configurations (Multitone Configuration)

The popup menu *Multitone Configuration* contains four tabs which determine the parameters of the *Multitone* measurement including the error tolerances.

The popup menu *Multitone Configuration* is activated by pressing the main softkey (labeled *AF Chan. One* or *AF Chan. Two*, depending of the application selected) in the measurement menu *Multitone* twice. It is possible to change between the tabs by pressing the associated hotkeys.

Measurement Control (Multitone Configuration – Control)

The *Control* tab controls the *Multitone* measurement by determining
The Repetition mode

The *Stop Condition* for the measurement

The AC or DC input *Path Coupling*

A settling time for the AF generator *(AF Generator Lead)*

The 0-dB line in the graphical diagram *(AF Ref. Level)*

Reference value for all levels in the graphical diagram *(Result)*

Besides, it configures the measurement diagram by adding or removing the *Grid*. All parameters can be set independently for the two AF channels 1 and 2.

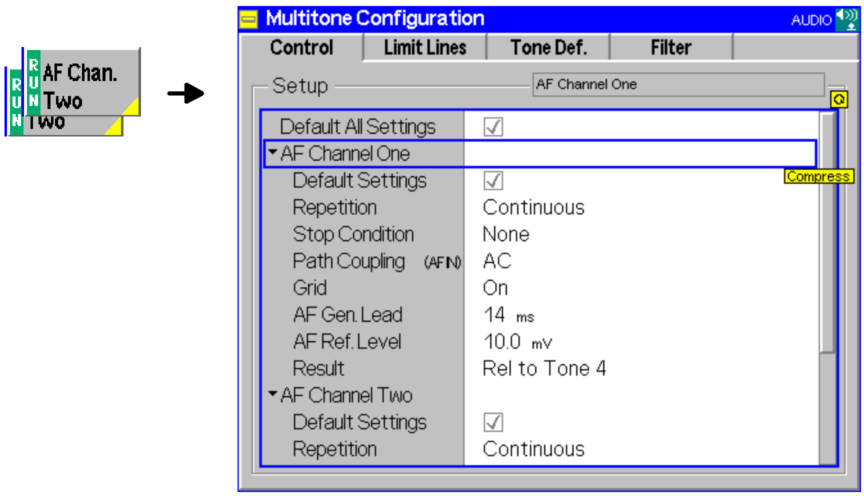


Fig. 4-41 Multitone Configuration – Control

Default Settings

The *Default* 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). Two additional default switches reset all *AF Channel One* or all *AF Channel Two* settings, respectively.

Remote Control
```
CONFigure:MULTitone:AFxChannel:CONTrol:REPetition
      DEF, DEF, DEF  (x = 1,2)
```

Repetition

Repetition determines the repetition mode, see chapter 3 and explanations given on page 4.46 for the *Power* measurement. In *Audio*, one statistics cycle is terminated when the system has settled and a valid result is available.

Remote control
```
CONFigure:MULTitone:AFxChannel:CONTrol:REPetition   (x = 1,2)
       CONTinuous | SINGleshot | 1 ... 10000,NONE,<Stepmode>
```

Stop Condition

Stop Condition defines a stop condition for the measurement:

None Continue measurement even if tolerance is exceeded

On Limit Failure Stop measurement if tolerance is exceeded

Remote control
```
CONFigure:MULTitone:AFxChannel:CONTrol:REPetition  (x = 1,2)
      CONTinuous | SINGleshot | 1 ... 10000,NONE,<Stepmode>
```

AF Path Coupling

*AF Path Coupling*sets the input path for measurement of the AC or AC and DC component of the AF signal:

AC DC component of the measured AF signal (including a possible DC offset of the input amplifier) blocked. This ensures accurate measurement of the AC component. The DC component, however, can not be measured.

DC Measurement of the complete AF input signal (DC plus AC components).

Note: *The AF path coupling has an impact on the allowed filter settings; see section Input Path Configuration (Multitone Configuration – Filter) on p. 4.94 f.*

Remote control
```
CONFigure:MULTitone:AFxChannel:COUPling  AC | DC
            (x = 1,2)
```

AF Generator Lead *AF Generator Lead* defines a settling time for the measurement to be applied after a change of the generator settings. A small value accelerates the measurement but may impair its accuracy.

Remote control
```
CONFigure:MULTitone:AFxChannel:AFGLead <Time> (x = 1,2)
```

AF Ref. Level *AF Ref. Level* defines an audio reference level. The reference level is entered as an RMS voltage (in mV) and defines the 0 dB line of the test diagram provided that *Relative to Ref. Lev.* is selected as *Result* (see below).

Remote control
```
CONFigure:MULTitone:AFxChannel:RLEVel <Voltage> (x = 1,2)
```

Result The *Result* function defines the reference value for all measurement results. This corresponds to the 0 dB reference line in the diagram.

Relative to Ref. Lev. All results are referenced to the AF Ref. Level; see above

Relative to Tone 1 All results are referenced to the measurement result at tone 1 (if available)

...

Relative to Tone 20 All results are referenced to the measurement result at tone 20 (if available)

The measurement is taken at up to 20 audio frequencies (tone 1 to 20) which can be defined and switched on or off in the *Tone Def.* tab of the configuration menu (see page 4.93 ff.).

Remote control
```
CONFigure:MULTitone:AFxChannel:RMODe  RLEV | TON<nr>
            (x = 1,2)
```

Limit Lines (Multitone Configuration – Limit Lines)

The *Limit Lines* tab defines upper and lower limits for the audio level at all test tones and enables or disables the limit check. All parameters can be set independently for the two AF channels 1 and 2.

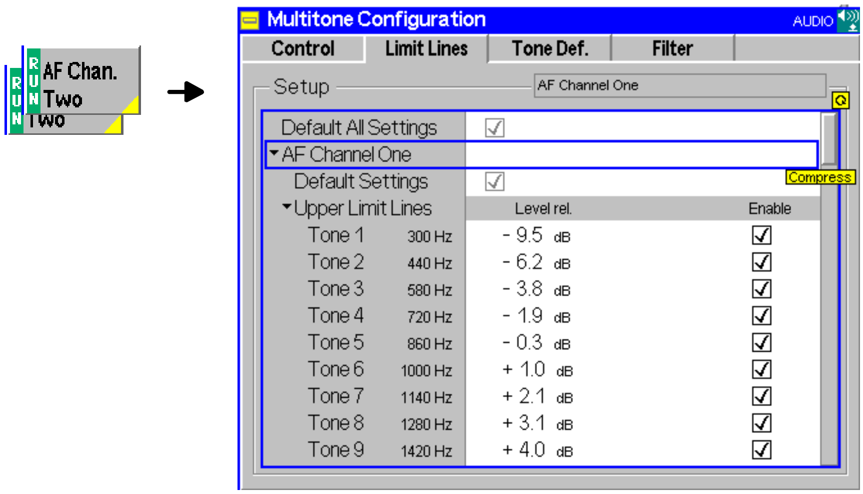


Fig. 4-42 Multitone Configuration – Limit Lines

Default Settings

The *Default All Settings* switch assigns default values to all fields in the *Limit Lines* tab (the default values are quoted in the command description in chapter 6 of this manual). Two additional default switches reset all *AF Channel One* or all *AF Channel Two* settings, respectively.

Remote control

```
DEFault:MULTitone:LIMit:LINE  ON | OFF
DEFault:MULTitone:AFxChannel:LIMit:LINE  ON | OFF (x = 1,2)
```

Upper Limit Line/ Lower Limit Line

Upper and lower limit lines for all 20 test points can be defined separately in the two table sections *Upper Limit Line* and *Lower Limit Line.*

The tone nos. and the corresponding frequencies are indicated in the two left columns of the table as defined in the *Tone Def.* tab (see p. 4.93). For each tone, the upper and lower limit can be entered as a single value in dB. The corresponding *Enable* checkbox switches the limit line in the test diagram and the limit check on (if checked) or off.

Remote control

```
CONFigure:MULTitone:AFxChannel:LIMit:LINE:ASYMmetric:UPPer
      <Limit_1>, <Enable_1>...
CONFigure:MULTitone:AFxChannel:TONE<nr>:LIMit:LINE
         :ASYMmetric:UPPer <Limit>, <Enable>
CONFigure:MULTitone:AFxChannel:LIMit:LINE:ASYMmetric:LOWer
         <Limit_1>, <Enable_1>...
CONFigure:MULTitone:AFxChannel:TONE<nr>:LIMit:LINE
         :ASYMmetric:LOWer <Limit>, <Enable>   (x = 1,2)
```

Test Tones (Multitone Configuration – Tone Def.)

The *Tone Def.* tab configures the audio test signal generated by the CMU. This signal is composed of up to 20 test tones with different frequencies and levels. All parameters can be set independently for the two AF channels 1 and 2.

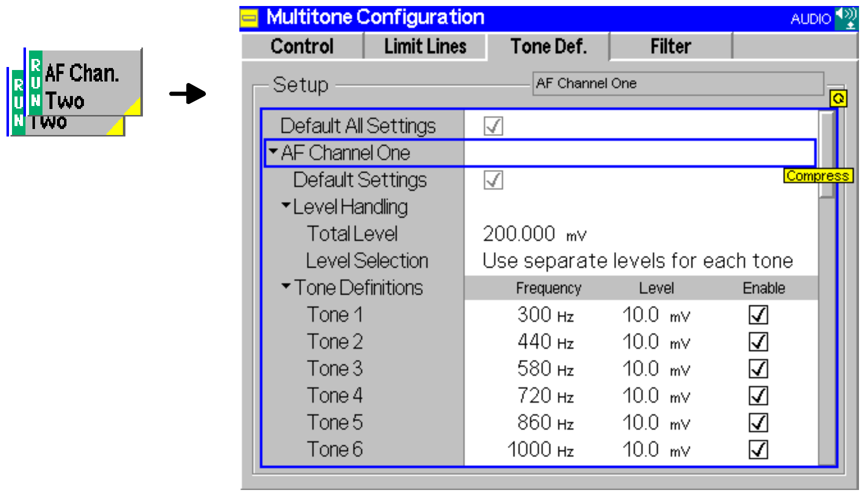


Fig. 4-43 Multitone Configuration – Tone Def.

Default Settings

The *Default All Settings* switch assigns default values to all fields in the *Tone Def.* tab (the default values are quoted in the command description in chapter 6 of this manual). Two additional default switches reset all *AF Channel One* or all *AF Channel Two* settings, respectively.

Remote control
```
DEFault:MULTitone:FILTer  ON | OFF
DEFault:MULTitone:AFxChannel:FILTer  ON | OFF (x = 1,2)
```

Level Handling: Total Level

Total Level defines the sum of the individual voltages of all enabled tones. The meaning of the total level depends on the *Level Selection* setting (see below):
If *Level Selection* is set to *Use Separate Levels,* a separate AF level (in mV) can be assigned to each of the 20 test tones.

If *Level Selection* is set to *Use Total Level,* a single sum level (also in mV) is defined for the whole multitone signal. This level is evenly distributed among all enabled test tones.

The *Total Level* entered must not exceed the maximum level of the AF generator quoted in the data sheet.

Remote control
```
CONFigure:MULTitone:AFxChannel:TDEFinition:TLEVel  (x = 1,2)
```

Level Selection

The *Level Selection* table section defines how the voltage of each of the test tones is determined:

Use separate levels for each tone
A separate AF level (in mV) can be assigned to each of the 20 test tones. The *Total Level* is ignored. It can still be edited for future measurements where the *Level Selection* parameter is set to *Manual*.

Use Total Level A single sum level (also in mV) is defined for the whole multitone signal. This level is evenly distributed among all enabled test tones. This means that the level of each enabled test tone is set to *Total Level / n* where n is the number of enabled test tones (n = 1 to 20). If a test tone is disabled, the total level is maintained and the share of the remaining test tones in the total level increases.

Remote control
```
CONFigure:MULTitone:AFxChannel:TDEFinition:MODE  (x = 1,2)
         SEParate | TLEVel
```

Tone Definitions The *Tone Definitions* table assigns an audio *Frequency* (in Hz) and *Level* (RMS voltage in mV) to each of the 20 test tones.

The frequencies must be multiples of 1 Hz. It is possible, however, to define several tones at the same frequency, or to number the tones in arbitrary order: The x-axis is scaled by the **number** of the test tones, not by their frequency. The RMS voltages of different tones may coincide and can vary within the range quoted in the remote control command description in chapter 6 of this manual. The sum of all test tones must not exceed the maximum level of the AF generator quoted in the data sheet.

Note: *The voltages of all test tones enabled can be set manually or automatically, depending on the setting of the* Level Selection *parameter described above.*

The *AF Gen.* checkbox switches the tone in the audio signal and the corresponding bar in the test diagram on (if checked) or off.

Remote control
```
CONFigure:MULTitone:AFxChannel:TDEFinition
         <Freq_1>,<Level_1>,<Enable_1>,...
CONFigure:MULTitone:AFxChannel:TDEFinition:TONE<nr>
         <Freq>,<Level>,<Enable>,... (x = 1,2)
```

Input Path Configuration (Multitone Configuration – Filter)

The *Filter* tab configures the receive path of the CMU for the *Multitone* measurement (see *Fig. 4-44 b*elow). All parameters can be set independently for the two AF channels 1 and 2.

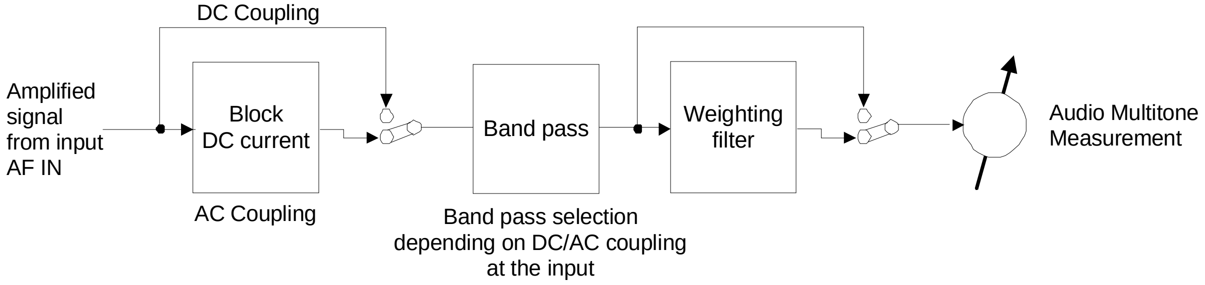


Fig. 4-44 Signal path for Multitone measurements

The audio receive path of the CMU may contain the following filter stages:

AF Path Coupling Capacitor stage to block the DC component of the AF input signal including a possible DC offset of the input amplifier. With DC coupling, the complete AF input signal is measured.

Weighting Weighting filter according to CCITT or C-message weighted filter.

Band Pass Audio band pass filter with selectable bandwidth to limit the input frequencies to a definite audio band and eliminate unwanted signal components. The allowed bandwidth depends on the *AF Path Coupling*.

The audio results are generated at the end of the audio receive path, after the audio signal has passed all filter stages that are switched on.

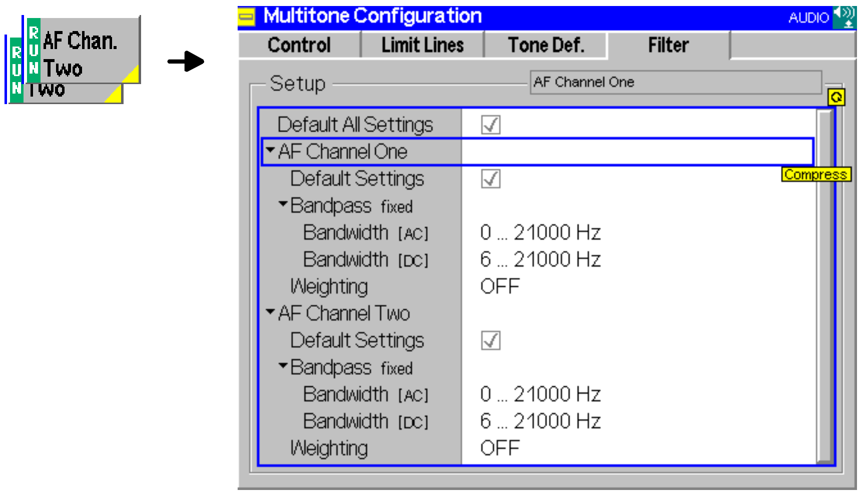


Fig. 4-45 Multitone Configuration – Filter

Default All Settings The *Default All Settings* switch assigns default values to all fields in the *Filter* tab (the default values are quoted in the command description in chapter 6 of this manual). Two additional default switches reset all *AF Channel One* or all *AF Channel Two* settings, respectively.

Remote control
```
DEFault:MULTitone:FILTer ON | OFF
DEFault:MULTitone:AFxChannel:FILTer ON | OFF (x = 1,2)
```

AF Channel One The table section *AF Channel One* defines the input path for the *Multitone* measurement. The following settings are provided:

Band pass Selection of the bandwidth of the CMU's audio band pass. A separate band pass can be selected for AC coupling and DC coupling.

Weighting Use of a C-message weighted filter *(C-Message)*, a *CCITT* weighting filter or none of these filters *(OFF)*.

The CMU provides a broad selection of bandwidths with lower cutoff frequencies between 0 Hz and 300 Hz and upper cutoff frequencies between 250 Hz and 21 kHz (see command description in Chapter 6).

Note: *If the AF Path Coupling is set to DC (see section Measurement Control (Multitone Configuration – Control) on page 4.89), the audio analyzer receives the complete AF input signal including a possible DC component. To avoid measurement inaccuracies, a band pass with a lower cutoff ≥ 6 Hz must be used.*

Remote control

```
CONFigure:MULTitone:AFxChannel:FILTer:BPASs:DCCoupling
                <Bandwidth>
CONFigure:MULTitone:AFxChannel:FILTer:BPASs:ACCoupling
                <Bandwidth>
CONFigure:MULTitone:AFxChannel:FILTer:BPASs:WEIGhting
                CME | CCI | OFF  (x = 1,2)
```

I/Q and IF Interface (Option CMU-B17)

Option CMU-B17 provides separate access to the I/Q and IF signals in the CMU200 receiver (RX) and transmitter (TX) paths. The functionality is applicable in conjunction with the *RF* function group (see section *I/Q-IF Interface (Connection Control – I/Q-IF) REFFORMATVERBINDEN*on p. 4.74 ff.) and with a wide range of network options in *Signalling* as well as in *Non Signalling* test modes (see separate manuals for network options). The insertion of option CMU-B17 in bypass mode does not cause any influence on signals; i.e. the additional insertion loss caused by option CMU-B17 will be corrected during the mandatory calibration procedure after installation.

Block diagram The diagram below shows the possible signal paths and the input and output connectors related to option CMU-B17. The position of the connectors on the rear panel is shown in Chapter 1; for the technical specifications and the pin assignment refer to Chapter 8.

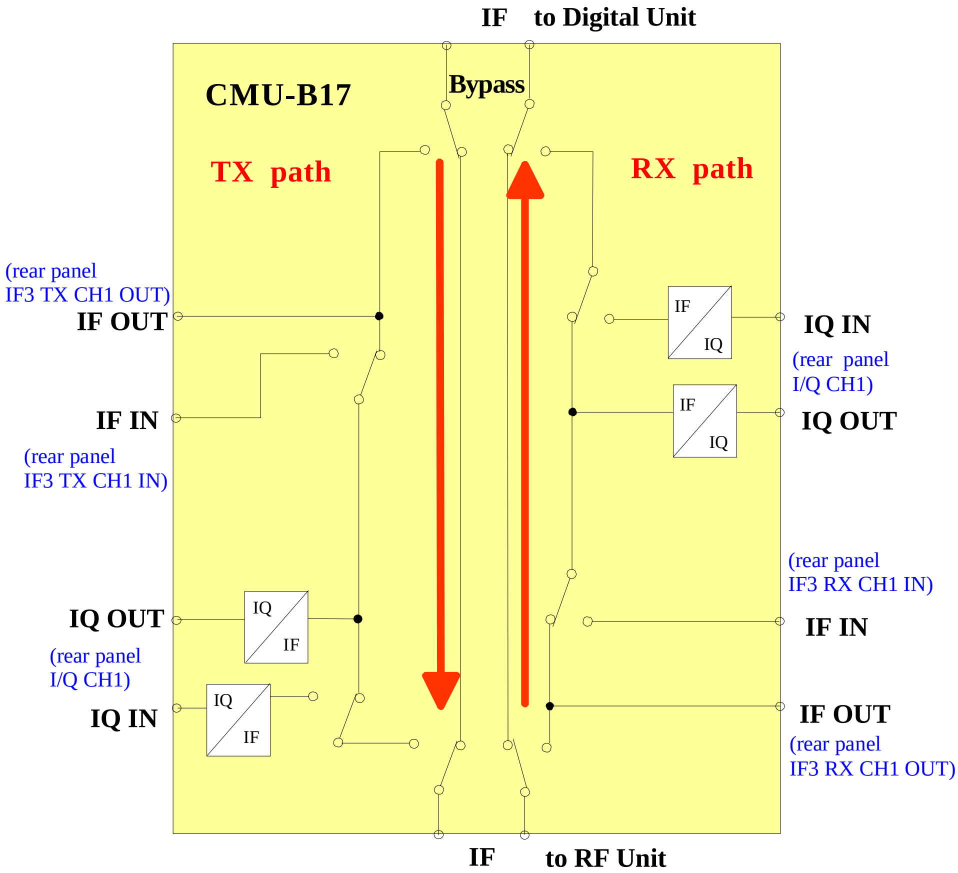


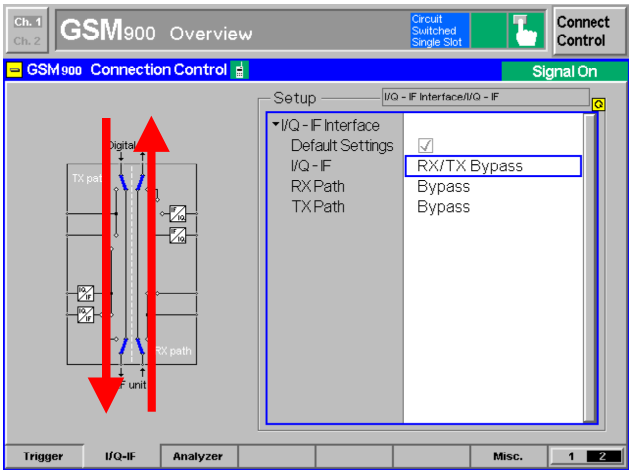
Fig. 4-46 I/Q-IF Interface

I/Q-IF Test Scenarios

A short overview of test scenarios with the necessary RX and TX path settings is given in *Table 4-1* on p. 4.75. The following examples illustrate the functionality in more detail.

The list of scenarios is not necessarily complete: Depending on the application, it is possible to define customized, *User defined* test scenarios.

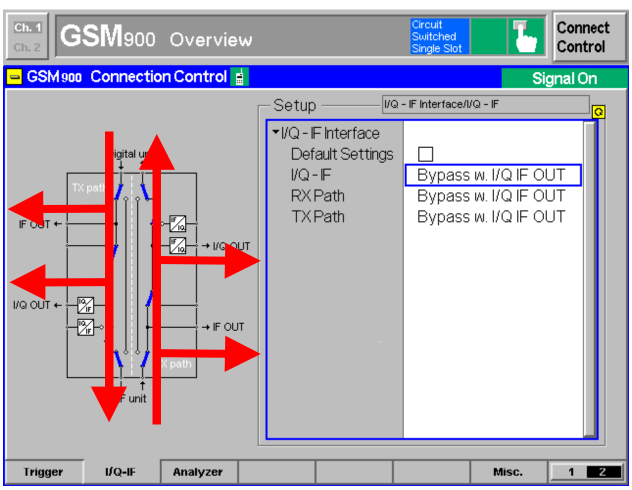
1. Default setting: Bypass mode for RF tests with maximum accuracy



The path loss due to the inserted board CMU-B17 will be corrected automatically during the mandatory calibration procedure after installation of the option.

The option has no influence on transmitted and received signals.

2. Scenarios for I/Q-IF signal monitoring

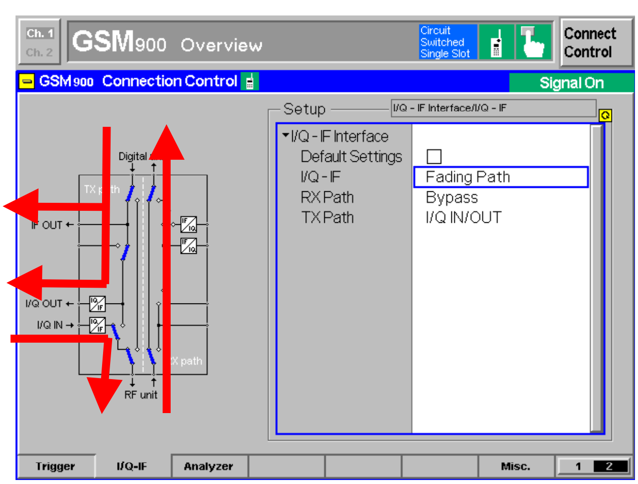


Monitoring of uplink and downlink signals via IF or I/Q outputs possible.

The insertion loss of option CMU-B17 will be corrected during the calibration procedure.

This mode can be used for fading applications.

3. Interruption of I/Q or IF signal paths for external signal processing

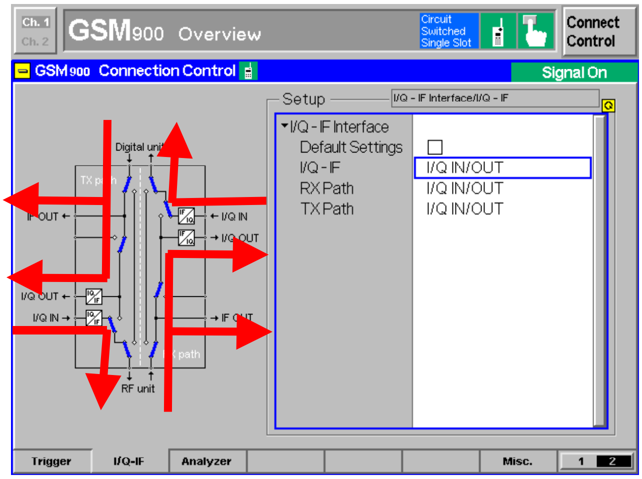


Fading Path scenario:

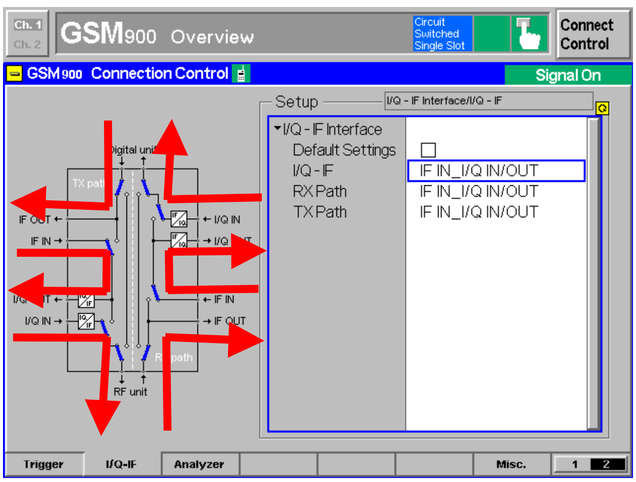
The *Fading Path* scenario can be used for connecting an external baseband-fading simulator (pls. see next chapter, CMU200 and ABFS).

The transmitted signal can be routed to the fading simulator via IF or IQ outputs.

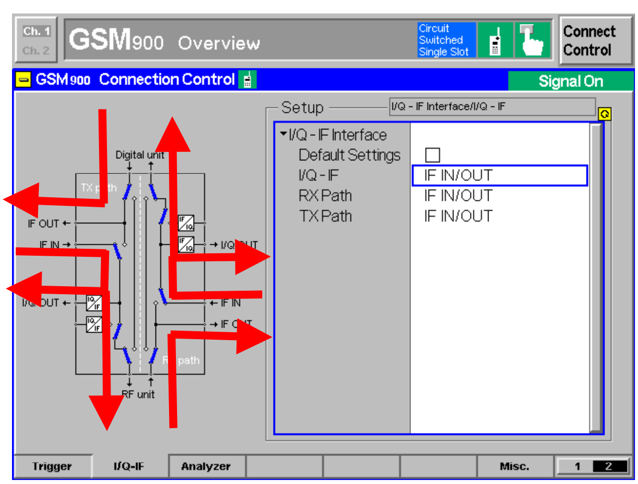
Additionally it is possible to return the faded signal via IQ input.



I/Q IN/OUT scenario



IF IN_I/Q IN/OUT scenario



IF IN/OUT scenario

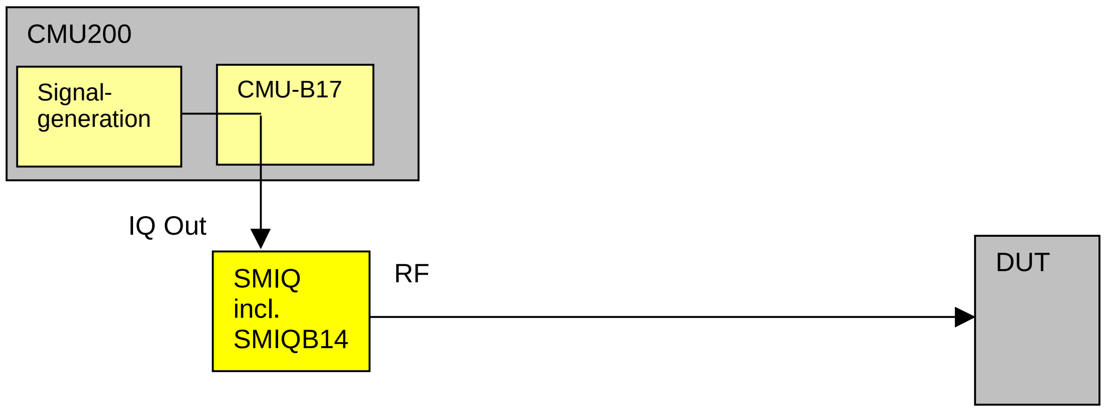
Application Examples

The following section is intended as a short introduction to possible applications of option CMU-B17. For detailed information refer to the relevant application notes.

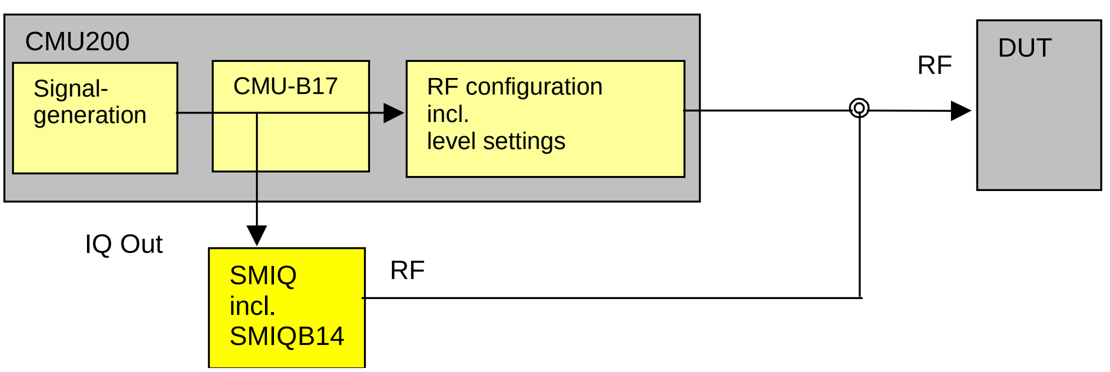
Bit Error Rate Measurements on Digital Receivers under Fading Conditions

1. CMU 200 / CMU-B17 in combination with SMIQ / SMIQ-B14

IQ/IF scenario: *Fading Path* or *Bypass w. I/Q IF OUT*



IQ/IF scenario: *Bypass w. I/Q IF OUT*

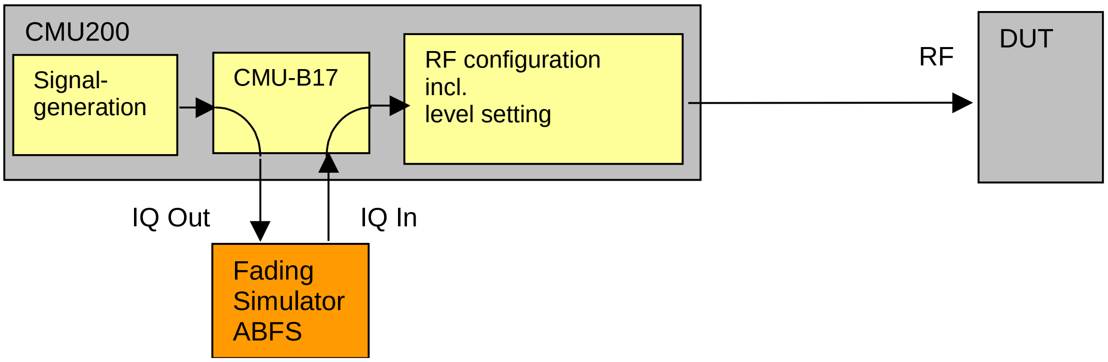


The CMU incl. option CMU-B17 in combination with R&S signal generator SMIQ incl. IQ fading simulator option SMIQB14 can be used for receiver Bit Error Rate tests under fading conditions. The IQ output of CMU-B17 transmitter (TX) path feeds the signal into SMIQ's IQ input. The SMIQ forwards the faded RF signal directly to the receiver (RX) of the DUT. The illustrated test setups depend on the test scenario selected on option CMU-B17.

For more information please refer to R&S application note 1MA07_0E: *SMIQ as Fading Simulator for External Signals*.

2. CMU 200 / CMU-B17 in combination with fading simulator ABFS

IQ/IF scenario: *Fading Path*



The CMU 200 incl. option CMU-B17 can be used in combination with the IQ fading simulator R&S ABFS for receiver tests under fading conditions. In this case the signal is routed to the DUT via the CMU's RF interface.

Additional information for GSM:

To avoid unwanted influences on the fading profile it is highly recommended:
To set all timeslots to the same level.

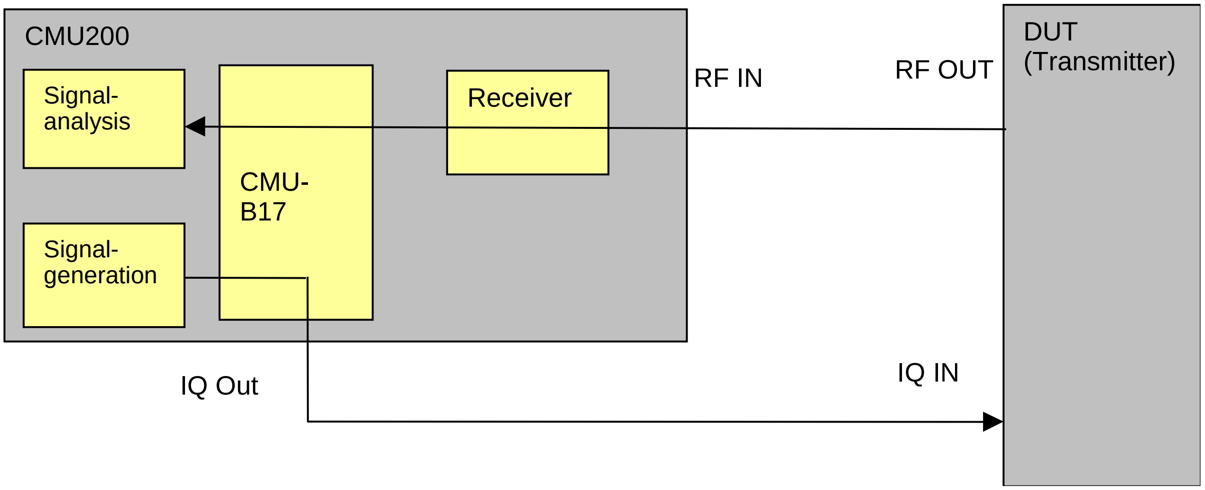
To configure the TX signal of the CMU with the same RF frequencies and RF levels for both TCH and BCCH.

To switch hopping off.

CMU200 as I/Q Generator and RF Analyzer

Another important application is the generation of IQ signals meeting the relevant standards. It is possible to generate complex signals that may even originate from a real signalling sequence. Most mobile radio chipsets comprise an RF chip and a baseband chip that communicate with each other via an analog IQ interface. The CMU-B17 IQ-interface can then be used to access the two chips. In mobile radio development, different teams are often required for this purpose and the new testing feature via the IQ interfaces allows development work to be divided in space and time.

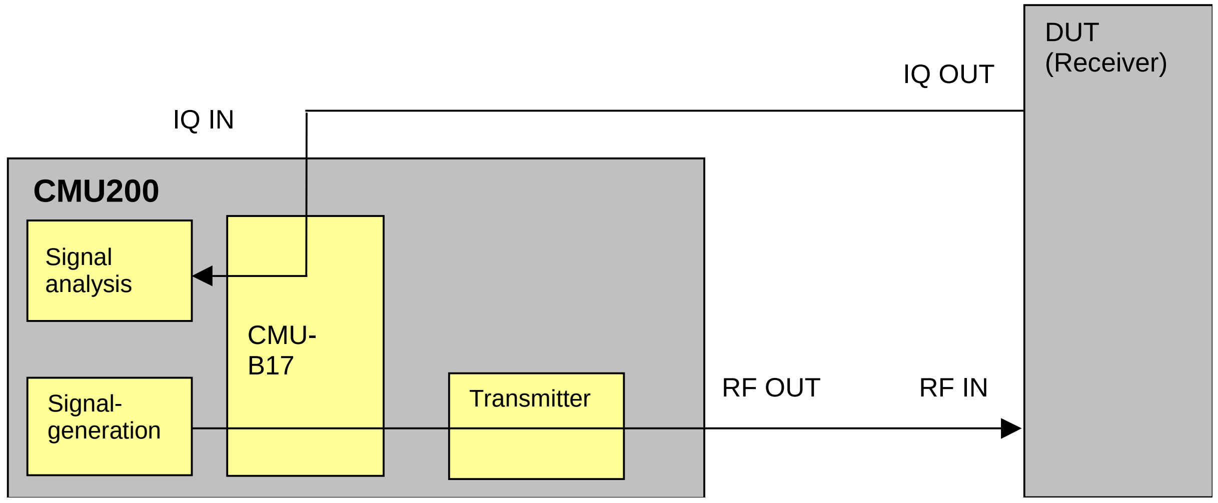
IQ/IF scenario: *Bypass w. I/Q IF OUT*



CMU200 as RF Generator and I/Q Analyzer

If IQ signals are applied to the receive section of the tester, signal analysis can be performed in the same manner as when analyzing an RF signal. In this test setup, a modulation analysis is useful since it assesses the quality of an IQ signal. The modulation analysis measures quantities such as the I/Q offset and I/Q imbalance, which are directly related to the I/Q signals. In addition, it provides more complex evaluations such as the error vector magnitude (EVM).

IQ/IF scenario: *User defined:* RX Path: *I/Q IN/OUT* TX Path: *Bypass*



Contents

5 Remote Control – Basics

This chapter provides:

- Instructions on how to set up the CMU for remote control operation.
- A general introduction to remote control of programmable instruments. This includes the description of the command structure and syntax according to the SCPI standard, the description of command execution and of the status registers.
- A comprehensive description of the CMU's remote control concept.

In section *Special Terms and Notation* on page 5.41, concepts and terms related to remote control of the CMU in particular are described. In Chapter 6, all *remote* control functions of the basic unit and of function groups *RF Analyzer* and *Audio* are described in detail. The commands for each function group and their parameters are listed according to their function and in alphabetical order in the command lists at the end of Chapter 6.

Program examples for the CMU can be found in Chapter 7.

Introduction

The instrument is equipped with an GPIB bus interface according to standard IEC 625.1/IEEE 488.1. The connectors are located at the rear of the instrument and permit to connect a controller for remote control.

This section assumes basic knowledge of GPIB bus programming and operation of the controller. A description of the interface commands can be obtained from the relevant manuals.

Not all of the commands supported by the instrument are taken from the SCPI standard (Standard Commands for Programmable Instruments), however, their syntax follows SCPI rules. The SCPI standard is based on standard IEEE 488.2 and aims at the standardization of device-specific commands, error handling and the status registers (see section *SCPI Introduction*).

The requirements of the SCPI standard placed on command syntax, error handling and configuration of the status registers are explained in detail in the following sections. Tables provide a fast overview of the bit assignment in the status registers. The tables are supplemented by a comprehensive description of the status registers.

Note: *In contrast to instruments with manual control, which are designed for maximum possible operating convenience, the priority of remote control is the "predictability" of the device status. This means that when incompatible settings are attempted, the command is ignored and the device status remains unchanged, i.e. other settings are not automatically adapted. Therefore, GPIB bus control programs should always define an initial device status (e.g. with the command *RST) and then implement the required settings.*

Operation via Remote Control

As any device, the CMU must be assigned a unique primary address in the range 0 to 30 decimal. In addition it uses extended addressing, i.e. a secondary address must be assigned to the individual function groups. Primary and secondary addresses can be defined in the *Remote* index card of the *Setup* menu (see Chapter 4) or via remote control.

Switchover to Remote Control

On power-on, the instrument is always in the manual operating state and can be operated via the front panel controls. The instrument is switched to remote control in the following cases:

With active GPIB bus	as soon as the Remote Enable (REN) GPIB line is asserted by the controller.
With active RS-232 interface	as soon as the instrument receives any characters via the interface.

Operation via the front panel is disabled. The instrument remains in the remote state until it is reset to the manual state via the front panel or via GPIB bus (see section *Return to Manual Operation*).

Note: ***Local to remote transition and signalling states***

Switching from manual operation to remote control does usually not affect the device settings. However, if the CMU operates in a Non Signalling *test mode, all generators are switched off. In a* Signalling *mode, the current connection or call is dropped and the CMU returns to its default signalling state.*

To change this behavior and preserve the generator and signalling states in a local to remote transition, the command `SYSTem:GTRMode:COMPatible OFF` can be used; see Chapter 6.

Setting the Device Address

The GPIB address (primary address) of the instrument is factory-set to 20. It can be changed manually via the *Primary Address* softkey in the *Setup - Remote* menu or via GPIB bus. For remote control, addresses 0 through 30 are permissible.

In addition to the primary address, up to 30 secondary addresses can be assigned to the individual function groups and test modes. Secondary address 0 is reserved for the CMU base system. The other secondary addresses are set via the *Second. Address* softkey in the *Setup - Remote* menu or via remote control.

Note: *In the Setup – Remote menu, secondary addresses between 1 and 29 can be assigned. When using the National Instruments driver, add 96 to the secondary address. For example, specify a secondary address of 96 to access secondary address 0 on the instrument.*

Changing the addresses manually:

- Call *Setup - Remote* menu.
- Press *Primary Address* softkey. Enter desired address in the input field.
- Press *Second. Address* softkey. Use the rotary knob to select the list line with the desired address (numbers 1 to 29). Press ENTER to edit the line. From the popup window select the desired function group (use the rotary knob to change between the entries in the popup window). Confirm your selection and close the popup window using the ENTER key.
- Press the *ESCAPE* key to close the *Setup – Remote* menu.

Via GPIB bus interface:

- Use the SYSTem:REMote:ADDRess:PRIMary <Addr_1> command to define the GPIB bus address of the CMU.
- Use the SYSTem:REMote:ADDRess:SECondary <Addr_2>,"<Fgroup>" command to assign distinct secondary addresses to all function groups needed. The secondary address is transferred with each command (physical/hardware addressing, see program example in Chapter 7). Alternatively, software switchover with a command preceded by a secondary address and a semicolon is possible:

  <Addr_2>;<Command> (logical addressing of secondary address; use semicolon)

Via RS-232 interface:

- Use the SYSTem:REMote:ADDRess:PRIMary <Addr_1> command to define the GPIB bus address of the CMU.
- Use the SYSTem:REMote:ADDRess:SECondary <Addr_2>,"<Fgroup>" command to assign distinct secondary addresses to all function groups needed.
- Use the *SEC <Addr_2> command for a software switchover from one secondary address to another. Alternatively place <Addr_2>; in front of the command:

  *SEC <Addr_2> followed by <Command> is equivalent to <Addr_2>;<Command>, provided that secondary address <Addr_2> has been appropriately defined.

Indications during Remote Control

In the REMOTE state no menus but only the header REMOTE is indicated.

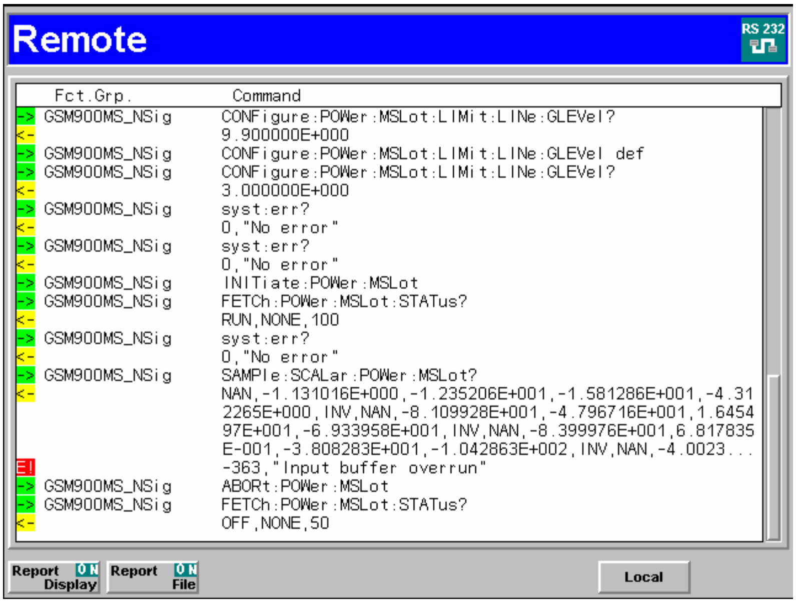


Fig. 5-1 Remote screen

Report Display

The *Report Display* hotkey can be activated (state *ON,* press the *ON/OFF* key*)* to display the input and output strings of the remote-control interface on the *Remote* screen. The remote display consists of three columns:

<Input/ouput>	Colored symbols for input (–>) to the CMU, output (<–) or error messages (E).
Fct. Grp.	Name of the addressed function group; see description of command `SYSTem:REMote:ADDRess:SECondary` in Chapter 6.
Command	Input command string, response/output string of the CMU or error message

Remote control
`TRACe:REMote:MODE:DISPlay ON | OFF`

Report File

The *Report File* hotkey can be activated (state *ON,* press the *ON/OFF* key*)* to write the input and output strings of the remote-control interface to a file named Remote.trc in the root directory of the internal hard disk *(INTERNAL* directory in the *Data* menu or directory C:\temp). The two softkeys *Report Display* and *Report File* may be active *(ON)* at the same time.

Remote control
`TRACe:REMote:MODE:FILE ON | OFF`

Local

The *Local* hotkey switches back to manual control. The current measurement and generator states and the current signalling state (if a *Signalling* test mode is active) are preserved; see also section *Return to Manual Operation* below.

Remote control
`GTL` interface message, included in the NI command `IBLOC (device%)` (addressed command; see Chapter 8)
Equivalent CMU-specific command, also for operation via serial interface: `*GTL`

Return to Manual Operation

Return to manual operation can be initiated via the front panel or the GPIB bus.

Manually:

➢ Press any key at the front panel or press the *Local* hotkey in the *Remote* screen. The current measurement and generator states and the current signalling state (if a *Signalling* test mode is active) are preserved.

Note:

– *Before returning to manual control, command processing must be completed. If this is not the case, the CMU switches back to remote control immediately.*

– *Returning to manual control by pressing any front panel key can be disabled by the GPIB Local Lockout Message (LLO; see Chapter 8, Table* Universal Commands*), which is also included in the NI commands SetRWLS (Set Remote With Lockout State) or SendLLO. This prevents unintentional switchover, i.e. return to manual control is possible via the GPIB bus only. The CMU-specific command `*LLO TRUE` is equivalent to LLO.*

– *Returning to manual control via the front panel keys can be enabled again by deactivating the REN control line of the GPIB bus (see Chapter 8). The CMU-specific command `*LLO FALSe` also enables return to manual control.*

Via GPIB bus:

```
...
CALL IBLOC(device%)          Set instrument to manual operation
...
```

Equivalent CMU-specific command, also for serial interface: `*GTL`

Target Menu

On switching over from remote to manual control, the CMU preserves the current measurement and generator states and the current signalling state (if a *Signalling* test mode is active). The instrument tries to open the menu that the user is likely to prefer, i.e. the measurement menu of the current, running measurement. If several measurements are running in parallel, the instrument applies the following selection rules to resolve the ambiguity and determine a preferred menu:

– The preferred menu must belong to a measurement that is in the *RUN* or *HLT* state (see section *Measurement Control Commands and States* on p. 5.28 ff.). *RDY* measurements and suppressed measurements are discarded.

– Measurement menus of the main application have the priority over configuration menus (e.g. for signalling and generators) and menus for additive applications (e.g. an *Audio* measurement that is performed in the context of a GSM-MS main application).

– Out of several running measurements of the same hierarchy level, the last one that was initiated (`INITiate:`… or `READ:`…?) is preferred.

If no measurement is in the *RUN* or *HLT* state, the last measurement that was aborted (`ABORt:`…) is preferred.

Setting the Transmission Parameters (RS-232 interface)

To ensure a correct data transmission, the parameters of the instrument and the controller must be set identically. The number of data and stop bits, the parity, baud rate and the handshake mode can be set independently for the two interfaces COM 1 and COM 2 in the *Setup - Comm.* menu:

➢ Open *Setup - Comm.* menu,

➢ Press one of the softkeys to select interface COM 1 or COM 2,

➢ Use the cursor keys and the rotary knob to select and change desired parameters,

➢ Terminate input using the *[ENTER]* key.

GPIB Bus Messages

The messages transferred via the data lines of the GPIB bus (see Chapter 8) can be divided into two groups:

- **interface messages**
- **device messages**

Interface Message

Interface messages are transferred on the data lines of the GPIB bus, the ATN control line being active. They are used for communication between controller and instrument and can only be sent by a computer which has the function of an GPIB bus controller.

Interface commands can be further subdivided into

- **universal commands**
- **addressed commands**

Universal commands act on all devices connected to the GPIB bus without previous addressing, addressed commands only act on devices previously addressed as listeners. The interface messages relevant to the instrument are listed in Chapter 8, section *Interface Messages*.

Device Messages (Commands and Device Responses)

Device messages are transferred via the data lines of the GPIB bus, the "ATN" control line not being active. The ASCII code is used. A distinction is made according to the direction in which device messages are transferred:

Commands are messages the controller sends to the instrument. They operate the device functions and request information. The commands are subdivided according to two criteria:

1. According to the effect they have on the instrument:

    Setting commands cause instrument settings such as a reset of the instrument or setting the output level to some value.

    Queries cause data to be provided for output on the GPIB bus, e.g. for identification of the device or polling the active input.

2. According to their definition in standard IEEE 488.2:

    Common Commands are exactly defined as to their function and notation in standard IEEE 488.2. They refer to functions such as management of the standardized status registers, reset and selftest.

    Device-specific Commands refer to functions depending on the features of the instrument such as frequency setting. A majority of these commands has also been standardized by the SCPI committee (cf. section *SCPI Introduction*).

Device responses are messages the instrument sends to the controller after a query. They can contain measurement results, instrument settings and information on the instrument status (cf. section 3.5.4).

Structure and syntax of the device messages are described in the next section. In Chapter 6 all commands are listed and explained in detail.

Structure and Syntax of Device Messages

SCPI Introduction

Not all of the commands supported by the instrument are taken from the SCPI standard (Standard Commands for Programmable Instruments), however, their syntax follows SCPI rules. All information given in this section and all the command examples apply to the CMU.

SCPI (Standard Commands for Programmable Instruments) describes a standard command set for programming instruments, irrespective of the type of instrument or manufacturer. The goal of the SCPI consortium is to standardize the device-specific commands to a large extent. For this purpose, a model was developed which defines the same functions inside a device or for different devices. Command systems were generated which are assigned to these functions. Thus it is possible to address the same functions with identical commands. The command systems are of a hierarchical structure. *Fig. 5-2* illustrates this tree structure using a section of command system SOURce, which operates the signal sources of the devices. The other examples concerning syntax and structure of the commands are derived from this command system.

SCPI is based on standard IEEE 488.2, i.e. it uses the same syntactic basic elements as well as the common commands defined in this standard. Part of the syntax of the device responses is defined with greater restrictions than in standard IEEE 488.2 (see section *Responses to Queries)*.

Command Structure

The commands consist of a so-called header and, in most cases, one or more parameters. Header and parameter are separated by a "white space" (ASCII code 0 to 9, 11 to 32 decimal, e.g. blank). The headers may consist of several key words. Queries are formed by directly appending a question mark to the header.

Common Commands

Common (=device-independent) commands consist of a header preceded by an asterisk "*" and eventually one or several parameters.

Examples:

`*RST`	RESET, resets the instrument.
`*ESE 253`	EVENT STATUS ENABLE, sets the bits of the event status enable registers.
`*ESR?`	EVENT STATUS QUERY, queries the contents of the event status register.

Device-specific commands

Hierarchy: Device-specific commands are of hierarchical structure (see *Fig. 5-2*). The different levels are represented by combined headers. Headers of the highest level (root level) have only one key word. This key word denotes a complete command system.

Example:

`SOURce` This key word denotes the command system `SOURce`.

For commands of lower levels, the complete path has to be specified, starting on the left with the highest level, the individual key words being separated by a colon ":".

Example:

`SOURce:RFGenerator:FHOPping:STATe ON`

This command is located on the fourth level of the SENse system. It switches on frequency hopping for the RF generator.

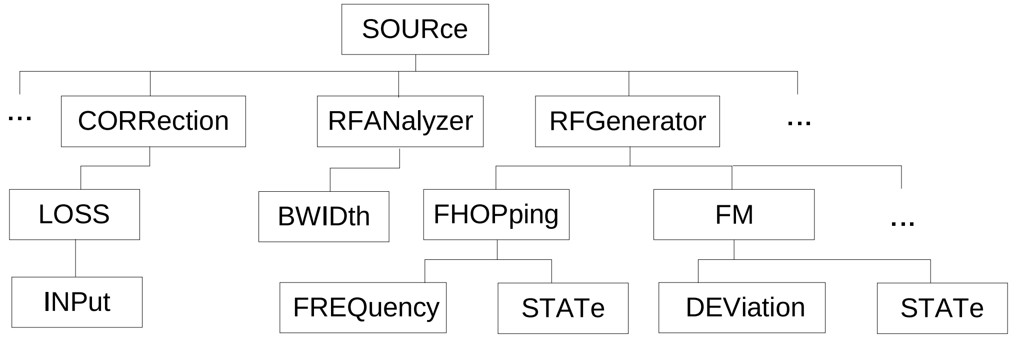


Fig. 5-2 Example for the tree structure of the SCPI command systems; the `SOURce` system

Multiple key words

Some key words occur on several levels within one command system. Their effect depends on the structure of the command, i. e. on the position in the command header they are inserted in.

Example: `SOURce:RFGenerator:FHOPping:STATe ON`

This command contains the key word `SOURce` in the first command level. It switches on frequency hopping for the RF generator.

`TRIGger:SOURce EXTern`

This command contains the key word `SOURce` in the second command level. It defines the trigger source “external trigger”.

Optional key words:

Some command systems permit certain key words to be optionally inserted into the header or omitted. These key words are marked by square brackets in this manual. The full command length must be recognized by the instrument for reasons of compatibility with the SCPI standard. Some commands are considerably shortened by omitting optional key words.

Example: `TRIGger[:SEQuence]:SOURce EXTern`

This command defines the trigger source “external trigger”. The following command has the same effect:

`TRIGger:SOURce EXTern`

Note: *An optional key word must not be omitted if its effect is additionally specified by a numeric suffix.*

Long and short form:

The key words feature a long form and a short form. Either the short form or the long form can be entered, other abbreviations are not permissible.

Example: `TRIGger:SOURce EXTern`
`TRIG:SOUR EXT`

Note: *The short form is marked by upper-case letters, the long form corresponds to the complete word. Upper-case and lower-case notation only serves to distinguish the two forms in the manual, the instrument itself does not distinguish upper-case and lower-case letters.*

Parameters: Parameters must be separated from the header by a "white space". If several parameters are specified in a command, they are separated by a comma ",". For a description of the types of parameter, refer to section *Parameters* on page 5.10.

Example: `CONFigure:POWer:CONTrol SCALar,100`

This command defines the type of measured values in a power measurement and the number of samples/bursts forming a statistics cycle.

Numeric suffix: If a device features several functions or features of the same kind, e.g. several inputs, the desired function can be selected by a suffix added to the command. Entries without suffix are interpreted like entries with the suffix 1.

Example: `SOURce:CORRection:LOSS:INPut2 10dB`

This command defines the external attenuation at the input connector RF 2

Structure of a Command Line

A command line may consist of one or several commands. It is terminated by a <New Line>, a <New Line> with EOI or an EOI together with the last data byte. Visual BASIC automatically produces an EOI together with the last data byte.

Several commands in a command line must be separated by a semicolon ";". If the next command belongs to a different command system, the semicolon is followed by a colon.

Example: `CALL IBWRT(device%, "TRIGger:SOURce EXTern;:FETCh:POWer:STATus?")`

This command line contains two commands. The first command belongs to the `TRIGger` system and defines the trigger source (external trigger). The second command belongs to the `FETCh` system and returns the status of the power measurement.

If the successive commands belong to the same system, having one or several levels in common, the command line can be abbreviated. To this end, the second command after the semicolon starts with the level that lies below the common levels (see also Fig. 5.1). The colon following the semicolon must be omitted in this case.

Example: `CALL IBWRT(device%, "TRIG:SOUR EXT;:TRIG:THR LOW")`

This command line is represented in its full length and contains two commands separated from each other by the semicolon. Both commands are part of the `TRIGger` command system, i.e. they have one level in common.
When abbreviating the command line, the second command begins with the level below `TRIG`. The colon after the semicolon is omitted.

The abbreviated form of the command line reads as follows:

`CALL IBWRT(device%, "TRIG:SOUR EXT;THR LOW")`

However, a new command line always begins with the complete path.

Example:
```
CALL IBWRT(device%, "TRIG:SOUR EXT ")
CALL IBWRT(device%, "TRIG:THR LOW ")
```

Responses to Queries

A query is defined for each setting command unless explicitly specified otherwise. It is formed by adding a question mark to the associated setting command. According to SCPI, the responses to queries are partly subject to stricter rules than in standard IEEE 488.2.

1. The requested parameter is transmitted without header.
   Example: `TRIGger:THReshold?` Response: `LOW`
2. Maximum values, minimum values and all further quantities, which are requested via a special text parameter are returned as numerical values
   Example: `CONFigure:POWer:CONTrol:REPetition? MAX` Response: `10000`
3. Numerical values are output without a unit. Physical quantities are referred to the basic units or to the units set using the Unit command.
   Example: `SENSe:SPECtrum:FREQuency:STARt?` Response: `1E6` for 1 MHz
4. Boolean values are returned as 0 (for OFF) and 1 (for ON).
   Example: `SOURce:DM:CLOCk:STATe?` Response: `1`
5. Text (character data) is returned in a short form (see also next section).
   Example: `FETCh:SPECtrum:STATus?` Response: `ERR`

Parameters

Most commands require a parameter to be specified. The parameters must be separated from the header by a "white space". Permissible parameters are numerical values, Boolean parameters, text, character strings and block data. The type of parameter required for the respective command and the permissible range of values are specified in the command description.

Numerical values

Numerical values can be entered in any form, i.e. with sign, decimal point and exponent. Values exceeding the resolution of the instrument are rounded up or down. The mantissa may comprise up to 255 characters, the values must be in the value range –9.9E37 to 9.9E37. The exponent is introduced by an "E" or "e". Entry of the exponent alone is not allowed. In the case of physical quantities, the unit can be entered. Permissible unit prefixes are G (giga), MA (mega), MOHM and MHZ are also permissible), K (kilo), M (milli), U (micro) and N (nano). If the unit is missing, the basic unit is used.

Example: `SENS:SPEC:FREQ:STOP 1.5GHz` is equivalent to `SENS:SPEC:FREQ:STOP 1.5E9`

Special numerical values

The texts MINimum, MAXimum, DEFault, UP and DOWN are interpreted as special numerical values.

In the case of a query, the associated numerical value is provided.

Example: Setting command: `CONF:POW:CONT:REP MAXimum`
Query: `CONF:POW:CONT:REP?`
Response: `100`

MIN/MAX — MINimum and MAXimum denote the minimum and maximum value.

DEF — DEFault denotes a preset value. This value conforms to the default setting, as it is called by the *RST command.

INF/NINF — INFinity, Negative INFinity (NINF) represent the numerical values -9.9E37 or 9.9E37, respectively. INF and NINF are only sent as device responses.

NAN — Not a Number (NAN) represents the value 9.91E37. NAN is only sent as device response. This value is not defined. Possible causes are division by zero, subtraction or addition of infinite and the representation of missing values.

Boolean Parameters Boolean parameters represent two states. The ON state (logically true) is represented by ON or a numerical value unequal to 0. The OFF state (logically untrue) is represented by OFF or the numerical value 0. ON or OFF is provided in a query.

Example: Setting command: `SOURce:DM:CLOCk:STATe ON`
Query: `SOURce:DM:CLOCk:STATe?`
Response: `ON`

Text Text parameters observe the syntactic rules for key words, i.e. they can be entered using a short or long form. Like any parameter, they have to be separated from the header by a white space. In the case of a query, the short form of the text is provided.

Example: Setting command: `TRIGger:SOURce EXTern`
Query: `TRIGger:SOURce?` Response: `EXT`

Strings Strings must always be entered within quotation marks (' or ").

Example: `:SYST:REM:ADDR:SEC 1,"GSM900MS_NSig"` or
`:SYST:REM:ADDR:SEC 1,'GSM900MS_Nsig'`

Block data Block data are a transmission format which is suitable for the transmission of large amounts of data. A command using a block data parameter with definite length has the following structure:

Example: `:HEADer:HEADer #45168xxxxxxxx`

The double dagger # introduces the data block. The next number indicates how many of the following digits describe the length of the data block. In the example the 4 following digits indicate the length to be 5168 bytes. The data bytes follow. During the transmission of these data bytes all End or other control signs are ignored until all bytes are transmitted.

A #0 combination introduces a data block of indefinite length. The use of the indefinite format requires a NL^END message to terminate the data block. This format is useful when the length of the transmission is not known or if speed or other considerations prevent segmentation of the data into blocks of definite length.

Overview of Syntax Elements

The following survey offers an overview of the syntax elements.

:	The colon separates the key words of a command. In a command line the separating semicolon marks the uppermost command level.
;	The semicolon separates two commands of a command line. It does not alter the path.
,	The comma separates several parameters of a command.
?	The question mark forms a query.
*****	The asterisk marks a common command.
"	Quotation marks introduce a string and terminate it.
#	The double dagger # introduces binary, octal, hexadecimal and block data. Binary: #B10110 Octal: #O7612 Hexa: #HF3A7 Block: #21313...
	A "white space" (ASCII-Code 0 to 9, 11 to 32 decimal, e.g. blank) separates header and parameter.

Instrument Model and Command Processing

The block diagram in figure *Fig. 5-3* shows how GPIB bus commands are serviced in the instrument. The individual components work independently and simultaneously. They communicate with each other by means of so-called "messages".

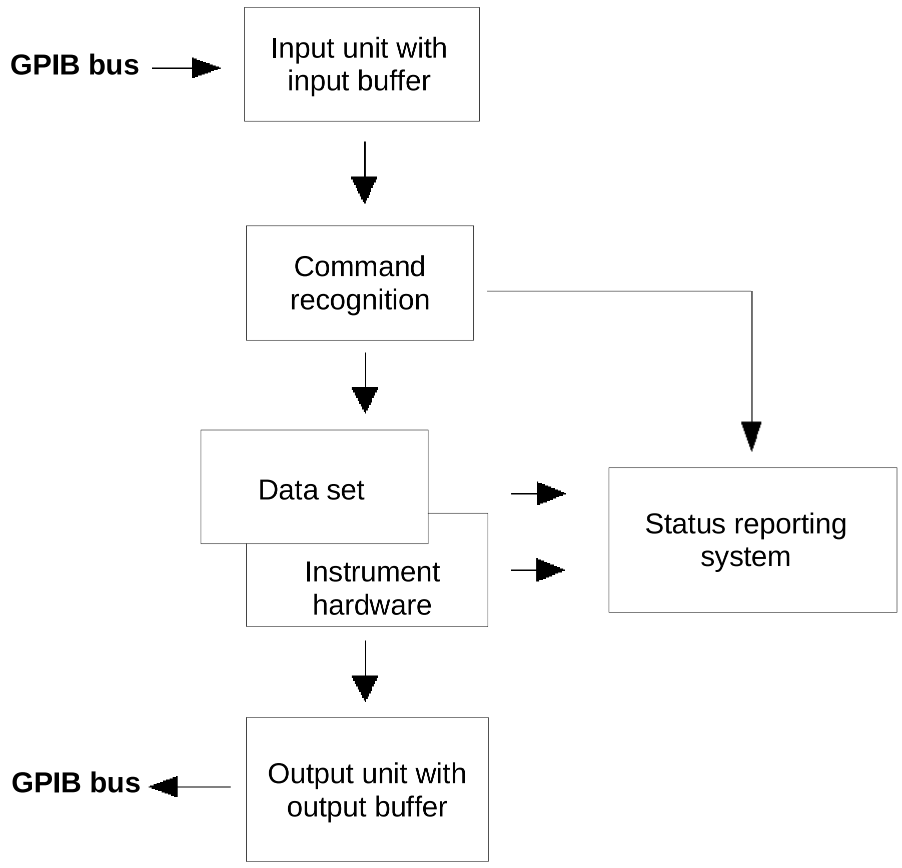


Fig. 5-3 Instrument model in the case of remote control via GPIB bus

Input Unit

The input unit receives commands character by character from the GPIB bus and collects them in the input buffer. The input unit sends a message to the command recognition as soon as the input buffer is full or as soon as it receives a delimiter, <PROGRAM MESSAGE TERMINATOR>, as defined in IEEE 488.2, or the interface message DCL.

If the input buffer is full, the GPIB bus traffic is stopped and the data received up to then are processed. Subsequently the GPIB bus traffic is continued. If, however, the buffer is not yet full when receiving the delimiter, the input unit can already receive the next command during command recognition and execution. The receipt of a DCL clears the input buffer and immediately initiates a message to the command recognition.

Command Recognition

The command recognition analyses the data received from the input unit. It proceeds in the order in which it receives the data. Only a DCL is serviced with priority, a GET (Group Execute Trigger), e.g., is only executed after the commands received before. Each recognized command is immediately transmitted to the data set but not executed immediately.

Syntactical errors in the command are recognized here and transferred to the status reporting system. The rest of a command line after a syntax error is ignored.

If the command recognition recognizes a delimiter or a DCL, it requests the data set to set the commands in the instrument hardware as well. Subsequently it is immediately prepared to process commands again. This means for the command servicing that further commands can already be serviced while the hardware is still being set ("overlapping execution").

Data Set and Instrument Hardware

The expression "instrument hardware" denotes the part of the instrument fulfilling the actual instrument function - signal generation, measurement etc. The controller is not included.

The data set is a detailed software reproduction of the instrument hardware.

GPIB bus setting commands lead to an alteration in the data set. The data set management enters the new values (e.g. frequency) into the data set, however, only passes them on to the hardware when requested by the command recognition. As this is always only effected at the end of a command line, the order of the setting commands in the command line is not relevant.

The data are only checked for their compatibility among each other and with the instrument hardware immediately before they are transmitted to the instrument hardware. If the detection is made that execution is not possible, an "execution error" is signaled to the status reporting system. All alterations of the data set are canceled, the instrument hardware is not reset. Due to the delayed checking and hardware setting, however, impermissible instrument states can be set for a short period of time within one command line without this leading to an error message (example: simultaneous activation of FM and PM). At the end of the command line, however, a permissible instrument state must have been reached again.

Before passing on the data to the hardware, the settling bit in the STATus:OPERation register is set (cf. section *STATus:OPERation Register*). The hardware executes the settings and resets the bit again as soon as the new state has settled. This fact can be used to synchronize command servicing.

GPIB bus queries induce the data set management to send the desired data to the output unit.

Status Reporting System

The status reporting system collects information on the instrument state and makes it available to the output unit on request. The exact structure and function are described in section Status Reporting System on page 5.16.

Output Unit

The output unit collects the information requested by the controller, which it receives from the data set management. It processes it according to the SCPI rules and makes it available in the output buffer. If the information requested is longer, it is made available "in portions" without this being recognized by the controller.

If the instrument is addressed as a talker without the output buffer containing data or awaiting data from the data set management, the output unit sends error message "Query UNTERMINATED" to the status reporting system. No data are sent on the GPIB bus, the controller waits until it has reached its time limit. This behavior is specified by SCPI.

Command Sequence and Command Synchronization

What was said above makes clear that overlapping execution is possible in principle for all commands. Equally, setting commands within one command line are not absolutely serviced in the order in which they have been received.

In order to make sure that commands are actually carried out in a certain order, each command must be sent in a separate command line, that is to say, with a separate IBWRT()-call.
In order to prevent an overlapping execution of commands, one of commands *OPC, *OPC? or *WAI must be used. All three commands cause a certain action only to be carried out after the hardware has been set and has settled. By a suitable programming, the controller can be forced to wait for the respective action to occur (cf. *Table 5-1*).

Table 5-1 Synchronization with *OPC, *OPC? and *WAI

Command	**Action after the hardware has settled**	**Programming the controller**
*OPC	Setting the operation-complete bit in the ESR	- Setting bit 0 in the ESE - Setting bit 5 in the SRE - Waiting for service request (SRQ)
*OPC?	Writing a "1" into the output buffer	Addressing the instrument as a talker
*WAI	Executing the next command Note: The GPIB bus handshake is not stopped	Sending the next command

Status Reporting System

The status reporting system (cf. Fig. 5-5) stores all information on the present operating state of the instrument, and on errors which have occurred. This information is stored in the status registers and in the error queue. The status registers and the error queue can be queried via GPIB bus.

The information is of a hierarchical structure. The register status byte (STB) defined in IEEE 488.2 and its associated mask register service request enable (SRE) form the uppermost level. The STB receives its information from the standard event status register (ESR) which is also defined in IEEE 488.2 with the associated mask register standard event status enable (ESE) and registers STATus:OPERation and STATus:QUEStionable which are defined by SCPI and contain detailed information on the instrument.

The IST flag ("Individual STatus") and the parallel poll enable register (PPE) allocated to it are also part of the status reporting system. The IST flag, like the SRQ, combines the entire instrument status in a single bit. The PPE fulfills an analog function for the IST flag as the SRE for the service request.

The output buffer contains the messages the instrument returns to the controller. It is not part of the status reporting system but determines the value of the MAV bit in the STB and thus is represented in *Fig. 5-5*.

Structure of an SCPI Status Register

Each standard SCPI register consists of 5 parts which each have a width of 16 bits and have different functions (cf. *Fig. 5-4*). The individual bits are independent of each other, i.e. each hardware status is assigned a bit number which is valid for all five parts. Bit 15 (the most significant bit) is set to zero for all parts. Thus the contents of the register parts can be processed by the controller as positive integer.

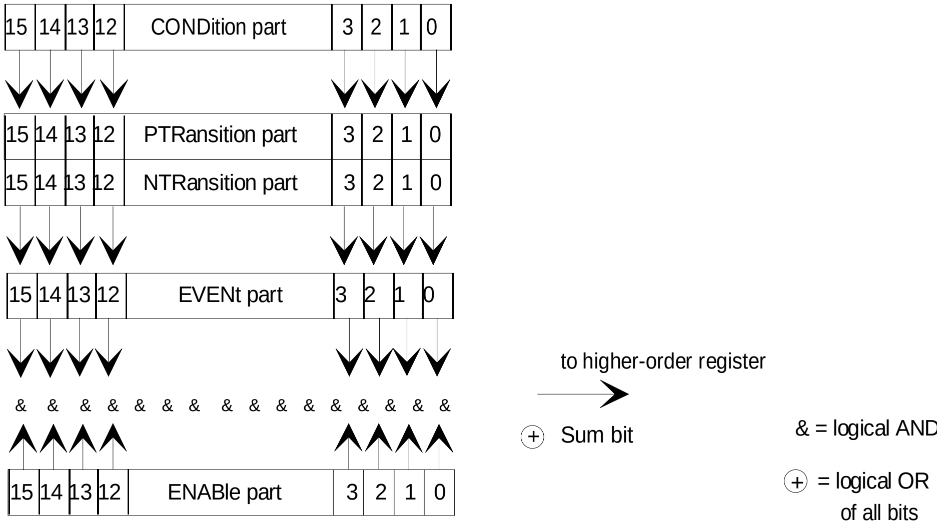


Fig. 5-4 The status register model

CONDition part

The CONDition part is permanently overwritten by the hardware or the sum bit of the next lower register. Its contents always reflect the current instrument status. This register part can only be read, but not overwritten or cleared. Reading the CONDition register is nondestructive.

PTRansition part

The Positive-TRansition part acts as a transition filter. When a bit of the CONDition part is changed from 0 to 1, the associated PTR bit decides whether the EVENt bit is set to 1.
PTR bit =1: the EVENt bit is set.
PTR bit =0: the EVENt bit is not set.
This status register part can be overwritten and read at will. Reading the PTRansition register is nondestructive.

NTRansition part

The Negative-TRansition part also acts as a transition filter. When a bit of the CONDition part is changed from 1 to 0, the associated NTR bit decides whether the EVENt bit is set to 1.
NTR bit =1: the EVENt bit is set.
NTR bit =0: the EVENt bit is not set.
This part can be overwritten and read at will. Reading the PTRansition register is nondestructive.

With these two transition register parts the user can define which state transition of the condition part (none, 0 to 1, 1 to 0 or both) is stored in the EVENt part.

EVENt part

The EVENt part indicates whether an event has occurred since the last reading, it is the "memory" of the condition part. It only indicates events passed on by the transition filters. It is permanently updated by the instrument. This part can only be read by the user. Reading the register clears it. This part is often equated with the entire register.

The CMU implementation of the EVENt parts of all status registers differs from the SCPI specification: The bits in the EVENt part are directly set by the instrument as soon as the instrument state changes so that the setting condition becomes true. The CONDition, PTRansition, and NTRansition register parts are not needed. The EVENt part is cleared upon reading.

ENABle part

The ENABle part determines whether the associated EVENt bit contributes to the sum bit (cf. below). Each bit of the EVENt part is ANDed with the associated ENABle bit (symbol '&'). The results of all logical operations of this part are passed on to the sum bit via an OR function (symbol '+').
ENAB bit =0: the associated EVENt bit does not contribute to the sum bit
ENAB bit =1: if the associated EVENT bit is "1", the sum bit is set to "1" as well.
This part can be written into and read by the user at will. Its contents is not affected by reading.

Sum bit

As indicated above, the sum bit is obtained from the EVENt and ENABle part for each register. The result is then entered into a bit of the CONDition part of the higher-order register.
The instrument automatically generates the sum bit for each register. Thus an event, e.g. a PLL that has not locked, can lead to a service request throughout all levels of the hierarchy.

Note:

The service request enable register SRE defined in IEEE 488.2 can be taken as ENABle part of the STB if the STB is structured according to SCPI. By analogy, the ESE can be taken as the ENABle part of the ESR.

Overview of the Status Registers

Fig. 5-5 shows the status registers used in the CMU. The STATus:QUEStionable register is not used. In addition to the standard STATus:OPERation register, the CMU offers 30 independent STATus:OPERation:CMU:SUM1|2:CMU<nr> sub-registers (<nr>=1 ... 15).

Cascading registers

The hierarchical structure of the STATus:OPERation register was designed with the aim of reporting and specifying the events generated during different measurements independently. Each sub-register receives entries from a particular combination of a function group and signalling mode (e.g. *RF Non Signalling, GSM900-MS Signalling* etc.). The function groups and modes are identified by means of their secondary address, an integer number between 0 and 29. Secondary address 0 is reserved for the CMU base system. The remaining secondary addresses can be arbitrarily assigned or queried via the `SYSTem:REMote:ADDRess:SECondary` command (see Chapter 6). The assignment between sub-registers and secondary addresses is as follows:

Sub-register	Secondary Address	Sub-register	Secondary Address
STAT:OPER:CMU:SUM1:CMU1	0 (reserved for CMU base system)	STAT:OPER:CMU:SUM2:CMU1	15
...	...	...	...
STAT:OPER:CMU:SUM1:CMU15	14	STAT:OPER:CMU:SUM2:CMU15	29

Contents of the sub-registers

The higher-level STATus:OPERation registers summarize the sub-registers as shown in Fig. 5-5. E.g., if the corresponding ENABle bit is set, any EVENt reported in one of the STATus:OPERation:CMU:SUM1|2:CMU<nr> sub-registers sets the sum bit of the STATus:OPERation:CMU:SUM1|2 register to 1.

This means that the STATus:OPERation register indicates whether any event occurred, the lower-level STATus:OPERation:CMU:SUM1|2 registers indicate the function group and signalling mode in which the event occurred, the lowest-level STATus:OPERation:CMU:SUM1|2 registers indicate the nature of the individual events.

The meaning of the bits in function group *RF Non Signalling* is given below (see section STATus:OPERation Register 5.22). For other function groups refer to the relevant manuals.

Accessing the sub-registers

Every single status register can be configured and queried individually by means of the commands of the STATus:OPERation subsystem (see Chapter 6).

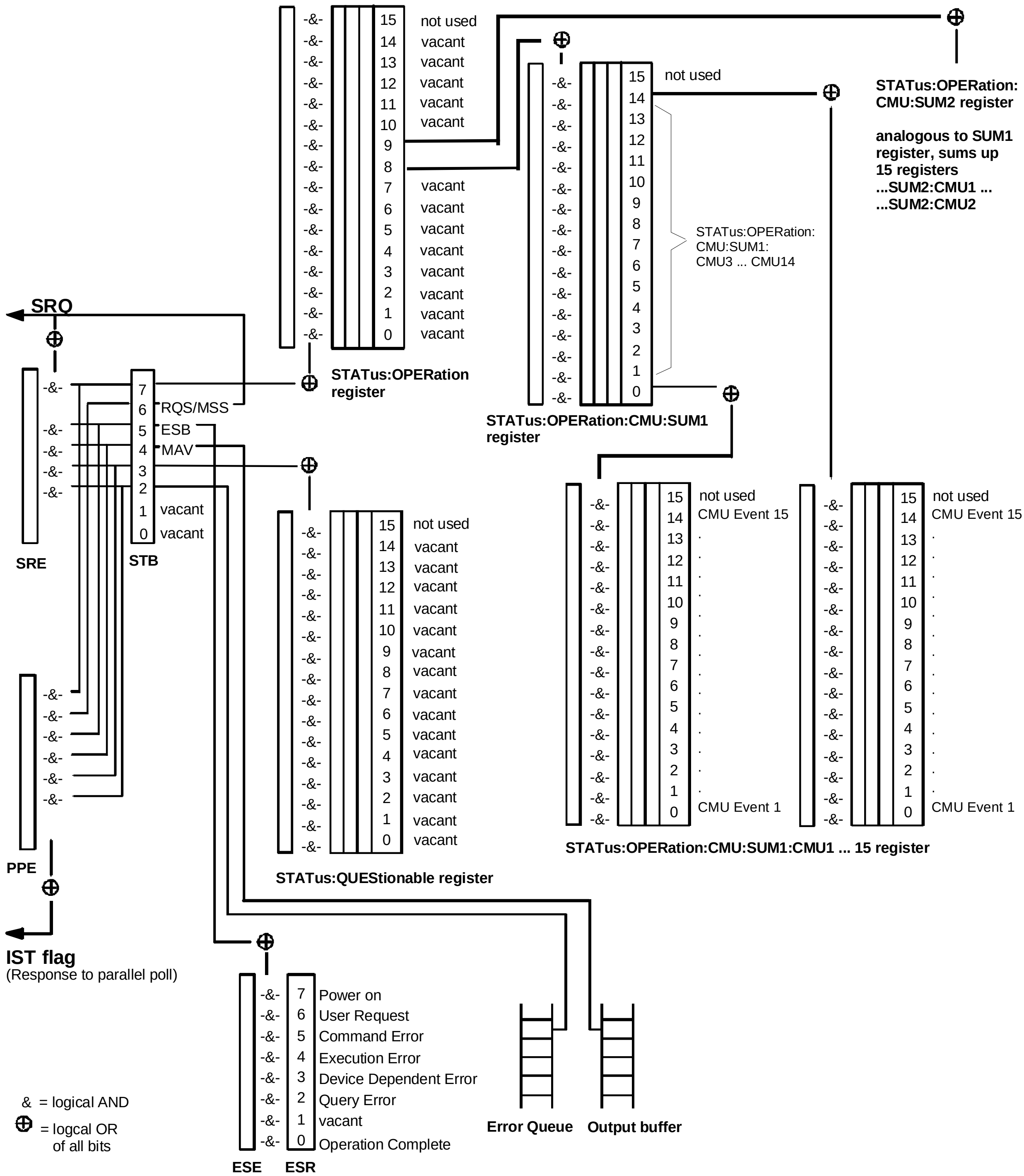


Fig. 5-5 The status registers

Status Byte (STB) and Service Request Enable Register (SRE)

The STB is already defined in IEEE 488.2. It provides a rough overview of the instrument status by collecting the pieces of information of the lower registers. It can thus be compared with the CONDition part of an SCPI register and assumes the highest level within the SCPI hierarchy. A special feature is that bit 6 acts as the sum bit of the remaining bits of the status byte.

The STATUS BYTE is read out using the command "*STB?" or a serial poll.

The STB is linked to the SRE. The latter corresponds to the ENABle part of the SCPI registers in its function. Each bit of the STB is assigned a bit in the SRE. Bit 6 of the SRE is ignored. If a bit is set in the SRE and the associated bit in the STB changes from 0 to 1, a Service Request (SRQ) is generated on the GPIB bus, which triggers an interrupt in the controller if this is appropriately configured and can be further processed there.
The SRE can be set using command "*SRE" and read using "*SRE?".

Table 5-2 Meaning of the bits used in the status byte

Bit no.	Meaning
2	**Error Queue not empty** The bit is set when an entry is made in the error queue. If this bit is enabled by the SRE, each entry of the error queue generates a Service Request. Thus an error can be recognized and specified in greater detail by polling the error queue. The poll provides an informative error message. This procedure is to be recommended since it considerably reduces the problems involved with GPIB bus control.
3	**QUEStionable status sum bit** The bit is set if an EVENt bit is set in the QUEStionable status register and the associated ENABle bit is set to 1. A set bit indicates a questionable instrument status, which can be specified in greater detail by polling the QUEStionable status register.
4	**MAV-Bit** (Message AVailable) The bit is set if a message is available in the output buffer which can be read. This bit can be used to enable data to be automatically read from the instrument to the controller (cf. annex D, program examples).
5	**ESB bit** Sum bit of the event status register. It is set if one of the bits in the event status register is set and enabled in the event status enable register. Setting of this bit indicates a serious error which can be specified in greater detail by polling the event status register.
6	**MSS-Bit** (Master Status Summary bit) The bit is set if the instrument triggers a service request. This is the case if one of the other bits of this register is set together with its mask bit in the service request enable register SRE.
7	**OPERation status register sum bit** The bit is set if an EVENt bit is set in the OPERation status register and the associated ENABle bit is set to 1. A set bit indicates that the instrument is just performing an action. The type of action can be queried by polling the OPERation status register.

IST Flag and Parallel Poll Enable Register (PPE)

By analogy with the SRQ, the IST flag combines the entire status information in a single bit. It can be queried by means of a parallel poll (cf. Section *Parallel Poll* on page 5.25) or using the command "*IST?".

The parallel poll enable register (PPE) determines which bits of the STB contribute to the IST flag. The bits of the STB are ANDed with the corresponding bits of the PPE, with bit 6 being used as well in contrast to the SRE. The IST flag results from the ORing of all results. The PPE can be set using commands "*PRE" and read using command "*PRE?".

Event Status Register (ESR) and Event Status Enable Register (ESE)

The ESR is defined in IEEE 488.2. It can be compared with the EVENt part of an SCPI register. The event status register can be read out using command "*ESR?".
The ESE is the associated ENABle part. It can be set using the command "*ESE" and read using the command "*ESE?".

Table 5-3 Meaning of the bits used in the event status register

Bit No.	Meaning
0	**Operation Complete** This bit is set on receipt of the command *OPC exactly when all previous commands have been executed.
2	**Query Error** This bit is set if either the controller wants to read data from the instrument without having sent a query, or if it does not fetch requested data and sends new instructions to the instrument instead. The cause is often a query which is faulty and hence cannot be executed.
3	**Device-dependent Error** This bit is set if a device-dependent error occurs. An error message with a number between -300 and -399 or a positive error number, which denotes the error in greater detail, is entered into the error queue (cf. annex B, Error Messages).
4	**Execution Error** This bit is set if a received command is syntactically correct but cannot be performed for other reasons. An error message with a number between -200 and -300, which denotes the error in greater detail, is entered into the error queue (cf. annex B, Error Messages).
5	**Command Error** This bit is set if a command which is undefined or syntactically incorrect is received. An error message with a number between -100 and -200, which denotes the error in greater detail, is entered into the error queue (cf. annex B, Error Messages).
6	**User Request** This bit is not used in the CMU.
7	**Power On** (supply voltage on) This bit is set on switching on the instrument.

STATus:OPERation Register

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 (see p. 5.18).

In the EVENt part, the STATus:OPERation register contains information on which actions the instrument has executed since the last readout. All five parts of the registers can be read using one of the commands of the subsystem `STATus:OPERation:CMU:SUM1|2:CMU<nr>:...` . Moreover, the EVENt part can be enabled and read by means of the `STATus:OPERation:SYMBolic...` commands, see section *Symbolic Status Event Register Evaluation* on page 5.25 ff.

The bit assignment for the CMU base system which is always assigned to the `...SUM1:CMU1` sub-register (secondary address 0) is as follows:

Table 5-4 Meaning of the bits used in the `STATus:OPERation:CMU:SUM1:CMU1` sub-register assigned to the CMU base system

Bit-No.	Meaning	Symbol in `STATus:OPERation:SYMBolic...`
4	**Measurement Result is Invalid** This bit is set if a measurement caused invalid results, e.g. because of no input signal was available (see also application example below and section *Retrieving Measurement Results* on p. 5.35 ff.).	**MINV**
6	**Reference Frequency Not Locked** This bit is set if synchronization to the reference frequency failed (e.g. because of a missing or faulty external reference frequency). The CMU checks the synchronization approx. once per second and updates the RFNL bit. Alternatively, the synchronization can be queried via `[SENSe:]SYNChronize:FREQuency:REFerence:LOCKed?` (see Chapter 6)	**RFNL**

For function group *RF Non Signalling,* the bit assignment is as follows:

Table 5-5 Meaning of the bits used in the `STATus:OPERation:CMU:SUM1|2:CMU<nr>` sub-register assigned to *RF Non Signalling*

Bit-No.	Meaning	Symbol in `STATus:OPERation:SYMBolic...`
0	**Overload** This bit is set if the currently used input connector is overloaded.	**IOV**
4	**Measurement Result is Invalid** This bit is set if a measurement caused invalid results, e.g. because no input signal was available (see also application example below and section *Retrieving Measurement Results* on p. 5.35 ff.).	**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**

Bit-No.	Meaning	Symbol in `STATus:OPERation:SYMBolic...`
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**

For optional function groups refer to the relevant manuals.

Application example (see also description of Winbatch tool in Chapter 7): The following command sequence shows how an event “Measurement Result is Invalid” is registered in the status reporting system and illustrates some of the tools that the CMU provides to monitor the instrument status.

...

`CMUBASE: *CLS`	Clear status reporting system.
`CMUBASE: TRACE:REMOTE:MODE:SRQ ON`	Include service requests sent by the CMU in the remote control report.
`CMUBASE: TRACE:REMOTE:MODE:DISPLAY ON`	Display remote report on screen.
`CMUBASE: *SRE 128`	Enable service request.
`CMUGSMNS: STAT:OPER:SYMB:ENAB MINV`	Enable event reporting for bit no. 4, MINV, in a different function group (GSMxxx-MS Non Signalling).
`CMUGSMNS: READ:SCAL:NPOW?`	Initiate a single-shot narrow-band power measurement using default settings and return results. In case of invalid measurement results (e.g. because no GSM input signal is applied to the input connectors of the CMU), a read symbol "S" for service request should appear on the screen.
`CMUBASE: STAT:OPER:EVEN:SADD?`	Check which function group reported an event. The query returns the GSM function group.
`CMUGSMNS: STAT:OPER:SYMB?`	Query events reported by the GSM function group: Bit MINV must be set

STATus:QUEStionable-Register

This register contains information on questionable instrument states. They can occur, e.g. if the instrument is operated outside its specified range. It can be queried using one of the commands `":STATus :QUEStionable:CONDition?"` or `":STATus:QUEStionable[:EVENt]?"`.

The CMU does not use this register.

Application of the Status Reporting Systems

In order to effectively use the status reporting system, the information contained there must be transmitted to the controller and further processed there. There are several methods which are outlined in the following.

Service Request

Under certain circumstances, the instrument can send a service request (SRQ) to the controller. Usually this service request initiates an interrupt at the controller, to which the control program can react appropriately. As evident from Fig. 5-5, an SRQ is always initiated if one or several of bits 2, 3, 4, 5 or 7 of the status byte are set and enabled in the SRE. Each of these bits combines the information of a further register, the error queue or the output buffer. The corresponding setting of the ENABle parts of the status registers can achieve that arbitrary bits in an arbitrary status register initiate an SRQ. In order to use the possibilities of the service request effectively, all bits should be set to "1" in the enable registers SRE and ESE.

Examples (cf. Fig. 5-5):

Use command "`*OPC`" to generate an SRQ

- Set bit 0 in the ESE (Operation Complete)
- Set bit 5 in the SRE (ESB)

After its settings have been completed, the instrument generates an SRQ.

Indication of an event (e.g. overloading of used input connector) by means of an SRQ with the controller:

- Set bit 7 in the SRE (sum bit of the STATus:OPERation register)

The following steps depend on the secondary address (0 ≤ <SecAddr> ≤ 29) assigned to the function group and signalling mode used.

0 ≤ <SecAddr> ≤ 14

- Set bit 8 in the STATus:OPERation:ENABle register.
- Set bit <SecAddr>-1 in the STATus:OPERation:CMU:SUM1:ENABle register
- Set bit 0 in the STATus:OPERation:CMU:SUM1:CMU <SecAddr>:ENABle register.

15 ≤ <SecAddr> ≤ 29

- Set bit 9 in the STATus:OPERation:ENABle register.
- Set bit <SecAddr>-16 in the STATus:OPERation:CMU:SUM2:ENABle register
- Set bit 0 in the STATus:OPERation:CMU:SUM2:CMU <SecAddr>:ENABle register.

When the event assigned to bit no. 0 of the STATus:OPERation:CMU:SUM1|2:CMU<SecAddr> register occurs (e.g. when the input connector is overloaded in function group *RF Non Signalling)* the instrument generates a SRQ.

The same procedure can be applied to find out which event caused an SRQ:

- `STB?`
- Query `STAT:OPER:EVENT?`
- Query `STAT:OPER:CMU:SUM1|2:EVENT?` (function group, signalling mode)
- Query `STAT:OPER:CMU:SUM1|2:CMU1...15:EVENT?` (measurement)

The SRQ is the only possibility for the instrument to become active on its own. Each controller program should set the instrument such that a service request is initiated in the case of malfunction. The program should react appropriately to the service request.

Symbolic Status Event Register Evaluation

The examples for status register handling given in section *Service Request* on p. 5.24 are based on a step-by-step evaluation of the `STATus:OPERation` register and its sub-registers. As a convenient alternative to this approach, the CMU provides commands for symbolic status event register evaluation. These commands are global (i.e. available in all function groups) and described in detail in Chapter 6. They organize and simplify the following actions:

`STATus:OPERation:EVENt:SADDress?`	Return the next secondary address and associated function group where an event was reported.
`STATus:OPERation:SYMBolic:ENABle <Event_1>[,<Event_2>,...<Event_15>]`	Enable the events of the parameter list up to the status byte, i.e. set the corresponding bits in the `STATus:OPERation:ENABle` register and in the sub-registers `STATus:OPERation:CMU:SUM1|2:ENABle` and `STATus:OPERation:CMU:SUM1|2:CMU <SecAddr>:ENABle` so that the events are reported in the status byte. <SecAddr> denotes the current secondary address, see also example in section *Service Request* on p. 5.24.
`STATus:OPERation:SYMBolic[:EVENt]?`	Return all events reported in the current function group. The event symbols listed with the bit assignment of the `STATus:OPERation...` registers; for an example see *Table 5-5* on page 5.22.

A program example for symbolic status register evaluation is included in chapter 7 of this manual.

Serial Poll

In a serial poll, just as upon the command "`*STB`", the status byte of an instrument is queried. However, the query is made via interface messages and is thus clearly faster. The serial-poll method has already been defined in IEEE 488.1 and used to be the only standard possibility for different instruments to poll the status byte. The method also works for instruments which do not adhere to SCPI or IEEE 488.2.

The quick-BASIC command for executing a serial poll is "`IBRSP()`". The serial poll is mainly used to obtain a fast overview of the state of several instruments connected to the GPIB bus.

Parallel Poll

In a parallel poll, up to eight instruments are simultaneously requested by the controller by means of a single command to transmit 1 bit of information each on the data lines, i.e., to set the data line allocated to each instrument to a logic "0" or "1". By analogy to the SRE register which determines under which conditions an SRQ is generated, there is a parallel poll enable register (PPE) which is ANDed with the STB bit by bit, considering bit 6 – AND as well. The results are ORed, the result is then sent (possibly inverted) as a response to the parallel poll of the controller. The result can also be queried without parallel poll by means of the command "`*IST`".

The instrument first has to be set for the parallel poll using the quick-BASIC command "`IBPPC()`". This command allocates a data line to the instrument and determines whether the response is to be inverted. The parallel poll itself is executed using "`IBRPP()`".

The parallel-poll method is mainly used in order to quickly find out after an SRQ which instrument has sent the service request if there are many instruments connected to the GPIB bus. To this effect, SRE and PPE must be set to the same value.

Query by Means of Commands

Each part of any status register can be read by means of queries. The individual commands are listed in Chapter 6. What is returned is always a number which represents the bit pattern of the register queried. This number is evaluated by the controller program.

Queries are usually used after an SRQ in order to obtain more detailed information on the cause of the SRQ.

Error Queue Query

Each error state in the instrument leads to an entry in the error queue. The entries of the error queue are detailed plain-text error messages which can be looked at in the ERROR menu via manual control or queried via the GPIB bus using command `"SYSTem:ERRor?"`. Each call of `"SYSTem:ERRor?"` provides <u>one</u> entry from the error queue. If no error messages are stored there any more, the instrument responds with 0, "No error".

The error queue should be queried after every SRQ in the controller program as the entries describe the cause of an error more precisely than the status registers. Especially in the test phase of a controller program the error queue should be queried regularly since faulty commands from the controller to the instrument are recorded there as well.

Reset Values of the Status Reporting Systems

Table 5-6 comprises the different commands and events causing the status reporting system to be reset. None of the commands, except for *RST and SYSTem:PRESet influences the functional instrument settings. In particular, DCL does not change the instrument settings.

Table 5-6 Resetting instrument functions

Event / Effect	Switching on supply voltage, Power-On-Status-Clear 0	Switching on supply voltage, Power-On-Status-Clear 1	DCL,SDC (Device Clear, Selected Device Clear)	*RST or SYSTem:PRESet	STATus:PRESet	*CLS
Clear STB,ESR	—	yes	—	—	—	yes
Clear SRE,ESE	—	yes	—	—	—	—
Clear PPE	—	yes	—	—	—	—
Clear EVENt parts of the registers	—	yes	—	—	—	yes
Clear ENABle parts of all OPERation-and QUEStionable registers, Fill ENABle parts of all other registers with "1".	—	yes	—	—	yes	—
Fill PTRansition parts with „1" Clear NTRansition parts	—	yes	—	—	yes	—
Clear error queue	yes	yes	—	—	—	yes
Clear output buffer	yes	yes	yes	1)	1)	1)
Clear command processing and input buffer	yes	yes	yes	—	—	—

1) Every command being the first in a command line, i.e. immediately following a <PROGRAM MESSAGE TERMINATOR> clears the output buffer.

Measurement Control

The CMU offers a variety of measurements which are arranged in function groups and measurement groups. All measurements are controlled according to the same basic concepts. The benefit of this structure lies in the close analogy of all function groups. Commands belonging to different measurements have the same structure and syntax.

The following sections are devoted to the principles of measurement control:

- A measurement group can be split up into different subgroups by means of *applications* (optional, i.e. not available for every measurement group).
- Four different measurement states are defined; they can be accessed with a set of measurement control commands.
- The end of the measurement (or of a particular measurement stage) can be indicated by means of *the event reporting system.*
- Statistical settings comprising the repetition mode, statistic count (optional), stop condition (optional), and display mode (optional) control how the measurement is performed. The possible measurement states depend on the repetition mode.
- The current status and the results of the measurement can be queried in a systematic way.

Some measurements do not require the full scheme. E.g., the function group *RF Non Signalling* described in this manual uses none of the features characterized as optional in the above enumeration. Examples for these features can be found in the operating manuals for digital network tests, e.g., *GSM900/1800/1900-MS*.

Applications

Applications are different measurements belonging to the same measurement group. Each application is assigned its own set of configuration parameters. With few exceptions (e.g. some tolerance values), all parameters assigned to the applications can be different from each other. Thus, applications effectively split up a measurement group into various independent subgroups which can be configured individually and serviced in parallel.

The benefit of this feature is that the results of an application will not become invalid when another application in the same measurement group is started.

Applications are generally identified by the third-level keyword in a command while the measurement group is identified by the second-level keyword. Examples can be found in the operating manuals for the network tests.

Measurement Control Commands and States

Measurement control commands are used to switch over between the following four measurement states:

OFF	measurement is switched off, no results available (after `STOP`)
RUN	measurement is running
STOP	measurement has been stopped, valid results are preserved
STEP	measurement has been interrupted after a statistics cycle (in repetition mode *Continuous* or *Counting* with *Stepping* mode set in addition). The next cycle must be launched with a `CONTinue` command.

The *STOP* state corresponds to the *HLT* state indicated next to the softkeys controlling a measurement in manual operation. A *STEP* state is not defined in manual control.

The three measurement states *OFF, STOP,* and *STEP* can be mapped onto the standard SCPI state *IDLE*, the *RUN* state can be mapped onto the SCPI state *INITiated*. This and the relation between control commands and measurement states is shown in the following diagram:

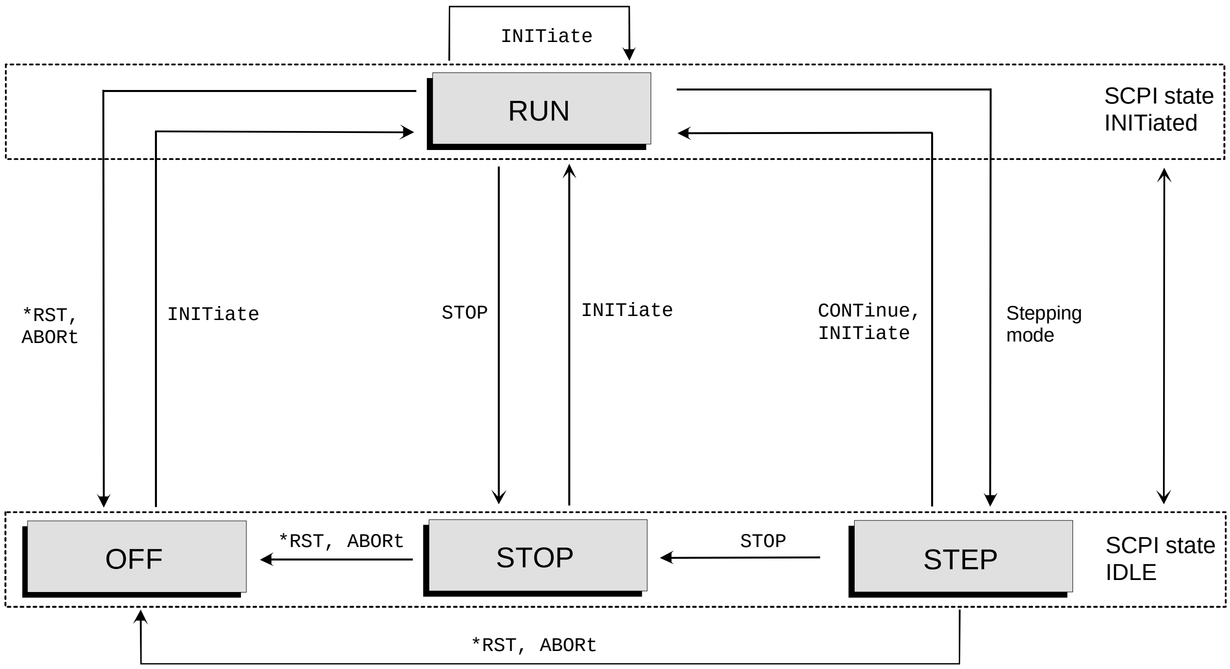


Fig. 5-7 Measurement states and control commands

The measurement control commands are supplemented by the measurement object, i.e.:

`INITiate:<meas_obj>` Starts a measurement in the repetition mode set via the `CONFigure:<meas_obj>:CONTrol:REPetition` command (single shot, continuous or counting mode, see section *Measurement Statistics* on page 5.34). The command resets the counters for the evaluation period and statistics (the latter is not used in RF measurements) to zero, furthermore, all measurement values are set invalid *(INV).*

As illustrated in *Fig. 5-7*, `INITiate` can be called in any measurement state. If the measurement is already running *(RUN),* `INITiate` aborts `(ABORt)` and restarts a running measurement.

The measurement reserves all necessary hardware resources and switches into the *RUN* state. If the measurement can not be started due to a resources conflict it remains in the *OFF* state, and the measurement status returned by the `FETCh:<meas_obj>:STATus?` is *ERR*. At the same time the SCPI error –213, *Init ignored*, is generated.

Possible resources conflicts

The RF connector is already allocated by another measurement or signal generator. The other measurement must be switched off first.

Due to the method used for the analysis, two measurements can not be evaluated at the same time.

Overlapping execution

`INITiate` is implemented as an overlapped command. In contrast to SCPI specifications, the `*OPC` command (see Chapter 6, *Common Com-*

mands) can not be applied together with the `INITiate` command. The *operation complete* bit (bit no. 0 in the event status register, ESR) is set immediately after the command sequence `INIT; *OPC`, i.e. as soon as the measurement is started and not after the end of the first evaluation period.

The command `CONFigure:<meas_obj>:EREPorting <Event>, <Mode>` represents a more flexible tool for generating a service request or setting the *operation complete* bit after the end of a measurement (see section *Event Reporting* on page 5.31).

READ command

Instead of `INITiate`, the `READ` command can be used to initiate a (single shot) measurement, see section *Retrieving Measurement Results* on page 5.35.

ABORt:<meas_obj>

Aborts the current measurement immediately and switches over to the *OFF* state. All measurement values are set invalid *(INV);* the hardware resources are released for other measurements.

As illustrated in *Fig. 5-7*, `ABORt` can be called in any measurement state.

Sequential execution

`ABORt` is implemented as a sequential command. This means that `ABORt` ist not complete until the measurement has released all resouces and has changed to the *OFF* state.

STOP:<meas_obj>

Stops (halts) the measurement as quickly as possible; i.e. after the end of the current evaluation period (or statistics cycle, if cycles comprising several evaluation periods are defined). The measurement changes to the *STOP* state such that all corresponding measurement values are kept unchanged. The hardware resources are retained.

As illustrated in *Fig. 5-7*, `STOP` can be called in the measurement states *RUN* and *STEP*. If called in the *OFF* state the command causes an SCPI error –221, *Settings conflict*.

Sequential execution

`STOP` is implemented as a sequential command. Execution of `STOP` is considered as complete as soon as the measurement state *STOP* is reached.

The `STOP` command causes no events which are set by the event reporting system (see section *Event Reporting* on page 5.31). This means that a service request must be explicitly requested by an `*OPC` command.

CONTinue:<meas_obj>

Resumes the measurement for the next measurement evaluation period and changes to the *RUN* state.

As illustrated in *Fig. 5-7*, `CONTinue` can be called in the measurement states *STOP* and *STEP*. If the previous measurement has been terminated (the measurement status returned by the `FETCh:<meas_obj>:STATus?` is *RDY),* `CONTinue` restarts the measurement and resets the counters for the evaluation period and statistics (the latter is not used for RF measurements) to zero.

In the other measurement states the command causes an SCPI error –221, *Settings conflict*.

Overlapping execution — `CONTinue` is implemented as an overlapping command like `INITiate`. As a consequence, `*OPC` can not be used together with `CONTinue`.

Stepping mode — The stepping mode determines whether a measurement in the *counting* or *continuous* mode (see section *Measurement Statistics* on page 5.34) is interrupted after each evaluation period (or each statistics cycle, if cycles comprising several evaluation periods are defined) or not. The mode is set via the `<Stepmode>` parameter of the `CONFigure:<meas_obj>:CONTrol:REPetition CONTinuous | 1 ... 10000, <StopCondition>, <Stepmode>` command:

`<Stepmode> = STEP` — The measurement is interrupted (⇒ measurement state *STEP)* after each evaluation period, and the event reporting system (see p. 5.31) is invoked. The next measurement cycle must be started with the `CONTinue:<meas_object>` command.

`<Stepmode> = NONE` — The measurement runs according to its repetition mode. Event reporting is invoked only when the measurement stops (status = RDY).

Note: *STEP can be set in all repetition* modes (single shot, continuous, counting). *For a single shot measurement which is always stopped after one evaluation period, the stepping mode has no effect.*

In function group *RF Non Signalling*, <meas_obj> can stand for any of the measurement objects `POWer and SPECtrum`.

Event Reporting

The event reporting system specifies in which way the CMU reports that a measurement or a measurement step has been correctly terminated, i.e., that the measurement status *STEP* or *RDY* has been reached. Event reporting is configured for each measurement group individually by means of the commands

```
CONFigure:<meas_obj>:EREPorting SRQ | SOPC | SRSQ | OFF
```

The parameters have the following meaning:

SRQ — Service request. A service request is generated (i.e. bit no. 6 (RQS/MSS) of the status byte (STB) is set) whenever the measurement status *STEP* or *RDY* is reached (see section *Service Request* on page 5.24).

SOPC — Single operation complete. The *operation complete* bit (bit no. 0 in the event status register) is set whenever the measurement status *STEP* or *RDY* is reached (see section *Status Reporting System* on page 5.16).

SRSQ — A service request is generated and the *operation complete* bit is set.

OFF — No special action is taken when the measurement status *STEP* or *RDY* is reached.

Note: *No action is taken if the* STOP *state is reached due to an explicit STOP command.*

Symbolic Measurement Ready Evaluation:

If event reporting is enabled (i.e. `CONFigure:<meas_obj>:EREPorting` is not set to `OFF`), each measurement that reaches the *STEP* or *RDY* status causes an entry in the *measurement queue*. The measurement queue can be queried by means of the `SYSTem:MQUeue[:COMPlete]<spec>?` commands described in Chapter 6.

Two different specifiers are provided:

`<spec> = [:LIST]`	Return the complete list of all ready measurements and reset all entries in the measurement queue to *NONE*.
`<spec> = :ITEM`	Return the next ready measurement in the list and reset the corresponding entry in the measurement queue to *NONE*.

Symbolic measurement ready evaluation is in order, e.g. to avoid inconsistencies when a `FETCh...?` command is used to retrieve measurement results (see section Retrieving Measurement Results on page 5.35).

Measurement Status

The status of the current measurement can be queried by means of the following command:

FETCh status `FETCh:<meas_obj>:STATus?`

Return the current status of the measurement. The `FETCh...` command can be used as well to poll the progress of a measurement. The response to the `FETCh...` query has the format `<Status>, <Counting_No>, <Statistic_No>`.

<Status> The first parameter in the response reports on the current status of the measurement. The measurement status returned is closely linked to the four measurement states described in section *Measurement Control Commands and States* on page 5.28 ff.:

OFF	measurement in the *OFF* state after *RST or `ABORt`
RUN	measurement in the *RUN* state after `INITiate`, `CONTinue`, or `READ`
STOP	measurement in the *STOP* state after `STOP` (stopped explicitly)
STEP	measurement in the *STEP* state due to `<Stepmode> = STEP`, valid measurement results
RDY	measurement in the *STOP* state because stopped according to the repetition mode and stop condition set.
ERR	measurement in the *OFF* state because it could not be started with `INITiate` or `READ` for lack of resources, e.g. because the RF connectors were already in use by another measurement.

<Counting_No> The second parameter in the response returns the current value of the statistics counter (the number of the current statistics cycle) if the measurement is performed in the *Counting* mode:

0 ... 10000	number of the current statistics cycle
NONE	no counter for statistics cycles used, i.e. a repetition mode other than *Counting* is set.

<Statistic_No> The third parameter in the response returns the number of the current *evaluation period* (e.g. a burst length in the case of *GSM Power vs Time* or *Modulation* measurements) within a statistics cycle. For *RF Non Signalling* Measurements this counter is not used (response *NONE*).

Generator Control

The commands used for control of the CMU's RF and AF signal generators are analogous to the measurement control commands explained on page 5.28. The generators are in one of the following two generator states:

OFF generator switched off, resources released

RUN generator running

The *RUN* state corresponds to the status indication *ON* in the *RF generator* softkey (see section *Analyzer/Generator Menu* in Chapter 4).

The relation between generator commands and generator states is shown in the following diagram:

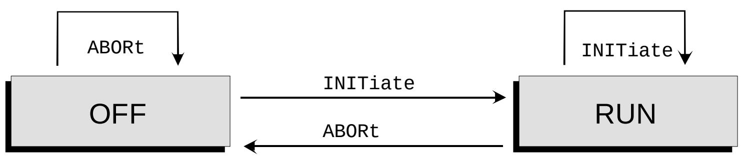


Fig. 5-8 Generator states and control commands

Generator control commands are recognized by the second-level keyword `RFGenerator` or `AFGenerator`. The generator control commands behave as follows:

`INITiate:RFGenerator`

`INITiate:AFGenerator...`

Starts the generator, reserves all necessary hardware resources and changes to the generator state *RUN.*

As illustrated in *Fig. 5-8*, `INITiate` can be called in any generator state. If the generator is already running *(RUN),* `INITiate` has no effect.

If the generator can not be started due to a resources conflict it remains in the *OFF* state, and the measurement status returned by the FETCh:<meas_obj>:STATus? is *ERR*. At the same time the SCPI error –213, *Init ignored*, is generated.

Possible resources conflicts

- The RF connector is already allocated by another generator. The other generator must be switched off first.

Sequential execution

`INITiate` is implemented as a sequential command. The `*OPC` command (see Chapter 6, *Common Commands)* can be applied together with the `INITiate` command.

`ABORt:RFGenerator`

`ABORt:AFGenerator...`

Switches the generator off, releases the hardware resources for other generators, and changes to the generator state *RUN.*

As illustrated in *Fig. 5-8*, `ABORt` can be called in any generator state. If the generator is switched off *(OFF),* `ABORt` has no effect.

Sequential execution

`ABORt` is implemented as a sequential command. The command is not terminated before the generator is completely switched off.

Note: *In some measurements (e.g. in function group* Audio)*, several RF or AF generators can be used, each of them corresponding to a separate application. In this case, one generator must be switched off (`ABORt:...`) before the application is changed and another generator is started. Otherwise, the measurement will be stopped and the CMU will display an error message.*

Generator Status

The generator status can be queried by means of the `FETCh...?` command:

FETCh command `FETCh:<meas_obj>:STATus?`

Return the current generator status. The `FETCh...` command can be used to poll the generator status. The `FETCh...` query returns one of the following generator states:

OFF generator is in the *OFF* state (default status after `*RST` or due to `ABORt...` command).

RUN generator running (*RUN* state after `INITiate...` command).

ERR generator is in the *OFF* state because it could not be started with an `INITiate...` command for lack of resources (e.g. the RF connector is already in use by another generator).

Measurement Statistics

The *repetition mode* defines how many evaluation periods are measured if the measurement is not stopped explicitly (measurement control commands `STOP..., ABORt...`) in the meantime. In case of remote control the three repetition modes *Single Shot, Continuous* and *Counting* are available (*Counting* is not available in manual control, see Chapter 3).

Table 5-7 Repetition mode in remote control

Repetition mode	Description	Command
Single Shot	The measurement is stopped after one evaluation period, i.e., after evaluation of the trace over the whole time/frequency range.	`CONFigure:<meas_obj>:CONTrol:REPetition` **`SINGleshot`**`, <StopCondition>, <Stepmode>` (in RF: `<meas_obj> = POWer | SPECtrum`)
Continuous	The measurement is continued until explicitly stopped. Results are valid after one evaluation period and updated after the next evaluation period has been terminated.	`CONFigure:<meas_obj>:CONTrol:REPetition` **`CONTinuous`**`, <StopCondition>, <Stepmode>` (in RF: `<meas_obj> = POWer | SPECtrum`)
Counting	Repeated single shot measurement with a definite number of evaluation periods. The stepping mode (<Stepmode> = STEP | NONE) determines whether the measurement is stopped after each evaluation period or not, see section *Measurement Control Commands and States* on page 5.28.	`CONFigure:<meas_obj>:CONTrol:REPetition` **`1 ... 10000`**`, <StopCondition>, <Stepmode>` (in RF: `<meas_obj> = POWer | SPECtrum`) (A counting measurement with 1 evaluation period is equivalent to a single shot measurement.)

The statistical evaluation is more refined for the digital network tests, see the relevant operating manuals. In particular, the counting mode is extended by introduction of statistics cycles consisting of an integer number of evaluation periods.

Retrieving Measurement Results

General command structure

The results of a measurement can be retrieved by means of the `FETCh`, `SAMPle` or `READ` query. All three commands have the same structure:

```
FETCh<type>:<meas_obj>[:RESult]<spec>?
SAMPle<type>:<meas_obj>[:RESult]<spec>?
READ<type>:<meas_obj>[:RESult]<spec>?
```

The literals written in angle brackets have the following meaning:

`<type>`	Measurement trace `(:ARRay)`, scalar values `([:SCALar])` can be retrieved in the network tests; see the relevant operating manuals. To limit the number of commands and simplify the program syntax, all scalar results determined in a measurement are generally read out with a single command. They are returned as a list of values separated by commas. The length of the arrays depends on the measurement group and possibly on the configuration settings; see also *Subarrays* paragraph below.
`<meas_obj>`	Measurement group (measurement object): `POWer | SPECtrum` are used in *RF Non Signalling* mode.
`<spec>`	`[:CURRent]` current evaluation period, other statistical traces can be retrieved in the network tests.

Subarrays

Arrays generally consist of a large number of values representing the measurement trace over the whole time or frequency range. With the `SUBarrays` commands, the CMU provides a flexible tool for handling large amounts of data. These commands restrict a measurement to up to 32 subranges where either all measurement results or a single statistical value can be read out.

Subarray configuration

The subarrays are configured with the following commands:

```
CONFigure:SUBarrays:<meas_obj> <Mode>, <Start>, <Samples>
                                    {,<Start>, <Samples>}
```

`<meas_obj>`	Measurement group (measurement object). For examples refer to the manuals for the network tests.
`<Mode>`	Statistics mode for **all** subranges. The following parameters can be set:

`ALL`	Return all measurement values (the number of values in every subrange is given by the `<Samples>` parameter).
`ARIThmetical`	Return the arithmetical mean value of the results in every subrange.
`MINimum`	Return the minimum of the results in every subrange.
`MAXimum`	Return the maximum of the results in every subrange.
`IVAL`	Return 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. Ignore the <Samples> parameter.

`<Start>`	Start of current range (time or frequency or channel number).
`<Samples>`	Number of samples in current range.

The subranges may overlap but must be within the total range of the `<meas_obj>`. 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.

Subarray results

Subarray results are retrieved by means of `FETCh, SAMPle` or `READ` queries, with `:SUBarrays` inserted as a second-level keyword:

```
FETCh:SUBarrays<type>:<meas_obj>[:RESult]<spec>?
SAMPle:SUBarrays<type>:<meas_obj>[:RESult]<spec>?
READ:SUBarrays<type>:<meas_obj>[:RESult]<spec>?
```

In the default subarray configuration, these commands are identical with the `FETCh, SAMPle` or `READ` queries described above (i.e. all measurement results are read out).

FETCh command

```
FETCh<type>:<meas_obj>[:RESult]<spec>?
```

Retrieves the latest valid measurement results.

If the `FETCh` query is used immediately after an `INITialize...` command, the first evaluation period is terminated before the query is executed so that a valid result can be acquired. If called up repeatedly after termination of the first evaluation period, the `FETCh` query may return the same results several times until they have been updated after the next period.

A `FETCh` returns the results without interaction with the measurement (unsynchronized query). In some cases this may cause inconsistent results to be read so that the `SAMPle` command should be used while the measurement is in the *RUN* state.

Measurement states

According to the definition given above the effect of the `FETCh` query depends on the measurement status and the history of the measurement:

Status	**Valid Results?**	**Effect of FETCh...?**
≠ OFF	Yes	Returns the current results.
OFF	No	Generates an SCPI error –230, *Data corrupt or stale*. This is why FETCh should not be used while the measurement is in the *OFF* state.
RUN	No	Waits until valid results are available and returns these results.
STOP	No	Generates an SCPI error –230, *Data corrupt or stale*. This scenario occurs, e.g. if the measurement is stopped explicitly before the first evaluation period has been terminated.

SAMPle command

```
SAMPle<type>:<meas_obj>[:RESult]<spec>?
```

Retrieves the results of the current evaluation period. In single shot measurements, `SAMPle` is equivalent to `READ`.

In a *continuous* measurement, or in *counting* mode (see *repetition mode* in *Table 5-7*), `SAMPle` is executed only after termination of the current evaluation period. This implies that a single measurement result can be returned only once by a SAMPle query; if called up repeatedly, SAMPle will return the result of subsequent evaluation periods.

Due to this behavior, the SAMPle query is suitable for monitoring the progress of *continuous* measurements in time. Multiple identical results, which might be returned by repeated FETCh commands, are avoided.

A SAMPle query returns the results after interacting with the measurement (synchronized query). This means that only valid results are returned, inconsistencies are avoided.

Measurement states

According to the definition given above the effect of the SAMPle query depends on the measurement status and the history of the measurement:

Status	Valid Results?	Effect of SAMPle...?
STOP | RDY | STEP	Yes	Returns the current results. In this case, the SAMPle command is equivalent to the FETCh command.
OFF	No	Generates an SCPI error –230, *Data corrupt or stale*. This is why SAMPle should not be used while the measurement is in the *OFF* state.
RUN	Yes | No	Waits until the end of the current evaluation period, returns the results, and resumes the measurement (unless the current evaluation period is the last to be measured).
STOP	No	Generates an SCPI error –230, *Data corrupt or stale*. This scenario occurs, e.g. if the measurement is stopped explicitly before the first evaluation period has been terminated.

READ command

READ<type>:<meas_obj>[:RESult]<spec>?

Starts a new measurement, terminates the measurement and returns the results after one single shot. The READ...? query is equivalent to:

```
ABORt...;
INITiate...;
FETCh...?
```

The READ command preserves all configurations (such as event reporting, stop condition, statistics count...). READ initiates a measurement which is terminated after one single shot (⇒ measurement state *STOP*, status *RDY*; if an error occurred, the status is *ERR*). However, it does not affect the repetition mode setting itself.

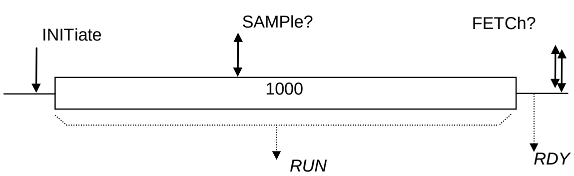
In case of no error (status *RDY*), the measurement can be continued by means of the CONTinue command. It will be performed with the repetition mode set before READ was executed.

Diagrammatic Overview of Measurement Control

As pointed out in the previous sections the commands used to configure and control the measurements, to query the status of the measurement, and to retrieve the measurement results are closely linked to the settings for the repetition mode and stop condition. The various scenarios are most easily explained by means of a graphical representation of the measurements.

Single Shot Measurements

Stop condition: NONE

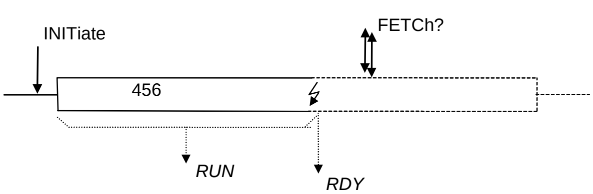


A single shot measurement comprising 1000 evaluation periods with stop condition none is performed. The measurement is started with the INITiate command. The results can be queried using the SAMPle...? (status *RUN* or *RDY)* or FETCh...? (status *RDY)* commands. The measurement is configured via:

```
CONFigure:<meas_obj>:CONTrol <type>,1000
CONFigure:<meas_obj>:CONTrol:REPetition
       SINGleshot,NONE,<Stepmode>
```

The <Stepmode> parameter has no effect.

Stop condition: SONerror



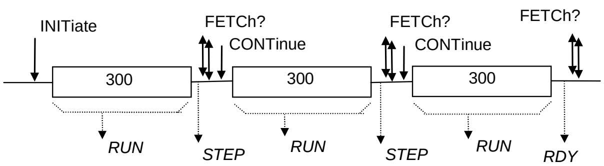
A single shot measurement comprising 1000 evaluation periods with stop condition SONerror is performed. The measurement is started with the INITiate command and stopped before the end of the statistics cycle. The results can be queried using the SAMPle...? (status *RUN* or *STOP)* or FETCh (status *STOP)* commands. The number of bursts measured can be queried using the FETCh:<meas_obj>:STATus? command. The measurement is configured via:

```
CONFigure:<meas_obj>:CONTrol <type>,1000
CONFigure:<meas_obj>:CONTrol:REPetition
                    SINGleshot,SONerror
                    <Stepmode>
```

The <Stepmode> parameter has no effect.

Counting Measurements

Stop condition: NONE

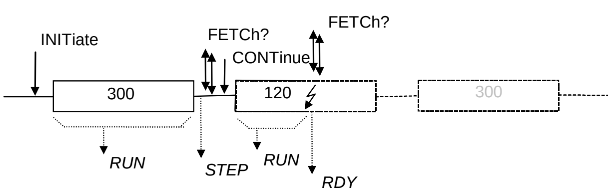


A counting measurement comprising 3 counts of measurements, each about a statistics cycle of 300 evaluation periods, is performed. The measurement is started with the `INITiate` command. The results can be queried using the `SAMPle...?` (status *RUN, STEP* or *RDY)* or `FETCh...?` (status *STEP* or *RDY)* commands. The measurement is configured via:

```
CONFigure:<meas_obj>:CONTrol <type>,300
CONFigure:<meas_obj>:CONTrol:REPetition
                         3,NONE,<Stepmode>
```

The STEP status occurs only if the stepping mode is set (`<Stepmode> = STEP`). In this case, the next cycle must be restarted via the `CONTinue` command.

Stop condition: SONerror



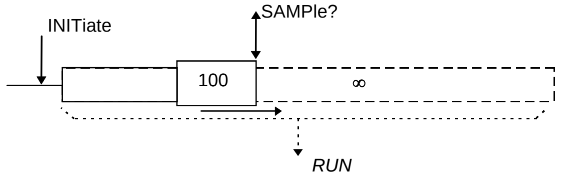
A counting measurement comprising counts of measurements, each about a statistics cycle of 300 evaluation periods, is performed. The measurement is started with the `INITiate` command. The results can be queried using the `SAMPle...?` (status *RUN, STEP* or *RDY)* or `FETCh...?` (status *STEP* or *RDY)* commands. The measurement is configured via:

```
CONFigure:<meas_obj>:CONTrol <type>,300
CONFigure:<meas_obj>:CONTrol:REPetition
                         3,SONerror,<Stepmode>
```

The STEP status occurs only if the stepping mode is set (`<Stepmode> = STEP`). In this case, the next cycle must be restarted via the `CONTinue` command.

Continuous Measurements

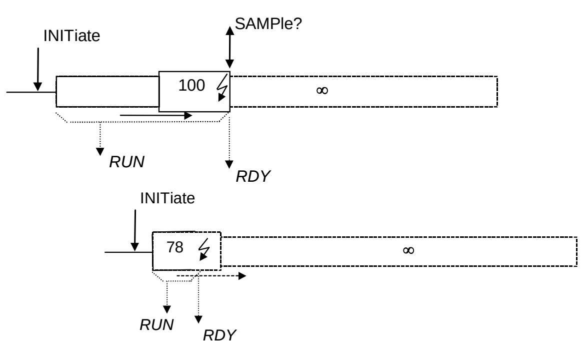
Statistics cycles, stop condition: NONE



A continuous measurement with statistics cycles consisting of 100 bursts each is performed. Average results are calculated according to the rules given in chapter 3. The measurement is started with the `INITiate` command. Results can be queried using the `SAMPle...?` command (status *RUN)*. During the measurement `FETCh...?` may return inconsistent results. The measurement is configured via:

```
CONFigure:<meas_obj>:CONTrol <type> 100
CONFigure:<meas_obj>:CONTrol:REPetition
                 CONTinuous,NONE,NONE
```

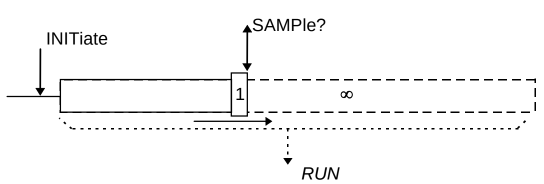
Statistics cycles, stop condition: SONerror



A continuous measurement with statistics cycles consisting of 100 evaluation periods each is performed. The measurement is started with the `INITiate` command. Results can be queried the `SAMPle...?` command (status *RUN, STOP)*. During the measurement `FETCh...?` may return inconsistent results. If the stop condition is met during the first statistics cycle no valid result is available. The measurement is configured via:

```
CONFigure:<meas_obj>:CONTrol <type> 100
CONFigure:<meas_obj>:CONTrol:REPetition
                 CONTinuous,SONerror,NONE
```

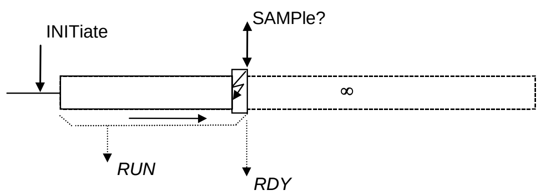
Statistics off, stop condition: NONE



A continuous measurement is performed. No statistics cycles are defined. The measurement is started with the `INITiate` command. Results can be queried using the `SAMPle...?` command (status *RUN)*. During the measurement `FETCh...?` may return inconsistent results. The measurement is configured via:

```
CONFigure:<meas_obj>:CONTrol <type> OFF
CONFigure:<meas_obj>:CONTrol:REPetition
                 CONTinuous,NONE,NONE
```

Statistics off, stop condition: SONerror



A continuous measurement is performed. No statistics cycles are defined. The measurement is started with the `INITiate` command. Results can be queried the `SAMPle...?` command (status *RUN, STOP)*. During the measurement `FETCh...?` may return inconsistent results. The measurement is configured via:

```
CONFigure:<meas_obj>:CONTrol <type> OFF
CONFigure:<meas_obj>:CONTrol:REPetition
                 CONTinuous,SONerror,NONE
```

Note: *The* stepping *mode can be set for continuous measurements as well (Parameter `<Stepmode>=STEP`, see section* *Counting Measurements* on page 5.39). In *this case, the system takes up the STEP status after each statistics cycle. It can be relaunched via the `CONTinue` command.*

Special Terms and Notation

Below we list some particular features in the syntax of the remote control commands. The general description of the SCPI command syntax can be found in section *Structure and Syntax of Device Messages* on page 5.7.

Description of commands

The commands are arranged in tables; all of them are arranged in the same way. From top to bottom, the table rows contain the following entries:

1. Complete command syntax including the parameter list and a short description of the command,
2. List and description of the parameters with their default values, the units, and unit rings.
3. Detailed description of the command, signalling state required for command execution, required firmware version.

Extensive lists of default values are annexed to the command description.

Order of commands

The commands are arranged according to their function. The general purpose of a command is described by the keyword in the second level. 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:MARKer:REFerence:POSition <Position>`

Commands with the keyword *POWer* in the second level belong to the power measurement. The keywords in the third, fourth and fifth level indicate that the command defines the position of the reference marker used in the power measurement.

Measurement object

The term *measurement object* denotes a group of remote control commands relating to the same group of measured quantities. E.g., all commands concerning the measurement of the signal power vs time form a common measurement object.

Combined measurements

To limit the number of remote control command and their parameters, scalar quantities of the same measurement object are always measured together and returned in lists.

Parameters

Many commands are supplemented by a parameter or a list of parameters. Parameters either provide alternative options (setting a or setting b or setting c ..., see special character "|"), or they form a list separated by commas (setting x,y).

<Par_Name>

In the command tables and lists, parameters are generally described by a name (literal) written in angle brackets (<>). This literal merely serves as a parameters description; in an application program it 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,OFF`

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 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. Either the short form or the long form are permissible. 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 stands for 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 *Base* system and the function groups *RF* and *Audio* will be presented in tabular form with their parameters and the ranges of numerical values. The chapter is organized as follows:

- Common commands, commands for the base system and the function groups *RF* and *Audio* are presented separately.
- Within the measurement modes, first the general configuration and then the individual measurement groups are described.

An introduction to remote control according to the SCPI standard, the status registers of the CMU, and the operating concept and measurement control is given in chapter 5.

Common Commands

The common commands are taken from the IEEE 488.2 (IEC 625-2) standard. These commands have the same effect on different devices. The headers of these commands consist of "*" followed by three letters. Many common commands are related to the status reporting system which is described in detail in chapter 5.

Table 6-1 Common Commands

Command	Parameters	Remark
***CLS**		no query
***ESE**	0 to 255	
***ESR?**		query only
***GTL**		not IEEE 488.2 confirmed; see p. 6.15 and Chapter 8, *Addressed Commands*
***IDN?**		query only
***IST?**		query only
***LLO**	TRUE | FALSe	not IEEE 488.2 confirmed; see p. 6.17 and Chapter 8, *Universal Commands*
***OPC**		
***OPT?**		query only
***PRE**	0 to 255	
***PSC**	0 | 1	
***RST**		no query
***SEC**	0 to 30	not IEEE 488.2 confirmed; see p. 6.11
***SRE**	0 to 255	
***STB?**		query only
***TST?**		query only
***WAI**		

***CLS**

CLEAR STATUS sets the status byte (STB), the standard event register (ESR) and the EVENt-part of the QUEStionable and the OPERation register to zero. The command does not alter the mask and transition parts of the registers. It clears the output buffer.

***ESE** 0 to 255

EVENT STATUS ENABLE sets the event status enable register to the value indicated. Query *ESE? returns the contents of the event status enable register in decimal form.

***ESR?**

STANDARD EVENT STATUS QUERY returns the contents of the event status register in decimal form (0 to 255) and subsequently sets the register to zero.

***IDN?**

IDENTIFICATION QUERY queries the instrument identification.

***IST?**

INDIVIDUAL STATUS QUERY returns the contents of the IST flag in decimal form (0 **|** 1). The IST-flag is the status bit which is sent during a parallel poll (see chapter 5).

***OPC**

OPERATION COMPLETE sets bit 0 in the event status register when all preceding commands have been executed. This bit can be used to initiate a service request (cf. chapter 5).

***OPC?**

OPERATION COMPLETE QUERY writes message "1" into the output buffer as soon as all preceding commands have been executed (cf. chapter 5).

***OPT?**

OPTION IDENTIFICATION QUERY queries the options included in the instrument and returns a list of the options installed. The response consists of Arbitrary ASCII Response Data according to IEEE 488.2. The options are returned at fixed positions in a comma-separated string. A zero is returned for options that are not installed.

Example:
0,0,0,0,B11,0,B21Var02,0,0,0,B41,B52Var02,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,PCMCIA,0,
0,0,0,0,0,0,0,K20,K21,K22,K23,K24,K27,K28,K29,0,0,0,0,0,0,0,0,K42,K43,0,0,0,0,0,0,0,0,0,0,0,0,K83,K84,
K85,K86,0,FMR5,AMD K6-2,64 MB,0,0,0,rxtx1,0,0,0,0,0

An alternative list of options can be queried via the command SYSTem:OPTions? See also description of *Setup – Options* menu in Chapter 4.

The CMU hardware options are listed at the beginning of the output string:

Response	Description	Response	Description
B1/B2	OCXO	B54Var02/Var14	Sig. Mod. for GSM, TDMA, AMPS
B5	GSM Linkhandler (CRTU)	B56Var14	Power PC for USU
B6	MAC/Speech Board (CRTU)	B56Var02/Var14	Power PC
B7	I/Q-IF Interface (CRTU)	B66	WCDMA L1 Copro
B9	Two auxiliary RF generators	B68	WCDMA L1 Copro, fully fitted
B11/B12	OCXO	B71	ABIS (CMU300)
B17	I/Q-IF Interface	B73	A/B Board
B21	Universal Signalling Unit	B76	WCDMA L1 Copro (CMU300)
B21Var14	USU for WCDMA, GPRS	B81	cdmaOne LH

Response	Description	Response	Description
B21Var02	ULH for GMS, TDMA, AMPS	B82	Access Board for B81/83
B21Var02/Var14	Universal Signalling Unit	B83	CDMA2000 LH
B41	Audio option	B85	Speech codec for B83
B52	Speech coder for CMU-B21	B88	HDR option for B83
B52Var14	Speech coder for USU	B91	Second RF Channel
B52Var02	Speech coder for ULH	B95	Additional RF Generator
B52Var02/Var14	Speech coder	U61	Floppy disk
B53	Bluetooth	B62	–
B53Var14	Bluetooth for USU	U65	DDC400 for WCDMA
B53Var02	Bluetooth for ULH	U75	DDC400 for WCDMA Var04
B53Var02/Var14	Bluetooth	U99	RF1 with RF2 Level Range
B54Var14	Sig. Mod. f. GSM, TDMA, AMPS	0	not used

The CMU software options are listed after the software options:

Response	Description	Response	Description
K0	DemoPack	K43	EGPRS Signalling
K2	GSM Activation (CRTU)	K45	AMR GSM for CMU200
K5	CRTU-G Activation (CRTU)	K53	Bluetooth
K6	WCDMA Activation (CRTU)	K65	WCDMA UE TX Test (3GPP/FDD)
K20	GSM400-MS	K66	WCDMA DL Generator
K21	GSM900-MS	K67	WCDMA Signalling Band III
K22	GSM1800-MS	K68	WCDMA Signalling Band I
K23	GSM1900-MS	K69	WCDMA Signalling Band II
K24	GSM850-MS	K75	WCDMA Node B Test (CMU300)
K27	IS 136-800-MS	K76	WCDMA UL Generator (CMU300)
K28	IS 136-1900-MS	K81	CDMA1-MS 800
K29	AMPS-MS	K82	CDMA1-MS 1700/1900
K30	GSM400-BS	K83	CDMA2000 450
K31	GSM900-BS	K84	CDMA2000 800
K32	GSM1800-BS	K85	CDMA2000 1700/1900
K33	GSM1900-BS	K86	CDMA2000 2200
K34	GSM850-BS	K88	1xEV-DO
K39	MOC/MTC for GSM-BS		
K41	EDGE		
K42	GPRS Signalling		

The CMU hardware equipment is listed after the hardware options:

Response	Description	Response	Description
FMR5/6	Front Module Controller	0	not used
<CPU_Type>	–	0	not used
<Memory>	–	0	not used

The CMU firmware versions are listed after the hardware equipment:

Response	Description	Response	Description
uP1	–	0	not used
uP2	–	0	not used
0	not used	0	not used

***PRE 0 to 255**

PARALLEL POLL REGISTER ENABLE sets parallel poll enable register to the value indicated. Query *PRE? returns the contents of the parallel poll enable register in decimal form.

***PSC 0 | 1**

POWER ON STATUS CLEAR determines whether the contents of the ENABle registers is maintained or reset in switching on.

*PSC = 0 causes the contents of the status registers to be maintained. Thus a service request can be triggered in switching on in the case of a corresponding configuration of status registers ESE and SRE.

*PSC ≠ 0 resets the registers.

Query *PSC? reads out the contents of the power-on-status-clear flag. The response can be 0 or 1.

***RST**

RESET sets the instrument to a defined default status. The command resets all function groups and test modes, restoring the default values defined for remote control operation. *RST is equivalent to `SYSTem:RESet[:ALL]`. The default settings are indicated in the description of commands.

***SRE 0 to 255**

SERVICE REQUEST ENABLE sets the service request enable register to the value indicated. Bit 6 (MSS mask bit) remains 0. This command determines under which conditions a service request is triggered. Query *SRE? reads the contents of the service request enable register in decimal form. Bit 6 is always 0.

***STB?**

READ STATUS BYTE QUERY reads the contents of the status byte in decimal form.

***TST?**

SELF TEST QUERY triggers selftests of the instrument and outputs an error code in decimal form (the output is zero in the current firmware version).

***WAI**

WAIT-to-CONTINUE only permits the servicing of the subsequent commands after all preceding commands have been executed and all signals have settled (see also chapter 5 and "*OPC").

CMU Base System

System Commands

The SYSTem subsystem contains the functions that are not related to instrument performance. The CMU supports the following SCPI-confirmed SYSTem commands:

SYSTem:ERRor?				Error Queue
Response	Parameter description	Def. value	Default unit	FW vers.
-32768 to +32768 and error string **Ex.: -230,"Data corrupt or stale"**	Error message	0, "No error"	–	V1.20
Command description				
This command queries the next entry from the error/event queue and deletes it. Positive error numbers are instrument-dependent; negative error numbers are reserved by the SCPI standard, see chapter 9. If the error queue is empty, the error number 0, "No error" is returned.				

SYSTem:VERSion?				SCPI Version
Response	Parameter description	Def. value	Default unit	FW vers.
YYYY.V **Ex.: 1990.0**	SCPI version of CMU	–	–	V1.20
Command description				
This command queries the SCPI version number for which the instrument complies. YYYY is the year of SCPI compliance, V is the version number within the year.				

SYSTem:NONVolatile:DISable	Disable Non Volatile RAM
Command description	FW vers.
This command has no query form. It prevents the CMU from saving measurement settings to the non volatile ram. This improves the system performance but implies that the current settings will not be saved for later sessions. Disabling the non volatile ram is recommended on instruments equipped with an FMR 6 Front Module controller. ***Note:*** *There is no way to cancel the effect of the `SYSTem:NONVolatile:DISable` command within the current session, even is the CMU is switched to manual control (Local). To re-enable the non volatile ram, the CMU must be rebooted.*	V3.0

Status Commands

The STATus subsystem controls the SCPI-defined status reporting structures. The purpose and definition of status registers is given in chapter 5, section "Status Reporting System". Unless otherwise stated, all the following commands are SCPI-confirmed.

STATus:OPERation[:EVENt]?				Event Part
Response	Parameter description	Def. value[1]	Default unit	FW vers.
0 to 32767	Event part	–	–	V1.20
Command description				
This command queries and deletes the contents of the EVENt part of the STATus:OPERation register.				

STATus:OPERation:ENABle *<Number>*				Enable part
<Number>	Parameter description	Def. value	Default unit	FW vers.
0 to 32767	Enable part	–	–	V1.20
Command description				
This command enters a number to be interpreted as a bit pattern in the ENABle part of the STATus:OPERation register. If a bit is set the corresponding event is reported in the summary bit of the status byte.				

STATus:OPERation:CMU:SUM<nr>[:EVENt]?				Event part
Response	Parameter description	Def. value	Default unit	FW vers.
0 to 32767	Event part	–	–	V1.20
Command description				
This command queries and deletes the contents of the EVENt part of the STATus:OPERation:CMU:SUM<nr> register (<nr> = 1,2).				

STATus:OPERation:CMU:SUM<nr>:ENABle *<Number>*				Enable part
<Number>	Parameter description	Def. value	Default unit	FW vers.
0 to 32767	Enable part	–	–	V1.20
Command description				
This command enters a number to be interpreted as a bit pattern in the ENABle part of the STATus:OPERation:CMU:SUM<nr> register (<nr> = 1,2). If a bit is set the corresponding event is reported in the summary bit of the status byte.				

STATus:OPERation:CMU:SUM<nr>:CMU<nr_event>[:EVENt]?				Event part
Response	Parameter description	Def. value	Default unit	FW vers.
0 to 32767	Event part	–	–	V1.20
Command description				
This command queries and deletes the contents of the EVENt part of the STATus:OPERation:CMU:SUM<nr>:CMU<nr_event> register (<nr> = 1 to 2; <nr_event> = 1 to 15).				

[1] *RST does not supersede the entries in the status registers; for an overview of the reset values of the STATus... system refer to section *Reset Values of the Status Reporting Systems* in chapter 5.

STATus:OPERation:CMU:SUM<nr>:CMU<nr_event>:ENABle *<Number>*				Enable part
<Number>	Parameter description	Def. value	Default unit	FW vers.
0 to 32767	Enable part	–	–	V1.20
Command description				
This command enters a number to be interpreted as a bit pattern in the ENABle part of the STATus:OPERation:CMU:SUM<nr>:CMU<nr_event> register (<nr> = 1 to 2; <nr_event> = 1 to 15). If a bit is set the corresponding event is reported in the summary bit of the status byte.				

STATus:OPERation:CMU:ALL?				Query all operation registers
Response	Parameter description	Def. value	Default unit	FW vers.
0 to 32767, ... , 0 to 32767	Event part of all CMU operation registers	–	–	V1.20
Command description				
This command queries the EVENt parts of all STATus:OPERation:CMU:SUM<nr>:CMU<nr_event> registers. The result is returned as a list of 30 integer values separated by commas.				

STATus:OPERation:CMU:CLEar	Clear all operation registers
Command description	FW vers.
This command clears the EVENt parts of all STATus:OPERation:CMU:SUM<nr>:CMU<nr_event> registers (<nr> = 1 to 2; <nr_event> = 1 to 15).	V1.20

STATus:QUEStionable[:EVENt]?				Event part
Response	Parameter description	Def. value	Default unit	FW vers.
0 to 32767	Event part	–	–	V1.20
Command description				
This command queries and deletes the contents of the EVENt part of the STATus:QUEStionable register.				

STATus:QUEStionable:ENABle *<Number>*				Enable part
<Number>	Parameter description	Def. value	Default unit	FW vers.
0 to 32767	Enable part	–	–	V1.20
Command description				
This command enters a number to be interpreted as a bit pattern in the ENABle part of the STATus:QUEStionable register. If a bit is set the corresponding event is reported in the summary bit of the status byte.				

STATus:PRESet	Reset status registers
Command description	FW vers.
This command sets the transition filters (PTRansition and NTRansition filters) and the ENABle registers of the STATus:OPERation and the STATus:QUEStionable registers to defined values: • PTRansition is set to 32767 (0x7FFF), i.e. all hardware events are detected and transferred to the EVENt register. • NTRansition is set to 0, i.e. a hardware event that disappears does not cause any change in the EVENt register. The ENABle registers are also set to 0 so that events are not reported in the status byte.	V1.20

Symbolic Status Event Register Evaluation

The following commands are used to retrieve the events reported and the corresponding function groups; see section *Symbolic Status Event Register Evaluation* in chapter 5.

STATus:OPERation:EVENt:SADDress? Check event reporting

Response	Parameter description	Def. Value[2]	Default Unit	FW vers.
1 to 30, **"Fgrp"**	"Next" secondary address Corresponding function group name (or "", if no event was reported)	31 ""	– –	V2.10

Command description

This command is always a query. It checks the `STATus:OPERation: CMU:SUM<nr>:EVENt` sum registers (<nr> = 1 | 2), returns the next secondary address and function group string where an event was reported, and deletes the entry in the `EVENt` register. If applied repeatedly, the command checks the secondary addresses in ascending order (i.e. the events are not queried chronologically).

The command is global; it is available in all function groups. Possible responses are:

1,"RF_NSig" An event was reported in function group *RF* (currently assigned to secondary address 1).

31,"" No (further) event reported.

STATus:OPERation:SYMBolic:ENABle <Event>{,<Event>} Symbolic status evaluation

Parameter list	Parameter description	Def. Value[3]	Default Unit	FW vers.
<Event>{,<Event>} | **NONE**	List of symbols for events to be reported No event reported	NONE	–	V2.10

Command description

This command enables event reporting for one or several events in the current 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 each function group are listed in chapter 5 of the relevant manuals (see section *Status Registers).* The symbols may be entered in arbitrary order.

STATus:OPERation:SYMBolic[:EVENt]? Symbolic status evaluation

Response	Parameter description	Def. Value[4]	Default Unit	FW vers.
NONE | **<Event>{,<Event>}**	No event in the current function group List of reported events	NONE	–	V2.10

Command description

This command is always a query. It lists the events reported in the current 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.

[2] The default values quoted in this command are achieved after a `*CLS` command. `*RST` does not supersede the entries in the status registers; see section *Reset Values of the Status Reporting Systems* in chapter 5.

[3] The default values quoted in this command are achieved after a `STATus:PRESet` command. `*RST` does not supersede the entries in the status registers; see section *Reset Values of the Status Reporting Systems* in chapter 5.

[4] The default values quoted in this command are achieved after a `*CLS` command. `*RST` does not supersede the entries in the status registers; see section *Reset Values of the Status Reporting Systems* in chapter 5.

Setup – Basic Device Settings

The SETup subsystem contains the commands for global configuration of the remote control parameters, the serial interfaces, the options, date and time, the keyboard and beeper. It corresponds to the *Setup* menu opened via the *SETUP* key on the front panel.

Subsystem Remote

The *REMote* subsystem contains the commands for configuration of the remote control parameters. It corresponds to the *Remote* tab in the *Setup* menu opened via the *SETUP* key on the front panel.

SYSTem:REMote:ADDRess:PRIMary *<Addr>*				Primary Address
<Addr>	Parameter description	Def. value	Default unit	FW vers.
0 to 30	Primary address to the GPIB (IEEE) bus	20	–	V1.20
Command description				
This command sets the primary address of the GPIB driver which is used to address the device (CMU). It is equivalent to `SYSTem:COMMunicate:GPIB[:SELF]:ADDRess` (see below).				

SYSTem:REMote:ADDRess:SECondary *<Addr>,<FGrp>*				Secondary Address
<Addr>,<FGrp>	Parameter description	Def. value	Default unit	FW vers.
1 to 29, **„FGrp_name“ | NONe**	Secondary address of the function group Name of the function group or NONE if the secondary address is not to be mapped	Configuration specific	–	V1.17

Command description

This command assigns the secondary addresses to the remote control modes (function groups) of the GPIB driver (compare next command). If a secondary address is successively assigned to different function groups, the previous assignments are overwritten. The function group names are quoted at the beginning of chapter 5 of each network test manual; some examples are:

FGrp_name	**Function Group**	**FGrp_name**	**Function Group**
BASE	CMU base system	Audio_NSig	Audio Generator and Analyzer
RF_NSig	RF Non Signalling	IS136800MS_NSig	TDMA800-MS Non Signalling
GSM900MS_NSig	GSM900-MS Non Signalling	IS136800MS_Sig	TDMA800-MS Signalling
GSM900MS_Sig	GSM900-MS Signalling	IS1361900MS_NSig	TDMA1900-MS Non Signalling
GSM1800MS_NSig	GSM1800-MS Non Signalling	IS1361900MS_NSig	TDMA1900-MS Signalling
GSM1800MS_Sig	GSM1800-MS Signalling	AMPSMS_NSig	AMPS-MS Non Signalling
GSM1900MS_NSig	GSM1900-MS Non Signalling	AMPSMS_Sig	AMPS-MS Signalling

The CMU base system (function group *BASE)* is always assigned to secondary address 0; the assignment cannot be changed by the `SYSTem:REMote:ADDRess:SECondary` command. A program example illustrating how to adapt the secondary addresses to the requirements of a specific driver can be found in chapter 7.

Example:	Setting:	SYST:REM:ADDR:SEC 2,”GSM900MS_NSig” SYST:REM:ADDR:SEC 1,NONE
	Query: --> Response:	SYST:REM:ADDR:SEC? 2 "GSM900MS_NSig”
	Query: --> Response:	SYST:REM:ADDR:SEC? 1 NONE
	Query: --> Response:	SYST:REM:ADDR:SEC? NONE,”GSM900MS_NSig”, ... (30 returned values)

***SEC <*Addr*>**				Secondary Address
<Addr>	Parameter description	Def. value	Default unit	FW vers.
0 to 29	Secondary address	0	–	V1.20
Command description				
This command has no query form. It switches over to the specified secondary address. It is required if the serial interface is used for remote control (software switchover, RS-232 remote interface, see previous command and section *Setting the Device Address* in chapter 5).				

Subsystem Communicate

The *COMMunicate* subsystem contains the commands for configuration of the remote serial interfaces. It corresponds to the *Communicate* tab in the *Setup* menu opened via the *SETUP* key on the front panel. The parameters set in this subsystem are explained in more detail in chapter 8, section *Hardware Interfaces*.

SYSTem:COMMunicate:GPIB[:SELF]:ADDRess <*Addr*>				Primary Address
<Addr>	Parameter description	Def. value	Default unit	FW vers.
0 to 30	Primary address to the GPIB (IEEE) bus	20	–	V1.20
Command description				
This command sets the primary address of the GPIB driver which is used to address the device (CMU). It is equivalent to `SYSTem:REMote:ADDRess:PRIMary` (see above).				

SYSTem:COMMunicate:SERial<1|2>:APPLication?				Application
Response	Parameter description	Def. value	Default unit	FW vers.
TRAN | **REM |** **PRIN**	Transfer Remote control Printer control (future extension)	dep. on SCPI connection (port) and printer settings	-	V1.20
Command description				
This command is always a query. It returns the current application (connection) of the serial (RS-232) interface. The numeric suffix distinguishes the two interfaces COM 1 and COM 2.				

SYSTem:COMMunicate:SERial<1|2>[:RECeive]:BAUD <*Baudrate*>				Baud Rate
<Baudrate>	Parameter description	Def. value	Default unit	FW vers.
110 | 300 | 600 | 1200 | 2400 | 4800 | 9600 | 19200 | 38400 | 57600 | 115200	baud rate	9600	baud	V1.20
Command description				
This command sets the baud rate of the serial interface no. 1 or 2 (connectors COM 1 or COM 2). If a COM port is selected as an GPIB connector, the default transmission rate is 19200 baud.				

SYSTem:COMMunicate:SERial<1|2>[:RECeive]:BITs *<DataBits>*				Data Bits
<DataBits>	Parameter description	Def. value	Default unit	FW vers.
7 | 8	number of data bits	8	–	V1.20
Command description				
This command sets the number of data bits of the serial interface no. 1 or 2 (connectors COM 1 or COM 2). The sum of data bits and stop bits must be equal to 9.				

SYSTem:COMMunicate:SERial<1|2>[:RECeive]:STOP *<StopBits>*				Stop bits
<StopBits>	Parameter description	Def. value	Default unit	FW vers.
1 | 2	number of stop bits	1	-	V1.20
Command description				
This command sets the number of stop bits of the serial interface no. 1 or 2 (connectors COM 1 or COM 2). The sum of data bits and stop bits must be equal to 9.				

SYSTem:COMMunicate:SERial<1|2>[:RECeive]:PARity[:TYPE] *<Parity>*				Parity
<Parity>	Parameter description	Def. value	Default unit	FW vers.
NONE **ODD** **EVEN**	no parity odd parity even parity	NONE	–	V1.20
Command description				
This command sets the parity of the serial interface no. 1 or 2 (connectors COM 1 or COM 2).				

SYSTem:COMMunicate:SERial<1|2>:TRANsmit:PACE *<Pace>*				Transmission Protocol
<Pace>	Parameter description	Def. value	Default unit	FW vers.
XON **ACK** **NONE**	Xon/Xoff – protocol Hardware protocol with CTS/RTS lines No protocol set	XON	–	V1.20
Command description				
This command sets the handshake protocol of the serial interface no. 1 or 2 (connectors COM 1 or COM 2).				

Subsystem Options

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?			Device Info
Response	Def. value	Default unit	FW vers.
Example: ROHDE&SCHWARZ,CMU 200,840675/018,V1.17B 1998-11-30	–	–	V1.20
Command description			
This command returns the information on the device comprising the manufacturer, model, serial number and base system firmware version. This command is always a query and is equivalent to the common command `*IDN?`			

SYSTem:OPTions?				Options
Response	Parameter description	Def. value	Def. unit	FW vers.
HWO, **"B11/12","B11",** **"B17",NAN,** **"B21","available",...**	Identifier for hardware options 1st option, 2nd option, not available. 3rd option, available	–	–	V1.20
SWO, **"K0",NAN,** **"K20","enabled",** **"K21","3x10.c05 available",**	Identifier for software options 1st option, not available 2nd option, enabled 3rd option, available but not enabled			
HWE, **“CPU(FMR)“, “FMR5“ ...**	Identifier for hardware equipment 1st equipment ...			
FWV, **„uP1“,"V7.00 26.08.02",** **"uP2",NAN**	Identifier for firmware versions 1st option, 2nd option, 3, 4 ...			
Command description				
This command returns a list of all options and equipment available in the instrument, equivalent to the list overview in the *Setup – Options* tab. It is always a query. An alternative list of options (following IEEE 488.2 conventions) can be queried via the common command *OPT?				

Subsystem Time

The *Time* subsystem contains the commands for the current time and date. It corresponds to the *Time* tab in the *Setup* menu opened via the *SETUP* key on the front panel.

SYSTem:TZONe *<Hour>[,<Minute>]* or **SYSTem:TIMe:TZONe *<Hour>[,<Minute>]***				Time Zone
Parameters	Parameter description	Def. value	Default unit	FW vers.
<Hour> **<Minute>**	integer value between –12 and +12 -59 to +59 (optional)	+1 0	–	V1.20
Command description				
This command defines the time zone via the time offset from Greenwich mean time. A time offset of +1 h (default setting) corresponds to Middle European time.				

SYSTem:TIMe[:TIMe] *<Hour>,<Minute>,<Second>* or **SYSTem:TIMe *<Hour>,<Minute>,<Second>***				Current Time
Parameters	Parameter description	Def. value	Default unit	FW vers.
<Hour>, **<Minute>,** **<Second>**	Hours (0 to 23) Minutes (0 to 59) Seconds (0 to 59)	– – –	h min s	V 1.20
Command description				
This command sets the internal system time of the CMU.				

SYSTem:TIMe:DATe *<Year>,<Month>,<Day>* or **SYSTem:DATE *<Year>,<Month>,<Day>***				Date
Parameters	Parameter description	Def. value	Default unit	FW vers.
<Year>, **<Month>,** **<Day>**	Four-digit year (1980 to 2099) Month (1 to 12) Day (1 to 31)	– – –	–	V1.20
Command description				
This command sets the internal system date of the CMU.				

Subsystem MISC

The *MISC* subsystem sets the acoustic signal and selecting the external keyboard assignment. It corresponds to the *Misc.* tab in the *Setup* menu opened via the *SETUP* key on the front panel.

SYSTem:MISC:KBEep *<Enable>*				Key Beep
<Enable>	Parameter description	Def. value	Default unit	FW vers.
ON | **OFF**	Key beep on Key beep off	OFF	–	V1.20
Command description				
This command switches the acoustic signal of the CMU on or off.				

SYSTem:MISC:KEYBoard *<Country>*				Keyboard
<Country>	Parameter description	Def. value	Default unit	FW vers.
US | **GR**	American keyboard German keyboard	US	–	V1.20
Command description				
This command selects the driver for the external keyboard.				

Subsystem GTRMode (Local to Remote Switchover)

The *GTRMode* subsystem determines the behavior of the CMU in a local to remote transition. The settings are provided in the *Remote* tab of the *Setup* menu.

SYSTem:GTRMode:COMPatible <*Enable*> — Local to Remote

<Enable>	Parameter description	Def. value	Default unit	FW vers.
ON | **OFF**	Connection or call dropped on local to remote switchover/ generator switched off Current signalling state or generator state maintained	ON	–	V3.05

Command description

This command defines the behavior of the CMU in a local to remote transition. The command is valid for all function groups and test modes, however, its effect depends on the test mode *(Signalling* or *Non Signalling* tests):

Signalling — In the *ON* setting, the connection or call is dropped and the CMU returns to its default signalling state (e.g. *SOFF* in the *GSMxxx-MS* function groups). In the *OFF* setting, all signalling states are maintained. This makes it possible to switch the instrument to remote control without dropping a call or connection. See also operating manuals for the different network tests.

Non Signalling — In the *ON* setting, all generators are switched off. In the *OFF* setting, the current operating state of all generators is maintained.

***GTL** — Go to Local

Command description

This command has no query form. It switches the instrument immediately back to local mode (manual control). The CMU opens the menu of the current running measurement; see also section *Return to Manual Control* in Chapter 5. This command can be used instead of the addressed command GTL is a serial connection is used.

Subsystem MQUeue

The *MQUeue* subsystem contains the commands for symbolic measurement ready evaluation. These commands are used to query the contents of the measurement queue. To activate the measurement queue, event reporting must not be switched off; see section *Event Reporting* in chapter 5.

SYSTem:MQUeue[:COMPlete][:LIST]? — Complete Measurement Queue

Response	Parameter description	Def. value	Default unit	FW vers.
<FGroup_Mode>, **<MeasObject>, ...**	Function group and test mode Ready measurement	"NONE", "NONE"	–	V2.10

Command description

This command is always a query. It returns and deletes the contents of the complete measurement queue. The individual results are returned in chronological order (first in first out). Examples of possible responses are:

"RF_NSig","POWer","RF_NSig","SPECtrum"
Power and spectrum measurement ready in function group *RF*,
Test mode *Non Signalling*

"NONE", "NONE"
No ready measurements reported

SYSTem:MQUeue[:COMPlete]:ITEM?		Next Entry in Measurement Queue		
Response	Parameter description	Def. value	Default unit	FW vers.
<FGroup_Mode>, **<MeasObject>**	Function group and test mode Ready measurement	"NONE", "NONE"	–	V2.10
Command description				
This command is always a query. It returns and deletes the oldest ready measurement in the measurement queue.				

Reset of Function Groups

The *PRESet/RESet* subsystem restores the (factory) default values for all instrument settings. It corresponds to the *Reset* menu opened via the *RESET* key on the front panel.

SYSTem:PRESet[:ALL] **SYSTem:RESet[:ALL]** Reset all function groups and test modes	
Command description	FW vers.
This command sets all parameters of the instrument to default values. The commands differ for instrument settings with distinct default values in manual and remote control (e.g. the repetition mode for many measurements): • `SYST:PRES` restores the default values for manual control, leaving the current remote control parameters unchanged. • `SYST:RES` (available for FW vers. ≥3.10) restores the default values for remote control leaving the current manual control parameters unchanged. This command is equivalent to `*RST`.	V1.20

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

Remote Report – Subsystem TRACe

The TRACe subsystem determines whether the remote report is displayed on screen or written to a file. It corresponds to the *Report...* hotkeys on the bottom of the *Remote* screen.

***LLO <*Boolean*>** — Local Lockout

<Boolean>	Parameter description	Def. value	Default unit	FW vers.
FALSe | **TRUE**	Hitting any front panel key switches to manual control Front panel keys locked	FALSe	–	V3.10

Command description

This command has no query form. It locks the front panel keys to prevent an inadvertent switchover to manual control. If TRUE is set, the hotkeys to control the remote screen are still active. The parameter FALSe re-activates all front panel keys for switchover to manual control.

This command can be used instead of the universal command LLO is a serial connection is used.

TRACe:REMote:MODE:DISPlay <*Enable*> — Report Display

<Enable>	Parameter description	Def. value	Default unit	FW vers.
ON | **OFF**	Remote report displayed on screen Remote report not displayed	OFF	–	V3.05

Command description

This command qualifies whether the remote report is displayed on screen.

TRACe:REMote:MODE:FILE <*Enable*> — Report File

<Enable>	Parameter description	Def. value	Default unit	FW vers.
ON | **OFF**	Remote report stored Remote report not stored	OFF	–	V3.05

Command description

This command qualifies whether the remote report is written to a file named Remote.trc in the root directory of the internal hard disk.

TRACe:REMote:MODE:ERRor <*Enable*> — Show/Hide Error Messages

<Enable>	Parameter description	Def. value	Default unit	FW vers.
ON | OFF	Show or hide error messages	ON	–	V3.08

Command description

This command qualifies whether error messages (marked by a "E !" symbol on a red square) are included in the remote report.

TRACe:REMote:MODE:SQR <*Enable*> — Show/Hide Service Requests

<Enable>	Parameter description	Def. value	Default unit	FW vers.
ON | OFF	Show or hide SRQs	OFF	–	V3.08

Command description

This command qualifies whether a message is written to the remote report whenever the CMU sends a service request to the controller. The message symbolizes the contents of the status byte (e.g. ERR, OPR, MAV, OPER,...) and is marked by a red "S" symbol.

TRACe:REMote:MODE:OUTLines *<Enable>*				Report Lines for Output
<Enable>	Parameter description	Def. value	Default unit	FW vers.
1 to 4	Maximum number of lines	4	–	V3.08
Command description				
This command defines the maximum number of lines available for each output string in the remote report screen. If the output string of a query (e.g. `READ:ARRay:POWer?` in the RF function group) is longer than the specified number of lines, it is truncated and the last three characters are replaced by "...".				

File Manager – System MMEMory

The `MMEMory` system provides mass storage capabilities for the CMU. Part of the functionality of this system is included in the *Data* menu.

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 `MMEMory:DIRectory [:CURRent]?`. The file name itself may contain the period as a separator for extensions.

Unless otherwise stated, all the following commands are SCPI-confirmed.

MMEMory:INFO? *<FileName> [,<msus>]*				View Info
<FileName>	Parameter description	Def. value	Def. unit	
"<8 dig.max>.<3dig.>"	Name of the file to be inquired in DOS (8.3) convention.	–	–	
<msus>	Parameter description	Def. value	Def. unit	
INTernal | **EXTernal**	Internal memory (hard disk) External memory (floppy disk or PCMCIA memory card)	INTernal[5]	–	
Returned info	Parameter description	Def. value	Def. unit	FW vers.
<Year>,<Month>,<Day>, **<Hour>,<Min>,<Sec>,** **<Size>,** **<Version>,** **"<Comment>"**	Date when the file was stored Time when the file was stored File size in byte File version number Comment string stored with the file	– – – " " " "	y, m, d h, min, s byte – –	V3.05

[5] See MMEMory:MSIS *[<msus>]* setting.

Description of command
This command retrieves information about a file stored on the external or internal mass memory. The <msus> parameter must be specified if information on an external file is needed and the internal memory contains a file of the same name. Alternatively, *msus* may be specified with the command *MMEMory:MSIS [<msus>]*.   This command is CMU-specific. The <Version> and <Comment> output parameters are reserved for future extensions.

MMEMory:COMMent *<Comment>*

<Comment>	Parameter description	Def. value	Def. unit	FW vers.
"<160 characters max.>"	Comment string	" "	–	V3.10

Description of command

This command defines a comment for a CMU configuration file. The comment is saved to the file generated via MMEMory:SAVE[:ALL] <FileName>[,<msus>] or MMEMory:SAVE:CURRent <FileName>[,<msus>]. The command is CMU-specific.

MMEMory:MSIS *[<msus>]* Internal/External

<msus>	Parameter description	Def. value	Def. unit	FW vers.
INTernal | **EXTernal**	Internal memory (hard disk) External memory (floppy disk or PCMCIA memory card)	INTernal	–	V3.05

Description of command

This *Mass Storage IS* command resets the default mass storage parameter *<msus>* for all MMEmory commands.

MMEMory:DIRectory[:CURRent]? Current Directory

Returned value	Parameter description	Def. value	Def. unit	FW vers.
INT | EXT, **"<DirectoryName>"**	Internal or external storage device Name and path of the current directory in DOS convention.	INT[6] "\USERDATA\SAVE"	–	V3.05

Description of command

This command is always a query and returns the current directory name and path. Possible return strings are INT, " " (for the internal root directory) or EXT, "\TEMP\TRASH" (for the \TEMP\TRASH subdirectory of the external root directory). This command is CMU-specific.

The current directory is set to default when the base system is booted but left unchanged when the base system is reset (*RST, SYSTem:RESet:CURRent).

[6] See MMEMory:MSIS *[<msus>]* setting.

MMEMory:CDIRectory ***[<DirName>], [<msus>]***				Change Directory
<DirName>	Parameter description	Def. value	Def. unit	FW vers.
"<DirectoryName>", **INTernal | EXTernal**	Name of the directory to be accessed Internal or external storage device	"\USERDA TA\SAVE"	–	V3.05
Description of command				
This command has no query form. It sets the directory specified via *<DirName>* as default directory. If this parameter is omitted, the directory is set to the USERDATA\SAVE subdirectory of the `INTernal` or `EXTernal` root directory, depending on the current *MMEMory:MSIS [<msus>]* settings.				

MMEMory:DELete ***<FileName> [,<msus>]***				Delete File
Parameters	Parameter description	Def. value	Def. unit	FW vers.
"<FileName>", **INTernal | EXTernal**	Name of the file to be deleted Storage device of the file to be deleted	– INTernal[6]	– –	V3.05
Description of command				
This command has no query form. It removes a single file from the specified mass storage device.				

MMEMory:RMDir ***<DirName> [,<msus>]***				Remove Directory
Parameters	Parameter description	Def. value	Def. unit	FW vers.
"<DirectoryName>", **INTernal | EXTernal**	Name of the directory to be removed Storage device of the directory	– INTernal[6]	– –	V3.05
Description of command				
This command has no query form. It removes a directory with all its contents and subdirectories from the specified mass storage device. The command is CMU-specific.				

MMEMory:MKDir ***<DirName> [,<msus>]***				Make Directory
Parameters	Parameter description	Def. value	Def. unit	FW vers.
"<DirectoryName>", **INTernal | EXTernal**	Name of the directory to be created Storage device of the directory	– INTernal[6]	– –	V3.05
Description of command				
This command has no query form. It creates a new subdirectory in the current directory. The command is CMU-specific.				

MMEMory:COPY ***<FileSource>, <msus1>, <FileDest>, <msus2>* | *<FileSource>, <FileDest>***				Copy File
Parameters	Parameter description	Def. value	Def. unit	FW vers.
"<FileSource>", **INTernal | EXTernal,** **"<FileDest>",** **INTernal | EXTernal**	Name of the file to be copied Storage device of the source file Name of the new file Storage device of the new file	– INTernal[6] – INTernal[6]	– – – –	V3.05
Description of command				
This command has no query form. It copies the contents of an existing file or directory to a new one.				

MMEMory:MOVE Move File
<FileSource>, <msus1>, <FileDest>, <msus2> | <FileSource>, <FileDest>

Parameters	Parameter description	Def. value	Def. unit	FW vers.
"<FileSource>",	Name of the file to be renamed	–	–	V3.05
INTernal | EXTernal,	Storage device of the source file	INTernal[6]	–	
"<FileDest>",	Name of the new file	–	–	
INTernal | EXTernal	Storage device of the new file	INTernal[6]	–	

Description of command

This command has no query form. It moves an existing file to another file name and mass storage device.

MMEMory:REName *<FileSource>, <FileDest> [,<msus>]* Rename File

Parameters	Parameter description	Def. value	Def. unit	FW vers.
"<FileSource>",	Name of the file to be renamed	–	–	V3.10
INTernal | EXTernal,	Storage device of the source file	INTernal[6]	–	
"<FileDest>",	Name of the new file	–	–	
INTernal | EXTernal	Storage device of the new file	INTernal[6]	–	

Description of command

This command has no query form. It renames an existing file. This command is CMU-specific.

MMEMory:SCAN? Scan Disk

Rückgabe	Parameter description	Def. value	Def. unit	FW vers.
INT | EXT,	Storage device	–	–	V3.05
D , ”<SubdirectoryName1>”, ”<SubdirectoryName2>”, ... ,	List of subdirectory names			
F , ”<FileName1>”, ”<FileName2>”, ... ,	List of file names			

Description of command

This command is always a query and lists the contents of the current directory. Subdirectories and files are listed in alphabetical order. The first entry specifies the mass storage device (internal or external), entries after ”D” denote the subdirectories, entries after ”F” denote the files. This command is CMU-specific.

MMEMory:DATA *<FileName> ,<Data>* Transfer Data

Parameters	Parameter description	Def. value	Def. unit	
"<FileName>", **<Data>**	Name of the destination file Data to be transferred to the CMU	– –	– –	
Parameters for query	Parameter description	Def. value	Def. unit	FW vers.
"<FileName>"	Name of the source file	–	–	V3.05

Description of command

This command loads `<data>` from the controller into the file `<FileName>` stored in the current directory of the current CMU mass storage device. `<data>` is in 488.2 block format. The data may be transferred via GPIB bus or via serial interface.

The query form is `MMEMory:DATA? <FileName>` with the response being the associated `<data>` in block format. In this form the command transfers data from the current CMU mass storage device to the controller.

Instead of the entire data transferred the remote protocol contains a string indicating the length of the block data in bytes, e.g. `<DEF BLOCK (Length = 19)>`.

MMEMory:SAVE[:ALL] *<FileName> [,<msus>]* Save all configurations

Parameters	Parameter description	Def. value	Def. unit	FW vers.
"<FileName>", **INTernal | EXTernal**	Name of the config. file to be created Storage device of the config. file	– INTernal	– –	V3.10

Command description

This command saves the configuration of all function groups and test modes to a single 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. This command is CMU-specific.

MMEMory:SAVE:CURRent *<FileName> [,<msus>]*

Save configurations in current function group and test mode

Parameters	Parameter description	Def. value	Def. unit	FW vers.
"<FileName>", **INTernal | EXTernal**	Name of the config. file to be created Storage device of the config. file	– INTernal	– –	V3.10

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[:ALL] *<FileName> [,<msus>]* Recall all configurations

Parameters	Parameter description	Def. value	Def. unit	FW vers.
"<FileName>", **INTernal | EXTernal**	Name of the config. file to be recalled Storage device of the config. file	– INTernal	– –	V3.10

Command description

This command recalls the configuration of all function groups and test modes stored in a configuration file. 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>", **INTernal | EXTernal**	Name of the config. file to be recalled Storage device of the config. file	– INTernal	– –	V3.10

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.

Synchronization

The *Synchronize* subsystem contains the commands for configuring the reference frequency. It corresponds to the *Reference Frequency* softkey in the *Sync.* tab of the *Connection Control* menu. Note that this tab is available in every function group

CONFigure:SYNChronize:FREQuency:REFerence _<Frequency>_ Reference Frequency

<Frequency>	Parameter description	Def. value	Default unit	FW vers.
10 kHz to 52 MHz	Reference frequency	10 MHz	Hz	V1.12

Command description

The command defines the frequency of the synchronization signal.

CONFigure:SYNChronize:FREQuency:REFerence:MODE _<Mode>_ Ref. Frequency Source

<Mode>	Parameter description	Def. value	Default unit	FW vers.
INTernal | **EXTernal**	Internal reference frequency used External reference frequency used	INT	–	V1.12

Command description

The command defines the source of the synchronization signal. After activating the external reference frequency (e.g. after a reset of the base system where the reference frequency is set to `INTernal`) it is necessary to allow for a setting time (~1 s) until the CMU has synchronized. The query `[SENSe:]SYNChronize:FREQuency:REFerence:LOCKed?` indicates whether the reference frequency is locked. A partial reset of all function groups with the exception of the base system does not reset the source of the reference frequency.

[SENSe:]SYNChronize:FREQuency:REFerence:LOCKed? Ref. Frequency Not Locked

Response	Parameter description	Def. value	Def. unit	FW vers.
ON | **OFF**	Synchronization to reference frequency achieved Synchronization to reference frequency failed	–	–	V3.10

Command description

This command is always a query. It indicates whether the CMU is synchronized to the (external) reference frequency.

Note: *After activating the external reference frequency (command `CONFigure:SYNChronize:FREQuency:REFerence:MODE EXTernal`) it is necessary to allow for a setting time (~1 s) until the CMU has synchronized. In this case it is recommended to check whether the reference frequency is locked before starting a measurement in remote control mode.*

[SENSe:]SYNChronize:FREQuency:REFerence:LOCKed?				Ref. Frequency Not Locked
Response	Parameter description	Def. value	Def. unit	FW vers.
ON | **OFF**	Synchronization to reference frequency achieved Synchronization to reference frequency failed	–	–	V3.10
Command description				
This command is always a query. It indicates whether the CMU is synchronized to the (external) reference frequency.				
Note:	*After activating the external reference frequency (command `CONFigure:SYNChronize:FREQuency:REFerence:MODE EXTernal`) it is necessary to allow for a setting time (~1 s) until the CMU has synchronized. In this case it is recommended to check whether the reference frequency is locked before starting a measurement in remote control mode.*			

RF Measurements

The commands listed in this chapter belong to the *RF* function group.

Subsystem Options

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"RF_NSig"	–	–	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.			

Configuration 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>", **INTernal | EXTernal**	Name of the config. file to be created Storage device of the config. file	– INTernal	– –	V3.10
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>", **INTernal | EXTernal**	Name of the config. file to be recalled Storage device of the config. file	– INTernal	– –	V3.10
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.				

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

Connection Control

The remote-control commands presented in this section provide settings that are valid for all measurements in the *RF* function group. They correspond to the settings in the *Connection Control* popup menu (see chapter 3 and 4).

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 and the *Analyzer Level – Reference* hotkey in the *Spectrum* menu.

[SENSe:]LEVel:MAXimum *<Level>*				Max. Level
<Level>	Parameter description	Def. value	Default unit	FW vers.
0 dBm to +53 dBm **–14 dBm to 39 dBm** **–37 dBm to 0 dBm**	Max. input level for RF 1 Max. input level for RF 2 Max. input level for RF 4 IN	0.0 0.0 0.0	dBm	V1.15
Command description				
This command defines the expected maximum input level for *Power* measurements and sets the input measurement path accordingly. The value range depends on the used RF input and the external attenuation.				

[SENSe:]LEVel:ATTenuation <*Mode*>				Attenuation
<Mode>	Parameter description	Def. value	Default unit	FW vers.
NORMal | **LNOise |** **LDIStortion**	Normal Low noise (level at mixer 10 dB higher than in normal setting) Low distortion factor (level at mixer 10 dB lower than in normal setting)	NORMal	–	V1.15
Command description				
This command defines the attenuation or gain of the input measurement path.				

[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	-	
Description of command				
This command defines the mode for setting the maximum input level.				

[SENSe:]LEVel:REFerence <*Level*>				Reference Level for Spectrum
<Level>	Parameter description	Def. value	Default unit	FW vers.
–100 dBm to +53 dBm **–100 dBm to +39 dBm** **–100 dBm to 0 dBm**	Reference level for RF 1 Reference level for RF 2 Reference level for RF 4 IN	+30 +30 0.0	dBm	V1.20
Command description				
This command defines the reference level for *Spectrum* measurements.				

[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 All or some 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* has no effect). 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* determines the trigger mode. It corresponds to the table section *Trigger* in the *Analyzer* tab of the *Connection Control* menu and the *Analyzer Level – Trigger...* hotkeys in the *Spectrum* or *Power* menu.

TRIGger[:SEQuence]:SOURce <*Source*>				Source
<Source>	Parameter description	Def. value	Default unit	FW vers.
IMMediate | **RFPower |** **IFPower |** **EXTern**	Free run, continuous measurement (without reference to input signal) The RF signal controls triggering depending on the trigger level (`TRIG:SEQ:THR`) The IF signal controls triggering depending on the trigger level (`TRIG:SEQ:THR`) External triggering (via connector AUX3)	IMM	–	V1.15
Command description				
This command determines the trigger source.				

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 slope Falling slope	POS	–	V1.15
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 (trigger source `IMMediate`).				

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 All or some 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* has no effect). If used as a query the command returns whether all parameters are set to their default values *(ON)* or not *(OFF)*.				

Subsystem RFANalyzer... (Analyzer Settings)

The subsystem *RFANalyzer...* sets the RF analyzer to a definite frequency and bandwidth. The settings correspond to the *Analyzer Settings* in the *Analyzer/Generator* menu.

[SENSe:]RFANalyzer:FREQuency *<Frequency>*				Frequency
<Frequency>	Parameter description	Def. value	Default unit	FW vers.
50 kHz to 2.7 GHz	Frequency (0.1 Hz resolution)	1000 MHz	Hz	V1.15
Command description				
This command defines the input frequency of the analyzer. The usable frequency range exceeds the specified range, see data sheet.				

[SENSe:]RFANalyzer:BANDwidth[:RESolution] *<Bandwidth>* [SENSe:]RFANalyzer:BWIDth[:RESolution] *<Bandwidth>*				Bandwidth
<Bandwidth>	Parameter description	Def. value	Default unit	FW vers.
10 Hz to 1 MHz | WIDE	Bandwidths of the analyzer (the values are rounded in the steps 1 | 2 | 3 | 5)	WIDE	–	V1.15
Command description				
This command defines the bandwidth of the analyzer. If WIDE is set no restriction is placed on the input frequency.				

Measurement Control – Subsystem RFANalyzer

The subsystem *RFANalyzer* controls the RF analyzer. The subsystem corresponds to the *Analyzer Power* softkey in the *Analyzer/Generator* menu.

INITiate:RFANalyzer	Start new measurement	⇒ *RUN*
ABORt:RFANalyzer	Abort running measurement and switch off	⇒ *OFF*
STOP:RFANalyzer	Stop measurement after current evaluation period	⇒ *STOP*
CONTinue:RFANalyzer	Next measurement step (only *stepping mode*)	⇒ *RUN*
Command description		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:RFANalyzer:EREPorting <*Mode*>		Event Reporting		
<Mode>	Parameter description	Def. value	Def. unit	FW vers.
SRQ | **SOPC |** **SRSQ |** **OFF**	Service request Single operation complete SRQ and SRSQ No reporting	OFF	–	V1.15
Command description				
This command defines the events generated when the measurement is terminated or stopped *(event reporting,* see chapter 5).				

FETCh:RFANalyzer:STATus?		Measurement status		
Returned value	Parameter description	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 evaluation period Counter not used	NONE	–	
Command description				
This command is always a query. It returns the status of the measurement (see chapters 3 and 5).				

Subsystem RFANalyzer:CONTrol

The subsystem *RFANalyzer:CONTrol* defines the repetition mode of the RF analyzer. This subsystem has no equivalent in manual control.

CONFigure:RFANalyzer:CONTrol:REPetition <*Repetition*> ,<*StopCondition*>,<*Stepmode*> — Test cycles

<Repetition>	Parameter description	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>	Parameter description	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	–	V1.15

Command description

This command determines the number of statistics cycles and the stepping mode for the measurement. A stop condition is not available.

Note: *In the case of READ commands (`READ:` to) the <Repetition> parameter has no effect; the measurement is always stopped after a single shot.*

CONFigure:RFANalyzer:POWer:RTIMe <Time> — Duration of power measurement

<Time>	Parameter description	Def. value	Def. unit	FW vers.
0 to 1	Duration of measurement. Accuracy: ± 5E-10 s	20E-3	s	V1.15

Command description

This command defines the time period during which the peak power is determined. With the time 0, the power is immediately measured on the measurement start, i.e. the instantaneous value is measured.

Results – Subsystem RFANalyzer:POWer?

The subsystem *RFANalyzer:POWer* starts the analyzer power measurement and returns the results. The subsystem corresponds to the *Analyzer Power* panel in the *Analyzer/Generator* menu.

Scalar measurement results:

READ[:SCALar]:RFANalyzer:POWer? — Start single shot measurement and return results
FETCh[:SCALar]:RFANalyzer:POWer? — Read out measurement results (unsynchronized)
SAMPle[:SCALar]:RFANalyzer:POWer? — Read out measurement results (synchronized)

Returned value	Description	Def. value	Default unit	FW vers.
–120.0 dBm to 47.0 dBm	RMS power of the RF input signal	NAN	dBm	V1.15

Command description

These commands are always queries. They start a measurement and return the scalar measurement result.

Subsystem RFGenerator

The subsystem *RFGenerator* configures and controls the RF generator. It corresponds to the *Generator* tab in the popup menu *Connect. Control*. The generator generates two independent RF signals Tx and Aux Tx, referenced by the third-level keywords [:TX] and :AUXTx respectively.

DEFault:RFGenerator				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	–	V3.40
Description of command				
If used as a setting command with the parameter *ON* this command sets all parameters of the `RFGenerator` 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)*.				

DEFault:RFGenerator:TX				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	–	V3.40
Description of command				
If used as a setting command with the parameter *ON* this command sets all parameters of the `RFGenerator` subsystem excluding the `RFGenerator:AUXTx` settings 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)*.				

Subsystem RFGenerator (Generator Control)

The subsystem *RFGenerator* controls the RF generator. It corresponds to the *Generator Control* function in the *Generator* tab of the *Connection Control* menu.

INITiate:RFGenerator **ABORt:RFGenerator**	Start RF generator, reserve resources Switch off RF generator, release resources	⇒ *RUN* ⇒ *OFF*
Command description		FW vers.
These commands have no query form. They start or stop the RF generator, setting it to the status indicated in the top right column. The type of RF signal generated is selected via `CONFigure:RFGenerator:APPlication`.		V1.15

CONFigure:RFGenerator:APPLication *<Signal>*				Application
<Signal>	Parameter description	Def. value	Def. unit	FW vers.
TX | **AUXTx |** **TXAT**	Generate Tx signal only Generate Aux Tx signal only Generator both RF signals (Tx and Aux Tx)	OFF	–	V3.40
Command description				
This command qualifies which RF signal is generated when the RF generator is switched on (`INITiate:RFGenerator`).				

FETCh:RFGenerator: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	–	V1.15
Command description				
This command is always a query. It returns the current generator status.				

Subsystem RFGenerator... (Generator Settings)

The subsystem *RFGenerator...* determines the level and frequency of the RF generator. It corresponds to the input field *RF Level* and the *Frequency* softkey in the *Generator* panel (in *Connection Control*, *Generator* tab and in the *Analyzer/Generator* menu).

SOURce:RFGenerator[:TX]:LEVel <*Level*>				RF Level
<Level>	Parameter description	Def. value	Def. unit	FW vers.
–137.0 to –27.0 dBm **–137.0 to –10.0 dBm** **–90.0 to +13.0 dBm**	RF1 level in the used timeslot RF2 level in the used timeslot RF 3 OUT level in the used timeslot	–27.0 –27.0 –27.0	dBm dBm dBm	V1.15
Command description				
This command defines the RF generator level. The permissible value 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, and the default value for RF1 OUT is –29.0 dBm. The level ranges are also modified if the Tx and Aux Tx signals are both active and superimposed at the same connector.				

SOURce:RFGenerator[:TX]:FREQuency <*Frequency*>				Frequency
<Frequency>	Parameter description	Def. value	Def. unit	FW vers.
100 kHz to 2.7 GHz	Output frequency (resolution 0.1 Hz)	1200 MHz	Hz	V1.15
Command description				
This command defines the output frequency of the RF generator. The usable frequency range exceeds the specified range, see data sheet.				

Subsystem RFGenerator:MODulation (Frequency Modulation)

The subsystem *RFGenerator:MODulation* determines the frequency modulation of the internal RF generator. It corresponds to the *Modulation* settings in the *Generator* tab of the *Connection Control* menu.

SOURce:RFGenerator:MODulation *<State>* — Modulation

<State>	Parameter description	Def. value	Def. unit	FW vers.
OFF | **SSB |** **AM**	No modulation, continuous wave RF output signal shifted by a constant offset frequency RF output signal amplitude-modulated	OFF	–	V1.15, V2.15 (AM)

Command description

This command determines the modulation of the RF output signal. In the *SSB* mode, the frequency of the RF output signal is shifted by the frequency defined via `CONF:RFG:MOD:SSB:FREQ`. In the *AM* mode, the signal is modulated with the frequency defined via `CONF:RFG:MOD:SSB:FREQ` and with the modulation index defined via `CONF:RFG:MOD[:AM]:IND`; see below.

SOURce:RFGenerator:MODulation:SSB:FREQuency *<Deviation>* — AF Frequency

<Deviation>	Parameter description	Def. value	Def. unit	FW vers.
–300 kHz to +300 kHz **|** **0 kHz to +300 kHz**	SSB frequency offset (resolution 1 kHz) AM modulation frequency	1000 1000	Hz Hz	V1.15, V2.15 (AM)

Command description

This command generates an AF frequency which defines either a frequency offset (if `SOUR:RFG:MOD` is set to `SSB`) or an AM modulation frequency (if `SOUR:RFG:MOD` is set to `AM`). A frequency offset can be either positive or negative; modulation frequencies must be positive.

SOURce:RFGenerator:MODulation[:AM]:INDex *<Mod_Index>* — Modulation Index

<Mod_Index>	Parameter description	Def. value	Def. unit	FW vers.
0 % to 100 %	Modulation index	100	%	V1.15, V2.15 (AM)

Command description

This command defines the modulation index for AM modulation, i.e. the amplitude ration between the modulating AM signal to the RF carrier signal in percent.

Subsystem RFGenerator:FHOPping (Frequency Hopping)

The subsystem *RFGenerator:FHOPping* determines the frequency hopping of the internal RF generator. It corresponds to the *Frequency Hopping* settings in the *Generator* tab of the *Connection Control* menu.

SOURce:RFGenerator:FHOPping:STATe <State>				Frequency Hopping
<State>	Parameter description	Def. value	Def. unit	FW vers.
OFF | **ON**	No frequency hopping Frequency hopping active (between the frequencies set via `SOUR:RFG:FREQ` and `SOUR:RFG:FHOP:FREQ`)	OFF	–	V1.15
Command description				
This command switches the hopping output frequency of the RF generator on or off.				

SOURce:RFGenerator:FHOPping:FREQuency *<Frequency>*				Hopping Frequency
<Frequency>	Parameter description	Def. value	Def. unit	FW vers.
absolute: **100.0 kHz to 2.7 GHz**	Hopping frequency (in multiples of 0.1 Hz)	0 MHz (Hopping off)	Hz	V1.15
relative: **depending on normal frequency**	within the rated generator frequency range			
Command description				
This command defines the hopping output frequency of the RF generator. This alternative frequency and the frequency set via `SOUR:RFG:FREQ` are used for hopping. The command `SOUR:RFG:FHOP:FREQ:MODE` qualifies whether the value is meant to be relative to `SOUR:RFG:FREQ` or absolute.				

SOURce:RFGenerator:FHOPping:FREQuency:MODE <Mode>				Hopping Mode
<Mode>	Parameter description	Def. value	Def. unit	FW vers.
ABSolute | **RELative**	Hopping frequency Absolute with respect to the RF generator frequency Relative to the RF generator frequency	RELative	–	V1.15
Command description				
This command qualifies whether the frequency set using `SOUR:RFG:FHOP:FREQ` is meant to be relative to `SOUR:RFG:FREQ` or absolute.				

Subsystem RFGenerator:PULSe (Ramping)

The subsystem *RFGenerator:PULSe* determines the ramping mode of the internal RF generator. It corresponds to the *Ramping* setting in the *Generator* tab of the *Connection Control* menu.

SOURce:RFGenerator:PULSe:STATe <State>				Ramping
<State>	Parameter description	Def. value	Def. unit	FW vers.
OFF | **ON**	CW signal Pulsed signal with 577 μs burst length	OFF	–	V1.15
Command description				
This command determines whether the RF generator generates a CW signal or a GSM-like burst signal.				

Subsystem RFGenerator:BANDwidth (Bandwidth)

The subsystem *RFGenerator:BANDwidth* sets the bandwidth of the modulation filter. It corresponds to the *Modulation Filter* setting in the *Generator* tab of the *Connection Control* menu.

SOURce:RFGenerator:BANDwidth *<Bandwidth>* **SOURce:RFGenerator:BWIDth *<Bandwidth>***				Bandwidth
<Bandwidth>	Parameter description	Def. value	Default unit	FW vers.
OFF | **F30Khz |** **F300khz**	Off (broadband) 30 kHz bandwidth 300 kHz bandwidth	F300	–	V1.15
Command description				
This command defines the bandwidth of the modulation filter.				

Subsystem RFGenerator:AUXTx... (Aux TX Signal)

The subsystem *RFGenerator:AUXTx* configures the auxiliary generator signal Aux Tx (only with option CMU-B95, *Additional RF Generator)*. It corresponds to the *Generator Aux Tx* section in the *Generator* tab of the *Connection Control* menu.

Aux Tx is an additional TX signal generated by the CMU that can be applied to the 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 (commands `OUTPut[:TX][:STATe]` and `OUTPut:AUXTx[:STATe]`). Moreover, it is possible to assign independent external attenuation factors to both signals (`[SENSe:] CORRection:LOSS:OUTPut<nr>[:TX][:MAGNitude]`, `SOURce:CORRection:LOSS:OUTPut<nr>[:TX][:MAGNitude]`, `[SENSe:]CORRection:LOSS:OUTPut<nr>[:TX][:MAGNitude]`, `SOURce:CORRection:LOSS:OUTPut<nr>[:TX][:MAGNitude]`).

Aux Tx is generated with the modulation settings of the primary TX signal (`...RFGenerator:MODulation...`) but with no frequency hopping or ramping.

DEFault:RFGenerator:AUXTx				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	–	V3.40

Description of command

If used as a setting command with the parameter *ON* this command sets all parameters of the `RFGenerator:AUXTx` 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)*.

SOURce:RFGenerator:AUXTx:LEVel *<Level>*				RF Level
<Level>	Parameter description	Def. value	Def. unit	FW vers.
–122 dBm to –72 dBm **–110 dBm to –60 dBm**	Aux Tx output level at RF1 Aux Tx output level at RF2	–72.0 –72.0	dBm dBm	V3.40

Command description

This command defines the Aux Tx signal level. The resolution is 1 dBm; all values entered are rounded to integer dBm steps. The value 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.

SOURce:RFGenerator:AUXTx:FREQuency *<Frequency>*				Frequency
<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	350 MHz	Hz	V3.40

Command description

This command defines the frequency of the generated Aux Tx signal. The resolution is 200 kHz; all values entered are rounded to 100 kHz steps. If a value between the three distinct frequency bands is entered, the instrument generates an error message.

Subsystem INPut, OUTPut, CORRection:LOSS (/Ext. Att.)

The subsystem for input and output contains the commands for configuration of the input and output connectors. The subsystem corresponds to the tab *RF* in the popup menu *Connect. Control*.

INPut[:STATe] <*State*> — RF Input

<State>	Parameter description	Def. value	Default unit	FW vers.
RF1	Connector RF1 used as input	RF2	–	V1.15
RF2	Connector RF2 used as input			
RF4	Connector RF4 IN used as input			

Command description

This command determines the connector to be used for incoming RF 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 a time, which is why the currently active one is automatically deactivated on switchover.

OUTPut[:TX][:STATe] <*State*> — RF Output

<State>	Parameter description	Def. value	Default unit	FW vers.
RF1	Connector RF1 used as output	RF2	–	V1.15
RF2	Connector RF2 used as output			
RF3	Connector RF3 OUT used as output			

Command description

This command determines the connector to be used for outgoing RF signals.

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 at a time, which is why the currently active one is automatically deactivated.

[SENSe:]CORRection:LOSS:INPut<nr>[:MAGNitude] <*Absorption*>
SOURce:CORRection:LOSS:INPut<nr>[:MAGNitude] <*Absorption*> — Ext. Att. Input

<Absorption>	Parameter description	Def. value	Default unit	FW vers.
–50 dB to +50 dB	Value for external attenuation at Input <nr>, where <nr> = 1,2	0.0	dB	V1.15
–90 dB to +90 dB	Value for external attenuation at Input <nr>, where <nr> = 4	0.0	dB	

Command description

This commands assigns an external attenuation value to the inputs of the instrument.

[SENSe:]CORRection:LOSS:OUTPut<nr>[:TX][:MAGNitude] <*Absorption*>
SOURce:CORRection:LOSS:OUTPut<nr>[:TX][:MAGNitude] <*Absorption*> Ext. Att. Output

<Absorption>	Parameter description	Def. value	Default unit	FW vers.
–50 dB to +50 dB	Value for external attenuation at output <nr>, where <nr> = 1,2	0.0	dB	V1.15
–90 dB to +90 dB	Value for external attenuation at output <nr>, where <nr> = 3	0.0	dB	

Command description

This command assigns an external attenuation value to the outputs of the instrument. An external attenuation of x dB increases the Tx signal level (`SOURce:RFGenerator[:TX]:LEVel`) by x dB.

OUTPut:AUXTx[:STATe] <*State*> RF Output

<State>	Parameter description	Def. value	Default unit	FW vers.
RF1 **RF2**	Connector RF1 used as output Connector RF2 used as output	RF2	–	V3.40

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

<Absorption>	Parameter description	Def. value	Default unit	FW vers.
–50 dB to +50 dB	Value for external attenuation at output <nr>, where <nr> = 1,2	0.0	dB	V3.40

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.

Subsystem DM:CLOCk (Synchronization)

The subsystem *DM:CLOCk* sets a network-specific system clock. The subsystem corresponds to the tab *Sync.* in the popup menu *Connect. Control*.

SOURce:DM:CLOCk:STATe <*Mode*> REF OUT 2

<Mode>	Parameter description	Def. value	Def. unit	FW vers.
ON | OFF	Switch system clock on/off	OFF	–	V1.15

Command description

This command switches the system clock at the output *REF OUT 2* on or off.

SOURce:DM:CLOCk:FREQuency <Frequency>				Clock Frequency
<Frequency>	Parameter description	Def. value	Def. unit	FW vers.
1.219 MHz to 40.000 MHz	Frequency of network-specific system clock	13	MHz	V1.15

Command description

This command defines the frequency at the output *REF OUT2*. In FW V2.15 ff. the frequency entered is rounded to the following discrete values:

40.000 MHz,	20.000 MHz,	13.333 MHz,	10.000 MHz,	8.000 MHz,	6.667 MHz,	5.714 MHz,
5.000 MHz,	4.444 MHz,	4.000 MHz,	3.636 MHz,	3.333 MHz,	3.077 MHz,	2.857 MHz,
2.667 MHz,	2.500 MHz,	2.353 MHz,	2.222 MHz,	2.105 MHz,	2.000 MHz,	1.905 MHz,
1.818 MHz,	1.739 MHz,	1.667 MHz,	1.600 MHz,	1.538 MHz,	1.481 MHz,	1.429 MHz,
1.379 MHz,	1.333 MHz,	1.290 MHz,	1.250 MHz			

The formula of the sequence reads as follows:

$$f_n = f_1 \frac{1}{n} \text{ with } n = 1, 2, 3, ... 32 \text{ and } f_1 = 40 \text{ MHz for RF}$$

If the entered value f is between two allowed values f_n and f_{n+1}, it is rounded to:

$$f \rightarrow f_n \text{ if } f \geq f_1 \frac{1}{n+0.5} \text{ and } f \rightarrow f_{n+1} \text{ if } f < f_1 \frac{1}{n+0.5}.$$

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 the menu description and the application examples in Chapter 4.

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)*.

Power Measurements (POWer)

The subsystem *POWer* measures the RF signal power versus time. The subsystem corresponds to the measurement menu *Power* and the associated popup menu *Power Configuration.*

Measurement Control – Subsystem POWer

The subsystem *POWer* controls the power measurement. The subsystem corresponds to the *Power* main softkey.

INITiate:POWer	Start new measurement	⇒ *RUN*
ABORt:POWer	Abort running measurement and switch off	⇒ *OFF*
STOP:POWer	Stop measurement after current evaluation period	⇒ *STOP*
CONTinue:POWer	Next measurement step (only *stepping mode*)	⇒ *RUN*
Command description		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:EREPorting <*Mode*>		Event reporting of the measurement		
<Mode>	Parameter description	Def. value	Def. unit	FW vers.
SRQ | **SOPC |** **SRSQ |** **OFF**	Service request Single operation complete SRQ and SOPC No reporting	OFF	–	V1.15
Command description				
This command defines the events generated when the measurement is terminated or stopped *(event reporting,* see chapter 5).				

FETCh:POWer:STATus?		Measurement status		
Returned value	Parameter description	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
0 to 10000 | **NONE**	Counter for measurement cycles Counter not used	NONE	–	
1 to 1000 | **NONE**	Counter for current evaluation period within a cycle Statistic count set to off	NONE	–	
Command description				
This command is always a query. It returns the status of the measurement (see chapters 3 and 5).				

Test Configuration

The commands in the following subsystems configure the *Power* measurement. They correspond to the *Power Configuration* popup menu.

Subsystem POWer:CONTrol (Control)

The subsystem *POWer:CONTrol* defines the scope of the *Power* measurement. The subsystem corresponds to the *Control* tab of the *Power Configuration* menu.

CONFigure:POWer:CONTrol <*Mode*>				Scope of measurement
<Mode>	Desciption of parameters	Def. value	Def. unit	
SCALar | **ARRay**	Scalar values only (incl. limit matching) Scalar measured values and arrays	ARRay	–	
<Statistics>	Description of parameters	Def. value	Def. unit	FW vers.
1 to 1000 | **NONE**	Number of sweeps per statistics cycle Statistics off (equivalent to 1)	1	–	≥1.15
Description of command				
This command specifies the type of measured values.				

CONFigure:POWer:CONTrol:REPetition <*Repetition*> ,<*StopCondition*>,<*Stepmode*>				Measurement cycles
<Repetition>	Parameter description	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>	Parameter description	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	–	V1.15
Command description				
This command defines the repetition mode and the stepping mode for the measurement. A stop condition is not available. **Note:** *In the case of READ commands (`READ:` to) the <Repetition> parameter has no effect; the measurement is always stopped after a single shot.*				

Subsystem POWer:FREQuency (Frequency/RBW)

The subsystem *POWer:FREQuency* sets the frequency and resolution bandwidth of the *Power* measurement. The subsystem corresponds to the *Analyzer Settings* softkey in the graphical measurement menu *Power.*

[SENSe:]POWer:FREQuency:CENTer <*Frequency*>				Frequency
<Frequency>	Parameter description	Def. value	Default unit	FW vers.
10 kHz to 2.7 GHz	Frequency (0.1 Hz resolution)	1000 MHz	Hz	V1.15
Command description				
This command defines the input frequency of the analyzer.				

[SENSe:]POWer:FREQuency:BANDwidth[:RESolution] <*Bandwidth*> **[SENSe:]POWer:FREQuency:BWIDth[:RESolution] <*Bandwidth*>**				RBW
<Bandwidth>	Parameter description	Def. value	Default unit	FW vers.
10 Hz to 1 MHz	Bandwidths of power measurement (the values are rounded in the steps 1 | 2 | 3 | 5)	300 kHz	–	V1.15
Command description				
This command defines the bandwidth of the power measurement.				

Subsystem POWer:LEVel (Level)

The subsystem *POWer:LEVel* sets the level range displayed. The subsystem corresponds to the *Level Scale* hotkey in the graphical measurement menu *Power.*

[SENSe:]POWer:LEVel:RANGe <*Range*>				Range
<Range>	Parameter description	Def. value	Default unit	FW vers.
10.0 dB to 100.0 dB	Level range of the power measurement	100.0 dB	–	V1.15
Command description				
This command defines the level range of the *Power* measurement.				

Subsystem POWer:TIME

The subsystem *POWer:TIME* configures the time axis. The subsystem corresponds to the *Time Scale* hotkey in the graphical measurement menu *Power.*

[SENSe:]POWer:TIME:DELay *<Delay>*				Delay
<Delay>	Parameter description	Def. value	Default unit	FW vers.
See below	Delay time between trigger time and start of the measurement	–10.0 µs	s	V1.15
Command description				
This command defines the time when the measurement is started relative to the trigger time. The permissible range of delays depends on the span and bandwidth, e.g.: - 152.9 µs to 142.9 µs (bandwidth 1 MHz, span 10 µs) - 15.7919207 s to 5.7919207 s (bandwidth 10 Hz, span 10 s)				

[SENSe:]POWer:TIME:SPAN *<Span>*				Span
<Span>	Parameter description	Def. value	Default unit	FW vers.
10 µs to 10 s	Span of the power measurement	100 µs	s	V1.15
Command description				
This command defines the span (i.e. the total evaluation time) of the *Power* measurement. The permissible spans depend on the selected bandwidth.				

CONFigure:POWer:CONTrol:TIMeout *<Timeout>*				Timeout for triggered measurements
<Timeout>	Parameter description	Def. value	Default unit	FW vers.
1 s to 60 s	Timeout period after which the measure-ment is aborted	10 s	s	V1.15
Command description				
This command defines a timeout period after which the measurement is aborted (e.g. if no trigger event could be detected).				

Subsystem SUBarrays:POWer

The subsystem *SUBarrays:POWer* defines the measurement range and the type of output values.

CONFigure:SUBarrays:POWer Definition of Subarrays
<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 subrange Return minimum value in every subrange Return maximum value in every subrange Return single interpolated value at <Start>	ALL	–	
<Start>	Description of parameters	Def. value	Def. unit	
–15 s to 15 s,	Start time in current range	Min	s	
<Samples>	Description of parameters	Def. value	Def. unit	FW vers.
1 to 500	Number of samples in current subrange	Max	–	3.0

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 to be measured.

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 defined via `[SENSe:]POWer:TIME:DELay` and `[SENSe:]POWer:TIME:SPAN`. 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.

Results – Subsystem POWer...?

The subsystem *POWer...?* starts the power measurement and returns the results. The subsystem corresponds to the graphical measurement menu *Power.*

READ:ARRay:POWer[:CURRent]?
READ:ARRay:POWer:AVERage?
READ:ARRay:POWer:MAXimum?
READ:ARRay:POWer:MINimum?

Power Results

Start single shot meas. and return results ⇒ *RUN*

FETCh:ARRay:POWer[:CURRent]?
FETCh:ARRay:POWer:AVERage?
FETCh:ARRay:POWer:MAXimum?
FETCh:ARRay:POWer:MINimum?

Read meas. results (unsynchronized) ⇒ *RUN*

SAMPle:ARRay:POWer[:CURRent]?
SAMPle:ARRay:POWer:AVERage?
SAMPle:ARRay:POWer:MAXimum?
SAMPle:ARRay:POWer:MINimum?

Read results (synchronized) ⇒ *RUN*

Returned value	Parameter description	Def. value	Default unit	FW vers.
–128.0 dBm to + 48.0 dBm,	1st value for power	NAN	dBm	V 1.15
...,				
–128.0 dBm to + 48.0 dBm	500th value for power	NAN	dBm	

Command description

These commands are always queries. They return the power values versus time at 1000 equidistant test points. The measurement range is defined via `[SENSe:]POWer:TIME:DELay` and `[SENSe:]POWer:TIME:SPAN`.

Note: The number of test points may be reduced at very narrow measurement ranges.

READ:SUBarrays:POWer[:CURRent]? **READ:SUBarrays:POWer:AVERage?** **READ:SUBarrays:POWer:MAXimum?** **READ:SUBarrays:POWer:MINimum?**	Start single shot meas. and return results	Subarray Results ⇒ *RUN*
FETCh:SUBarrays:POWer[:CURRent]? **FETCh:SUBarrays:POWer:AVERage?** **FETCh:SUBarrays:POWer:MAXimum?** **FETCh:SUBarrays:POWer:MINimum?**	Read meas. results (unsynchronized)	⇒ *RUN*
SAMPle:SUBarrays:POWer[:CURRent]? **SAMPle:SUBarrays:POWer:AVERage?** **SAMPle:SUBarrays:POWer:MAXimum?** **SAMPle:SUBarrays:POWer:MINimum?**	Read results (synchronized)	⇒ *RUN*

Ret. values by subrange	Description of parameters	Def. value	Def. unit	FW vers.
–128.0 dBm to + 48.0 dBm	Power[1], 1st value for power	NAN	dBm	V3.0
...	...	...	...	
–128.0 dBm to + 48.0 dBm	Power[x], xth value for power	NAN	dBm	

Description of command

These commands are always queries. They return the power versus time 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`) or `IVAL` is set, only one value is returned by subrange.

Spectrum Measurements (SPECtrum)

The subsystem *SPECtrum* measures the RF frequency spectrum. The subsystem corresponds to the measurement menu *Spectrum* and the associated popup menu *Spectrum Configuration.*

Measurement Control – Subsystem SPECtrum

The subsystem *SPECtrum* controls the spectrum measurement. It corresponds to the *Spectrum.* softkey in the measurement menu *Spectrum*.

INITiate:SPECtrum	Start new measurement	⇒ *RUN*
ABORt:SPECtrum	Abort running measurement and switch off	⇒ *OFF*
STOP:SPECtrum	Stop measurement after current evaluation period	⇒ *STOP*
CONTinue:SPECtrum	Next measurement step (only *stepping mode*)	⇒ *RUN*
Command description		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:SPECtrum:EREPorting <*Mode*>				Event Reporting
<Mode>	Parameter description	Def. value	Def. unit	FW vers.
SRQ | **SOPC |** **SRSQ |** **OFF**	Service request Single operation complete SRQ and SOPC No reporting	OFF	–	V1.15
Command description				
This command defines the events generated when the measurement is terminated or stopped *(event reporting,* see chapter 5).				

FETCh:SPECtrum:STATus?				Measurement status
Returned value	Parameter description	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
0 to 10000 | **NONE**	Counter for measurement cycles Counter not used	NONE	–	
1 to 1000 | **NONE**	Counter for current evaluation period within a cycle Statistic count set to off	NONE	–	
Command description				
This command is always a query. It returns the status of the measurement (see chapters 3 and 5).				

[SENSe:]SPECtrum:DETector <*Mode*>				Detect Mode
<Mode>	Desciption of parameters	Def. value	Def. unit	FW vers.
PEAK | **RMS**	Meas. curve interpolated from maximum values Meas. curve interpolated from RMS averaged values	PEAK	–	V3.05
Description of command				
This command defines how the measurement curve is calculated from the entire set of measurement points.				

Test Configuration

The commands in the following subsystems configure the *Spectrum* measurement. They correspond to the *Spectrum Configuration* popup menu.

Subsystem SPECtrum:CONTrol

The subsystem *SPECtrum:CONTrol* defines the scope of the spectrum measurement. It corresponds to the tab *Control* in the popup menu *Spectrum Configuration*.

CONFigure:SPECtrum:CONTrol <*Mode*>, <*Statistics*>				Scope of measurement
<Mode>	Desciption of parameters	Def. value	Def. unit	
SCALar | **ARRay**	Scalar values only (incl. limit matching) Scalar measured values and arrays	ARRay	–	
<Statistics>	Description of parameters	Def. value	Def. unit	FW vers.
1 to 1000 | **NONE**	Number of sweeps per statistics cycle Statistics off (equivalent to 1)	1	–	≥1.15
Description of command				
This command specifies the type of measured values and defines the number of sweeps forming a statistics cycle.				

CONFigure:SPECtrum:CONTrol:REPetition *<Repetition>* ,*<StopCondition>*,*<Stepmode>*

Measurement cycles

<Repetition>	Parameter description	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>	Parameter description	Def. value	Def. unit	
NONE	Continue measurement 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

Command description

This command defines the repetition mode and the stepping mode for the measurement. A stop condition is not available.

Note: In the case of READ commands (`READ:` to) the <Repetition> parameter has no effect; the measurement is always stopped after a single shot.

Subsystem SPECtrum:FREQuency (Frequency/RBW)

The subsystem *SPECtrum:FREQuency* defines the display range of the frequency axis and the resolution bandwidth. The subsystem corresponds to the *Analyzer Settings* softkey in the graphical measurement menu *Spectrum.*

[SENSe:]SPECtrum:FREQuency:CENTer *<Frequency>*
[SENSe:]SPECtrum:FREQuency:SPAN *<Frequency>*
[SENSe:]SPECtrum:FREQuency:STARt *<Frequency>*
[SENSe:]SPECtrum:FREQuency:STOP *<Frequency>*

Center / Span / Start

<Frequency>	Parameter description	Def. value	Default unit	FW vers.
10.0 MHz to 2.7 GHz **0.00001 MHz to 2.690 GHz** **10 MHz to 2.7 GHz** **10.00001 MHz to 2.7 GHz**	Center frequency Frequency span Start frequency Stop frequency	1105 2190 10 2200	MHz MHz MHz MHz	V1.15

Command description

This command sets the center frequency and span or the start and stop frequency of the spectrum analyzer. Start and stop frequency are used for calculation of the other two frequencies.

[SENSe:]SPECtrum:FREQuency:BANDwidth[:RESolution] *<Bandwidth>*
[SENSe:]SPECtrum:FREQuency:BWIDth[:RESolution] *<Bandwidth>*

RBW

<Bandwidth>	Parameter description	Def. value	Default unit	FW vers.
10 Hz to 1 MHz | **AUTO**	Bandwidths of measurement (the values are rounded in the steps 1 | 2 | 3 | 5)	AUTO	–	V1.15

Command description

This command defines the bandwidth of the spectrum measurement. The range of the bandwidth is shifted and increased along with the span of the measurement.

Subsystem SPECtrum:LEVel (Level)

The subsystem *POWer:LEVel* sets the level range of the *Spectrum* measurement. The subsystem corresponds to the *Level Scale* hotkey in the graphical measurement menu *Spectrum.*

[SENSe:]SPECtrum:LEVel:RANGe *<Range>*				Range
<Range>	Parameter description	Def. value	Default unit	FW vers.
10.0 dB to 100.0 dB	Level range for the spectrum measurement.	100.0 dB	–	V1.15
Command description				
This command defines the level range for the spectrum measurement.				

Subsystem SUBarrays:SPECtrum

The subsystem *SUBarrays:SPECtrum* defines the measurement range and the type of output values.

CONFigure:SUBarrays:SPECtrum <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 subrange Return minimum value in every subrange Return maximum value in every subrange Return single interpolated value at <Start>	ALL	–	
<Start>	Description of parameters	Def. value	Def. unit	
10 MHz to 2.69999999 GHz,	Start frequency in current range	Min	Hz	
<Samples>	Description of parameters	Def. value	Def. unit	FW vers.
1 to 560	Number of samples in current subrange	Max	–	3.0
Description of command				

This command configures the `READ:SUBarrays:SPECtrum...`, `FETCh:SUBarrays:SPECtrum...`, and `SAMPle:SUBarrays:SPECtrum` 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 frequency and the number of test points to be measured.

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 `SPECtrum` measurement defined by the commands `[SENSe:]SPECtrum:FREQuency:CENTer` and `[SENSe:]SPECtrum: FREQuency:SPAN` or by `[SENSe:]SPECtrum:FREQuency:STARt` and `[SENSe:]SPECtrum: FREQuency:STOP`. 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.

Results – Subsystem SPECtrum

The subsystem *SPECtrum* starts the *Spectrum* measurement and returns the results. The subsystem corresponds to the various output elements in the graphical measurement menu *Spectrum.*

READ:ARRay:SPECtrum[:CURRent]? **READ:ARRay:SPECtrum:AVERage?** **READ:ARRay:SPECtrum:MAXimum?** **READ:ARRay:SPECtrum:MINimum?**	Spectrum Results Start single shot meas. and return results ⇒ *RUN*			
FETCh:ARRay:SPECtrum[:CURRent]? **FETCh:ARRay:SPECtrum:AVERage?** **FETCh:ARRay:SPECtrum:MAXimum?** **FETCh:ARRay:SPECtrum:MINimum?**	Read meas. results (unsynchronized) ⇒ *RUN*			
SAMPle:ARRay:SPECtrum[:CURRent]? **SAMPle:ARRay:SPECtrum:AVERage?** **SAMPle:ARRay:SPECtrum:MAXimum?** **SAMPle:ARRay:SPECtrum:MINimum?**	Read results (synchronized) ⇒ *RUN*			
Returned value	Parameter description	Def. value	Default unit	FW vers.
–128.0 dBm to + 48.0 dBm **...** **–128.0 dBm to + 48.0 dBm**	1^{st} power value 560^{th} power value	NAN NAN	dBm dBm	V1.15
Command description				
These commands are always queries. They return the results of the spectrum measurement at 560 equidistant test points. The measurement range is defined by the commands `[SENSe:]SPECtrum:FREQuency:CENTer` and `[SENSe:]SPECtrum:FREQuency: SPAN` or by `[SENSe:]SPECtrum:FREQuency:STARt` and `[SENSe:]SPECtrum: FREQuency:STOP`. **Note:** The number of test points may be reduced at very narrow measurement ranges.				

READ:SUBarrays:SPECtrum[:CURRent]? Subarray Results
READ:SUBarrays:SPECtrum:AVERage?
READ:SUBarrays:SPECtrum:MAXimum?
READ:SUBarrays:SPECtrum:MINimum? Start single shot meas. and return results ⇒ *RUN*

FETCh:SUBarrays:SPECtrum[:CURRent]?
FETCh:SUBarrays:SPECtrum:AVERage?
FETCh:SUBarrays:SPECtrum:MAXimum?
FETCh:SUBarrays:SPECtrum:MINimum? Read meas. results (unsynchronized) ⇒ *RUN*

SAMPle:SUBarrays:SPECtrum[:CURRent]?
SAMPle:SUBarrays:SPECtrum:AVERage?
SAMPle:SUBarrays:SPECtrum:MAXimum?
SAMPle:SUBarrays:SPECtrum:MINimum? Read results (synchronized) ⇒ *RUN*

Ret. values by subrange	Description of parameters	Def. value	Def. unit	FW vers.
–128.0 dBm to + 48.0 dBm	Power[1], 1st value for power	NAN	dBm	3.0
...	...	...	...	
–128.0 dBm to + 48.0 dBm	Power[x], xth value for power	NAN	dBm	

Description of command

These commands are always queries. They return the power versus frequency in the subranges defined by means of the `CONFigure:SUBarrays:SPECtrum` 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` command defines a maximum of 32 subranges. If one of the statistical modes (`ARIThmetical`, `MINimum`, `MAXimum`) or `IVAL` is set, only one value is returned by subrange.

The calculation of `CURRent`, `AVERage`, `MINimum`, and `MAXimum` results is explained in Chapter 3 (see *Display Mode)*.

WPOWer

The subsystem *WPOWer* measures the power of the signal transmitted by the mobile phone over a wide frequency range. It corresponds to the softkey *Pow. Meter Wideband* in the *RF* connector tab of 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.		V3.10

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	–	V3.10
Description of command				
This command defines the events generated when the measurement is terminated or stopped *(event reporting,* see Chapter 5).				

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	– –	V3.10
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).				

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	–	V3.10
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.
0 dBm to +55 dBm **–10 dBm to +35 dBm** **–35 dBm to +2 dBm**	Maximum RF power at RF1 Maximum RF power at RF2 Maximum RF power at RF 4 IN	NAN	dBm	V3.10
Description of command				
These commands are always queries. They start the measurement of the maximum RF power (peak power, not averaged) and return the result.				

NPOWer (Function Group RF)

The subsystem *NPOWer* measures the power of an RF signal using a narrow-band filter with variable bandwidth. Gaussian filters with bandwidths between 10 Hz and 1 MHz are available. In addition, the measurement can be performed with the root-raised cosine filter specified in standard TIA/EIA-136.xxx or with an 1.4 MHz bandpass filter specified for CDMA measurements.

The *NPOWer* measurement is performed at the frequency set via `[SENSe:]RFANalyzer:FREQuency`. The filter bandwidth *(RBW)* is set via `[SENSe:]NPOWer:BWIDth[:RESolution]`; it does not depend on the RBW defined for the *POWer* and *SPECtrum* measurement*.*

The CMU measures the average, maximum and minimum power of the RF signal in a basic evaluation period comprising a fixed number of samples (4096). 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 (see section *Measured Values – Subsystem NPOWer?* on p. 6.62 ff.). The measurement time depends on the filter bandwidth but never exceeds the order of magnitude of 100 ms for a single evaluation period. The frequency of the RF signal is also measured, provided that is close enough to the measurement frequency set via `[SENSe:]POWer:FREQuency:CENTer`. The characteristics of the *NPOWer* measurement makes it particularly suitable for the analysis of CW signals where no measurement curves are needed. Compared to the *Analyzer Power* measurement (subsystem `RFANalyzer`), it provides a wider range of filters, additional statistical evaluations and an additional frequency counter.

Note: *The configuration of the RF input path (`[SENSe:]LEVel:MAXimum`, `[SENSe:]LEVel:MODE`) and the trigger settings (`TRIGger[:SEQuence]:SOURce`, `TRIGger[:SEQuence]:THReshold`) can have an effect on 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.		V3.07

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	–	V3.07
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 Status
Return	Description of parameters	Def. value	Def. unit	FW vers.
OFF | **RUN |** **STOP |** **ERR |** **STEP |** **RDY,** **1 to 10000 |** **NONE** **1 to 1000 |** **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 Counter for current evaluation period within a cycle Statistic count set to off	OFF NONE NONE	– – –	V3.07
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).				

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 evaluation periods within a statistics cycle Statistics off	1	–	
<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	–	V3.07
Description of command				
This command defines the statistic count, repetition mode, stop condition, and stepping mode for the measurement.				

CONFigure:NPOWer:CONTrol:STATistics *<Statistics>*				Statistic Count
<Statistics>	Description of parameters	Def. value	Def. unit	FW vers.
1 to 1000 | **NONE**	No. of evaluation periods within a statistics cycle Statistics off	1	–	V3.07
Description of command				
This command defines the number of evaluation periods that represent 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	–	V3.07
Description of command				
This command determines the repetition mode, 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.*				

Subsystem NPOWer:FREQuency (RBW)

The subsystem *NPOWer:FREQuency* sets the filter bandwidth of the narrow-band power measurement.

[SENSe:]NPOWer:BWIDth[:RESolution] *<Bandwidth>*				RBW
<Bandwidth>	Parameter description	Def. value	Default unit	FW vers.
10 Hz to 1 MHz | **TDMA | CDMA**	Bandwidths of power measurement (the values are rounded in 1 | 2 | 3 | 5 steps) TDMA or CDMA filter	300 kHz	–	V3.07
Command description				
This command defines the bandwidth of the power measurement. The TDMA filter is a matched (root-raised cosine) filter specified in standard TIA/EIA-136xxx for the test of modulation parameters. The CDMA filter is a 1.4 MHz bandpass filter specified for cdmaOne and CDMA2000 tests.				

Measured Values – Subsystem NPOWer?

The subsystem *NPOWer?* retrieves the results of the narrow-band power measurement (see general information on p. 6.59).

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, **Min. Power of Current evaluation period,** **Max. Power of Current evaluation period,** **Avg. Power ref. to the last stat. cycle,** **Min. Power of the entire measurement,** **Max. Power of the entire measurement** **Frequency**	–137 dBm to +53 dBm –137 dBm to +53 dBm –137 dBm to +53 dBm –137 dBm to +53 dBm –137 dBm to +53 dBm –137 dBm to +53 dBm 10 kHz to 2.7 GHz	NAN NAN NAN NAN NAN NAN NAN	dBm dBm dBm dBm dBm dBm Hz	V3.07
Description of command				
These commands are always queries. They start the *NPOWer* measurement and return the results. As the CMU is capable of determining frequencies with an accuracy of 0.1 Hz, the frequency is returned in exponential representation and with a 10-digit mantissa.				

Symbolic Status Event Register Evaluation

The following commands are used to retrieve the events reported in function group *RF*; see section *Symbolic Status Event Register Evaluation* in chapter 5.

STATus:OPERation:SYMBolic:ENABle <Event>{,<Event>}		Symbolic status evaluation		
Parameter list	Parameter description	Def. Value[7]	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 *RF* 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 RF function group) and in all sum registers up to the status byte. The events and the corresponding symbols for function group *RF* 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[8]	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 *RF* 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.				

[7] The default values quoted in this command are achieved after a `STATus:PRESet` command. `*RST` does not supersede the entries in the status registers; see section *Reset Values of the Status Reporting Systems* in chapter 5.

[8] The default values quoted in this command are achieved after a `*CLS` command. `*RST` does not supersede the entries in the status registers; see section *Reset Values of the Status Reporting Systems* in chapter 5.

Audio Generator and Analyzer (with Option CMU-B41)

Audio measurements form a separate function group (*Non Signalling* mode) with associated secondary address. The *Signalling* mode is not available for audio measurements. However, it is possible to perform audio measurements while using the signalling modes from other function groups (e.g. establish a call to a mobile in function group *GSM900-MS Signalling* and switch over to perform additional audio measurements). Consequently, additional audio-related commands may be provided in other contexts (for example, see the `ROUTe:SPENcoder...` and `ROUTe:SPDecoder...` commands in the *GSM-MS* and other function groups).

The audio function group provides two independent measurements:

- In a single-tone audio measurement, the CMU generates an audio signal at constant level and frequency (see section *AF Generator (AFGenerator* on p. 6.73 ff.) and analyzes a single-tone audio input signal (see section *Audio Analyzer (AFANalyzer)* on p. 6.68 ff.).
- In a multitone measurement (see section *Multitone Measurements (MULTitone* on p. 6.75 ff.), the CMU generates a composite audio signal consisting of up to 20 distinct test tones and analyzes an audio input signal containing the same tones.

Note: *The single-tone generator and the multitone audio measurement must not be running simultaneously. In manual control, this is ensured because the single-tone audio generator is automatically switched off upon swichover to the* Multitone *menu and vice versa. In remote control, the conflict must be resolved explicitly:*

- *The single tone AF generator must be switched off before a multitone measurement is started.*
- *A running multitone measurement must be aborted before the single tone AF generator is switched on.*

In the case of two conflicting audio measurements, the `READ..., FETCh..., SAMPle...` *commands will result in an error message.*

Two independent audio circuits are provided for both single tone and multitone measurements:

- In the primary audio circuit (subsystems `AFANalyzer[:PRIMary]` and `AFGenerator[:PRIMary]` for single tone measurements, `MULTitone:AF1Channel` for multitone measurements), the audio signals are applied to the connectors AF OUT (output, AF generator signal) and AF IN (input) on the CMU front panel. The `[:PRIMary]` single tone audio circuit corresponds to the *Audio Analyzer/Generator* menu and the associated configuration menu. The `MULTitone:AF1Channel` audio circuit corresponds to the *AF Chan. One* multitone application.
- In the secondary audio circuit (subsystems `AFANalyzer:SECondary` and `AFGenerator:SECondary` for single tone measurements, `MULTitone:AF2Channel` for multitone measurements), the audio signals are applied to the connectors AUX 2 (output, AF generator signal) and AUX 1 (input) on the CMU front panel. The `:SECondary` single tone audio circuit can not be controlled manually. The `MULTitone:AF2Channel` audio circuit corresponds to the *AF Chan. Two* multitone application.

With the exception of the input and output connectors, the two audio circuits are identical. Configurations such as the input path (`AFLevel`) can be set independently. All remote control commands are analogous.

Subsystem Options

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"Audio_NSig"	–	–	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.				

Configuration 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>", **INTernal | EXTernal**	Name of the config. file to be created Storage device of the config. file	– INTernal	– –	V3.10
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>", **INTernal | EXTernal**	Name of the config. file to be recalled Storage device of the config. file	– INTernal	– –	V3.10
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.				

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

Subsystem AFLevel (AF Input Level)

The subsystem `AFLevel` configures the input path for both channels of the single tone and the *Multitone* audio measurement. In manual control the single tone measurement uses the `[:PRIMary]` settings. In the *Multitone* measurement the `AFLevel` subsystem corresponds to the *Analyzer Level* softkey with the hotkeys *Mode* and *AF Max. Level*. Note that the `AFLevel[:PRIMary]` and `AFLevel:SECondary` settings are valid for both single tone and multitone measurements (see table below).

Audio Channel	**Manual Control, Menu**	**Remote control keyword**	**`AFLevel` keyword**
Single tone, channel 1	Analyzer/Generator	`[:PRIMary]`	`[:PRIMary]`
Single tone, channel 2	–	`:SECondary`	`:SECondary`
Multitone, channel 1	Multitone, AF Chan. One	`AF1Channel`	`[:PRIMary]`
Multitone, channel 2	Multitone, AF Chan. Two	`AF2Channel`	`:SECondary`

[SENSe:]AFLevel[:PRIMary]:MODE *<Mode>* **[SENSe:]AFLevel:SECondary: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	–	V3.05
Description of command				
This command defines the mode for setting the maximum input level. For firmware versions <3.05, only one `[SENSe:]AFLevel:MODE` command is available to configure all audio channels.				

[SENSe:]AFLevel[:PRIMary]:MAXimum <*Level*> **[SENSe:]AFLevel:SECondary:MAXimum <*Level*>**				AF Max. Level
<Level>	Description of parameters	Def. value	Def. unit	FW vers.
0 V to +30 V	Maximum audio input voltage	1	V	V3.05
Description of command				
This command defines the maximum expected AF input level. For firmware versions <3.05, only one `[SENSe:]AFLevel:MAXimum` command is available to configure all audio channels.				

[SENSe:]AFLevel:DEFault				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	–	V3.0
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 results in an error message). If used as a query the command returns whether all parameters are set to their default values *(ON)* or not *(OFF)*.				

Audio Analyzer (AFANalyzer)

The AFANalyzer subsystem measures the single tone audio signal. It corresponds to the *Analyzer* softkey in the main menu *Audio Analyzer/Generator* and the associated output fields.

Subsystem AFANalyzer (Measurement Control)

The subsystem *AFANalyzer* controls the single-tone audio analysis.

INITiate:AFANalyzer[:PRIMary]		Analyzer
INITiate:AFANalyzer:SECondary	Start new AF measurement	⇒ *RUN*
STOP:AFANalyzer[:PRIMary]		
STOP:AFANalyzer:SECondary	Stop AF measurement after current evaluation period	⇒*STOP*
ABORt:AFANalyzer[:PRIMary]		
ABORt:AFANalyzer:SECondary	Abort and switch off AF analyzer	⇒ *OFF*
CONTinue:AFANalyzer[:PRIMary]		
CONTinue:AFANalyzer:SECondary	Next measurement step (only stepping mode)	⇒ *RUN*
Description of command		FW vers.
These commands have no query form. They start and stop the AF analyzer, setting it to the status given in the top right column.		V2.10

CONFigure:AFANalyzer[:PRIMary]:EREPorting *<Mode>*				Event Reporting
CONFigure:AFANalyzer:SECondary:EREPorting *<Mode>*				
<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	–	V2.10
Description of command				
This command defines the events generated when the measurement is terminated or stopped (event reporting see chapter 5)				

FETCh:AFANalyzer[:PRIMary]:STATus?				Measurement Status
FETCh:AFANalyzer:SECondary: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	–	V2.10
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) and the number of the current statistics cycle.				

CONFigure:AFANalyzer[:PRIMary]:MTReduce <Mode>, <Frequency> **CONFigure:AFANalyzer:SECondary:MTReduce**		Reduce Measurement Time		
<Mode>	Description of parameters	Def. value	Def. unit	
LOWF | **EXPF**	Measurement time according to lowest frequency (10 kHz) Measurement time according to *<Frequency>*	LOWF	–	
<Frequency>	Description of parameters	Def. value	Def. unit	FW vers.
10 Hz to 20 kHz	Expected frequency of the audio input signal	100	Hz	V3.0
Description of command				
This command is to reduce the measurement time the audio analyzer uses to calculate the measurement results *(<Mode>=EXPF);* see section *Subsystem AFANalyzer... (Measured Values)* on page 6.73. The measurement time must be adapted to the period of the input signal, which is the reverse of the frequency. Therefore, the audio measurement can be accelerated for high-frequency signals. In the *LOWF* mode, *<Frequency>* is not taken into account.				

Subsystem AFANalyzer...:CONTrol (Control)

The subsystem *AFANalyzer:...CONTrol* defines the scope of the audio analysis and sets the reference frequency for the distortion measurement. The settings are provided in the *Control* and *Distortion* tabs of the *Analyzer Configuration* popup menu.

CONFigure:AFANalyzer[:PRIMary]:CONTrol:REPetition **CONFigure:AFANalyzer:SECondary: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	
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 statistic cycle Continue measurement according to its rep. mode	NONE	–	V2.10
Description of command				
This command determines the number of statistics cycles and the stepping mode for the measurement. A stop condition is not available. **Note:** *In the case of READ commands (READ: to) the <Repetition> parameter has no effect; the measurement is always stopped after a single shot.*				

CONFigure:AFANalyzer[:PRIMary]:CONTrol:DISTortion[:FREQuency] *<Frequency>* CONFigure:AFANalyzer:SECondary:CONTrol:DISTortion[:FREQuency] *<Frequency>*				Frequency
<Frequency>	Description of parameters	Def. value	Def. unit	FW vers.
20 Hz to 20000 Hz	Reference frequency for distortion measurement	1000	Hz	V2.10
Description of command				
This command determines the reference frequency for the harmonic distortion measurement.				

CONFigure:AFANalyzer[:PRIMary]:CONTrol:COUPling *<Coupling>* CONFigure:AFANalyzer:SECondary:CONTrol:COUPling *<Coupling>*				AF Path Coupling
<Coupling>	Description of parameters	Def. value	Def. unit	FW vers.
AC | DC	AC coupling of AF path DC coupling of AF path	AC (`[:PRIMary]` channel) DC (`:SECondary` channel)	–	V3.05
Description of command				
These commands determine the AF path coupling for measurements using the AF analyzer. In firmware versions <3.05, the commands are replaced by two equivalent `CONFigure:...COUPling` commands.				

Subsystem AFANalyzer...:FILTer (Filter)

The subsystem *AFANalyzer:...FILTer* configures the input path of the AF analyzer. The subsystem corresponds to the *Filter* tab in the *Analyzer Configuration* menu. The input path of the AF analyzer is as shown below:

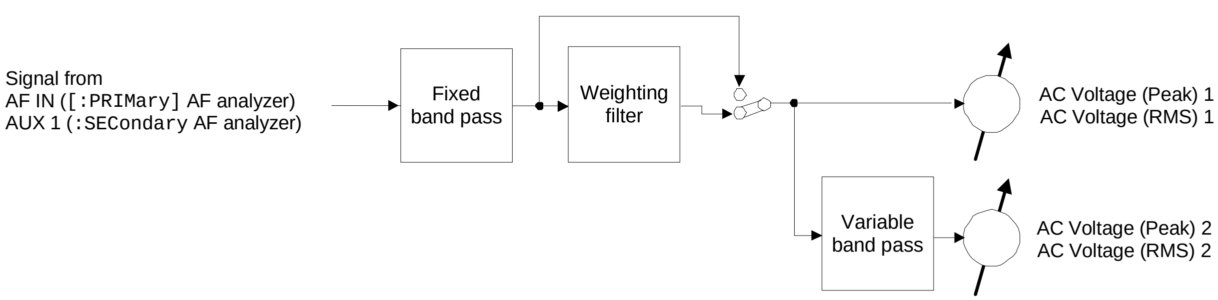


Fig. 6-1 AF analyzer input path configuration

CONFigure:AFANalyzer[:PRIMary]:FILTer:VBPass:CFRequency *<Center>* CONFigure:AFANalyzer:SECondary:FILTer:VBPass:CFRequency *<Center>*				Frequency
<Center>	Description of parameters	Def. value	Def. unit	FW vers.
20 Hz to 20000 Hz	Center frequency of band pass	1000	Hz	V2.12
Description of command				
This command determines the center frequency of the variable band pass.				

CONFigure:AFANalyzer[:PRIMary]:FILTer:VBPass:BWIDth <*Bandwidth*>
CONFigure:AFANalyzer:SECondary:FILTer:VBPass:BWIDth <*Bandwidth*> — Bandwidth

<Bandwidth>	Description of parameters	Def. value	Def. unit	FW vers.
10 Hz to 1000 Hz	Bandwidth of band pass	200	Hz	V2.12

Description of command

This command determines the bandwidth of the variable band pass filter.

CONFigure:AFANalyzer[:PRIMary]:FILTer:WEIGhting <*Weighting*>
CONFigure:AFANalyzer:SECondary:FILTer:WEIGhting <*Weighting*> — Weighting Filter

<Weighting>	Description of parameters	Def. value	Def. unit	FW vers.
CME |	Switch on C-message weighted filter	OFF	–	V2.12
CCI |	Switch on CCITT weighting filter			
OFF	No weighting filter			

Description of command

This command selects the weighting filter after the fixed band pass (see *Fig. 6-1*).

Bandwidth (AC Coup.)

CONFigure:AFANalyzer[:PRIMary]:FILTer:BPASs:ACCoupling <*Band pass*>
CONFigure:AFANalyzer:SECondary:FILTer:BPASs:ACCoupling <*Band pass*>

<Band pass>	Description of parameters	Def. value	Def. unit	FW vers.
	CMU band pass filter with a bandwidth of	BP16	–	V3.05
BP01 |	0 Hz to 250 Hz			
BP02 |	6 Hz to 250 Hz			
BP03 |	50 Hz to 250 Hz			
BP04 |	0 Hz to 3000 Hz			
BP05 |	6 Hz to 3000 Hz			
BP06 |	50 Hz to 3000 Hz			
BP07 |	300 Hz to 3000 Hz			
BP08 |	0 Hz to 4000 Hz			
BP09 |	6 Hz to 4000 Hz			
BP10 |	50 Hz to 4000 Hz			
BP11 |	300 Hz to 4000 Hz			
BP12 |	0 Hz to 15000 Hz			
BP13 |	6 Hz to 15000 Hz			
BP14 |	50 Hz to 15000 Hz			
BP15 |	300 Hz to 15000 Hz			
BP16 |	0 Hz to 21000 Hz			
BP17 |	6 Hz to 21000 Hz			
BP18	50 Hz to 21000 Hz			

Description of command

This command selects the first band pass in the AF analyzer to be used if the AF path coupling is set to AC (see `CONFigure:AFANalyzer...:COUPling` command).

Note: *In firmware versions ≥V2.12 but <V3.05, the CONFigure:AFANalyzer... :FILTer:BPASs commands replace the CONFigure:AFANalyzer... :FILTer:BPASs:ACCoupling and CONFigure:AFANalyzer...:FILTer: BPASs:DCCoupling commands. No distinction is made between AC and DC path coupling.*

Bandwidth (DC Coup.)

CONFigure:AFANalyzer[:PRIMary]:FILTer:BPASs:DCCoupling *<Band pass>*
CONFigure:AFANalyzer:SECondary:FILTer:BPASs:DCCoupling *<Band pass>*

<Band pass>	Description of parameters	Def. value	Def. unit	FW vers.
	CMU band pass filter with a bandwidth of	BP17	–	V3.05
BP02 |	6 Hz to 250 Hz			
BP03 |	50 Hz to 250 Hz			
BP05 |	6 Hz to 3000 Hz			
BP06 |	50 Hz to 3000 Hz			
BP07 |	300 Hz to 3000 Hz			
BP09 |	6 Hz to 4000 Hz			
BP10 |	50 Hz to 4000 Hz			
BP11 |	300 Hz to 4000 Hz			
BP13 |	6 Hz to 15000 Hz			
BP14 |	50 Hz to 15000 Hz			
BP15 |	300 Hz to 15000 Hz			
BP17 |	6 Hz to 21000 Hz			
BP18	50 Hz to 21000 Hz			

Description of command

This command selects the first band pass in the AF analyzer to be used if the AF path coupling is set to DC (see `CONFigure:AFANalyzer...:COUPling` command).

Note: *In firmware versions ≥V2.12 but <V3.05, the CONFigure:AFANalyzer... :FILTer:BPASs commands replace the CONFigure:AFANalyzer... :FILTer:BPASs:ACCoupling and CONFigure:AFANalyzer...:FILTer: BPASs:DCCoupling commands. No distinction is made between AC and DC path coupling. In firmware V3.00, no band pass selection is possible if DC path coupling is set. The CMU always uses a default band pass with a bandwidth of 6 Hz to 21000 Hz (BP17).*

Subsystem AFANalyzer... (Measured Values)

The subsystem *AFANalyzer...* starts the audio analysis and returns the results.

READ[:SCALar]:AFANalyzer[:PRIMary]? **READ[:SCALar]:AFANalyzer:SECondary?** **FETCh[:SCALar]:AFANalyzer[:PRIMary]?** **FETCh[:SCALar]:AFANalyzer:SECondary?** **SAMPle[:SCALar]:AFANalyzer[:PRIMary]?** **SAMPle[:SCALar]:AFANalyzer:SECondary?**	Scalar Results Start single shot meas. and return results Read out meas. results (unsynchronized) Read out meas. results (synchron.)			
Return	Description of parameters	Def. value	Def. unit	FW vers.
PeakVoltage1	0 V to 42.4 V	NAN	V	V2.10
RMSVoltage1	0 V to 30 V	NAN	V	V2.12
DCVoltage	–30 V to 30 V	NAN	V	(last 3
Distortion	0% to 100%	NAN	%	output
PeakVoltage2	0 V to 42.4 V	NAN	V	values)
RMSVoltage2	0 V to 30 V	NAN	V	
Frequency	10 Hz to 204.8 kHz	NAN	Hz	
Description of command				

These commands are always queries. They start a measurement and output all scalar measurement results (see also Fig. 6-1). These are:

- Peak1 and RMS1 value of AC voltage after first band pass and the weighting filter
- DC voltage
- Total harmonic distortion
- Peak2 and RMS2 value of AC voltage after first band pass and second band pass (variable band pass)
- Frequency counter

AF Generator (AFGenerator)

The subsystem AFGenerator configures and controls the AF generator. It corresponds to the measurement softkey *Generator* in the measurement menu *Audio Analyzer/Generator* and the associated input fields.

INITiate:AFGenerator[:PRIMary] **INITiate:AFGenerator:SECondary**	AF Generator Control Start AF generator, reserve resources	⇒ *RUN*
ABORt:AFGenerator:[PRIMary] **ABORt:AFGenerator:SECondary**	Switch off AF generator, release resources ⇒	*OFF*
Description of command		FW vers.
These commands have no query form. They start and stop the AF generator, setting it to the status given in the top right column. **Note:** *A running multitone measurement must be aborted before the single tone AF generator is switched on. See note in section* Audio Generator and Analyzer (with Option CMU-B41) *on page 6.64.*		V2.10

FETCh:AFGenerator[:PRIMary]:STATus? **FETCh:AFGenerator:SECondary:STATus?**				Generator Status
Return	Description of parameters	Def. value	Def. unit	FW vers.
OFF | **RUN |** **ERR**	Generator switched off (`ABORt`, `*RST` or `OFF` due to conflict of resources) Running (`INITiate`) Switched off (could not be started)	OFF	–	V2.10
Description of command				
This command is always a query. It returns the current generator status.				

SOURce:AFGenerator[:PRIMary]:LEVel <*Level*> **SOURce:AFGenerator:SECondary:LEVel <*Level*>**				Generator Level
<Level>	Description of parameters	Def. value	Def. unit	FW vers.
0 V to 5 V	AF generator voltage	1	V	V2.10
Description of command				
This command defines the RMS voltage of the generated AC audio signal or the constant DC voltage, depending on the selected signal type (see command `SOURce:AFGenerator...SMODe`).				

SOURce:AFGenerator[:PRIMary]:FREQuency <*Frequency*> **SOURce:AFGenerator:SECondary:FREQuency <*Frequency*>**				Frequency
<Frequency>	Description of parameters	Def. value	Def. unit	FW vers.
20 Hz to 20 kHz	AF-Generator frequency	1000	Hz	V2.10
Description of command				
This command determines the AF generator frequency.				

SOURce:AFGenerator[:PRIMary]:SMODe <*Signal*> **SOURce:AFGenerator:SECondary:SMODe <*Signal*>**				Generator Signal
<Frequency>	Description of parameters	Def. value	Def. unit	FW vers.
AF | DC	AF generator signal type	AC	–	V3.10
Description of command				
This command determines whether the AF generator signal is an AC or DC signal.				

Multitone Measurements (MULTitone)

The subsystem *MULTitone* measures the level of an audio test signal comprising up to 20 test tones. The subsystem corresponds to the measurement menu *Multitone* and the associated popup menu *Multitone Configuration.*

In analogy to the `AFGenerator` and `AFANalyzer` subsystems reported above, the *Multitone* measurement provides two independent circuits:

- In the first audio channel (subsystem `MULTitone:AF1Channel...`), the audio signals are applied to the connectors AF OUT (output, AF generator signal) and AF IN (input) on the CMU front panel. The first audio channel corresponds to the *Multitone* menu, application *AF Chan. One,* and the associated configuration menu.
- In the second audio channel (subsystem `MULTitone:AF2Channel...`), the audio signals are applied to the connectors AUX 2 (output, AF generator signal) and AUX 1 (input) on the CMU front panel. The second audio channel corresponds to the *Multitone* menu, application *AF Chan. Two,* and the associated configuration menu.

With the exception of the input and output connectors, the two audio circuits are identical. All remote control commands are analogous.

Measurement Control – Subsystem MULTitone

The subsystem *MULTitone* controls the measurement. It corresponds to the softkey *AF Chan. One* in the measurement menu *Multitone* and some of the associated hotkeys.

INITiate:MULTitone:AF1Channel **INITiate:MULTitone:AF2Channel**	Start new measurement	⇒ *RUN*
ABORt:MULTitone:AF1Channel **ABORt:MULTitone:AF2Channel**	Abort running measurement and switch off	⇒ *OFF*
STOP:MULTitone:AF1Channel **STOP:MULTitone:AF2Channel**	Stop measurement after current stat. cycle	⇒ *STOP*
CONTinue:MULTitone:AF1Channel **CONTinue:MULTitone:AF2Channel**	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. **Note:** *The single tone AF generator must be switched off before a multitone measurement is started. See note in section* Audio Generator and Analyzer (with Option CMU-B41) 6.64.	V3.0

CONFigure:MULTitone:AF1Channel:EREPorting <*Mode*>
CONFigure:MULTitone:AF2Channel: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).

FETCh:MULTitone:AF1Channel:STATus?
FETCh:MULTitone:AF2Channel:STATus? Measurement Status

Ret. 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).				

DISPlay:MULTitone:AF1Channel:GRID *<Enable>*
DISPlay:MULTitone:AF2Channel:GRID *<Enable>* Grid on/off

<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	Switch on grid lines Switch off grid lines	ON	–	V3.0
Description of command				
This command switches the grid lines in the test diagrams on or off.				

CONFigure:MULTitone:AF1Channel:COUPling *<Coupling>*
CONFigure:MULTitone:AF2Channel:COUPling *<Coupling>* AF Path Coupling

<Coupling>	Description of parameters	Def. value	Def. unit	FW vers.
AC | **DC**	AC coupling of AF path DC coupling of AF path	AC (`:AF1Channel`) DC (`:AF2Channel`)	–	V3.05
Description of command				
This command determines the AF path coupling for multitone measurements.				

CONFigure:MULTitone:AF1Channel:RLEVel *<Voltage>*
CONFigure:MULTitone:AF2Channel:RLEVel *<Voltage>* AF Reference Level

<Voltage>	Description of parameters	Def. value	Def. unit	FW vers.
0.001 V to 5.000 V	Reference Level	0.010	V	V3.0
Description of command				
This command defines the AF reference level, i.e. the 0-dB line in the test diagram.				

CONFigure:MULTitone:AF1Channel:RMODe <*Reference*>
CONFigure:MULTitone:AF2Channel:RMODe <*Reference*> — Result

<Reference>	Description of parameters	Def. value	Def. unit	FW vers.
RLEV | **TON<nr>**	Results relative to the reference level Results relative to level at test tone <nr>, where <nr> = 1 to 20	TON4	–	V3.0

Description of command

This command defines the reference value for the results of the *Multitone* measurement. The reference level is defined via `CONFigure:MULTitone:AF1Channel:RLEVel.` To choose one of the test tones no. 1 to 20, it must be enabled via the `CONFigure:MULTitone:AF1Channel:TDEFinition:TONE<nr>` command.

CONFigure:MULTitone:AF1Channel:AFGLead <*Time*>
CONFigure:MULTitone:AF2Channel:AFGLead <*Time*> — AF Generator Lead

<Time>	Description of parameters	Def. value	Def. unit	FW vers.
0 s to 0.1 s	Hold off time	0.014	s	V3.0

Description of command

This command defines a hold off time for the AF generator.

Test Configuration

The commands of the following subsystems configure the *Multitone* measurement. They correspond to the *Multitone Configuration* menu.

Subsystem MULTitone:...CONTrol

The subsystem *MULTitone:...CONTrol* defines the scope of the measurement. It corresponds to the *Control* tab in the popup menu *Multitone Configuration.*

CONFigure:MULTitone:AF1Channel:CONTrol:REPetition
CONFigure:MULTitone:AF2Channel:CONTrol:REPetition
<Repetition>, <StopCond>, <Stepmode> — Test Cycles

<Repetition>	Description of parameters	Def. value	Def. unit	
CONTinuous | **SINGleshot |** **1 to 1000,**	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	–	V3.0

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.*

Subsystem SUBarrays:MULTitone:...

The subsystem *SUBarrays:MULTitone:...* defines the measurement range and the type of output values.

CONFigure:SUBarrays:MULTitone:AF1Channel — Definition of Subarrays
CONFigure:SUBarrays:MULTitone:AF2Channel
<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 to 20,	Start test tone in current range	1	–	
<Samples>	Description of parameters	Def. value	Def. unit	FW vers.
1 to 20	Number of test tones in current range	20	–	V3.0

Description of command

This command configures the `READ:SUBarrays:MULTitone:AF1Channel...`, `FETCh:SUBarrays:MULTitone:AF1Channel...`, and `SAMPle:SUBarrays:MULTitone:AF1Channel` commands. It restricts the measurement to up to 32 subranges where either all measurement results (the number of which is given by the <Samples> parameter) or a single statistical value is returned.

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 are subsets of the full range of test tones defined via `CONFigure:MULTitone:AF1Channel:TONE<nr>`. Each subrange contains all test tones between the start test tone (test tone no. <Start>) and test tone no. <Start>+<Samples>–1. Test points inside this range that are disabled 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.

Tolerance values – Subsystem MULTitone:...LIMit

The subsystem *MULTitone:...LIMit* defines tolerance values for the *Multitone* measurement. The subsystem corresponds to the *Limits* tab of the popup menu *Multitone Configuration.*

CONFigure:MULTitone:AF1Channel:LIMit:LINE:ASYMmetric:UPPer
CONFigure:MULTitone:AF2Channel:LIMit:LINE:ASYMmetric:UPPer
<Limit_1>, <Enable_1>, ... <Limit_20>, <Enable_20> Upper Limit, Overall

<Limit_nr>	Description of parameters	Def. value	Def. unit	
–80 dB to +80 dB,	Upper limit line at tone <nr>	See below	dB	
<Enable_nr>	Description of parameters	Def. value	Def. unit	FW vers.
ON | OFF	Enable upper limit line at tone <nr>	ON	–	V3.0

Description of command

This command configures the upper limit lines and enables the limit check at the 20 test tones that can be defined via `CONFigure:MULTitone:AF1Channel:TONE<nr>`.

By default, the limit check is switched on at all tones and the following limit lines apply:

Tone <nr>	**Limit Line/[dB]**	**Enable**	**Tone <nr>**	**Limit Line/[dB]**	**Enable**
1	–9.5	ON	11	+5.6	ON
2	–6.2	ON	12	+6.3	ON
3	–3.8	ON	13	+6.9	ON
4	–1.9	ON	14	+7.5	ON
5	–0.3	ON	15	+8.0	ON
6	+1.0	ON	16	+8.6	ON
7	+2.1	ON	17	+9.1	ON
8	+3.1	ON	18	+9.6	ON
9	+4.0	ON	19	+10.0	ON
10	+4.8	ON	20	+10.5	ON

CONFigure:MULTitone:AF1Channel:TONE<nr>:LIMit:LINE:ASYMmetric:UPPer
CONFigure:MULTitone:AF2Channel:TONE<nr>:LIMit:LINE:ASYMmetric:UPPer
<Limit>, <Enable> Upper Limit, Single Point

<Limit>	Description of parameters	Def. value	Def. unit	
–80 dB to +80 dB,	Upper limit line at tone <nr>	See below	dB	
<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | OFF	Enable upper limit line at tone <nr>	ON	–	V3.0

Description of command

This command configures the upper limit and enables the limit check at one of 20 test tones that can be defined via `CONFigure:MULTitone:AF1Channel:TONE<nr>`. The test tones are numbered by <nr> = 1 to 20. The default limits at all test points are quoted in the previous command.

CONFigure:MULTitone:AF1Channel:LIMit:LINE:ASYMmetric:LOWer
CONFigure:MULTitone:AF2Channel:LIMit:LINE:ASYMmetric:LOWer
<Limit_1>, <Enable_1>, ... <Limit_20>, <Enable_20> Lower Limits, Overall

<Limit_nr>	Description of parameters	Def. value	Def. unit	
–80 dB to +80 dB,	Lower limit line at tone <nr>	See below	dB	
<Enable_nr>	Description of parameters	Def. value	Def. unit	FW vers.
ON | OFF	Enable lower limit line at tone <nr>	ON	–	V3.0

Description of command

This command configures the lower limit lines and enables the limit check at the 20 test tones that can be defined via `CONFigure:MULTitone:AF1Channel:TONE<nr>.`

By default, the limit check is switched on at all tones and the following limit lines apply:

Tone <nr>	**Limit Line/[dB]**	**Enable**	**Tone <nr>**	**Limit Line/[dB]**	**Enable**
1	–13.5	ON	11	+1.6	ON
2	–10.2	ON	12	+2.3	ON
3	–7.8	ON	13	+2.9	ON
4	–5.9	ON	14	+3.5	ON
5	–4.3	ON	15	+4.0	ON
6	–3.0	ON	16	+4.6	ON
7	–1.9	ON	17	+5.0	ON
8	–0.9	ON	18	+5.0	ON
9	0.0	ON	19	+5.0	ON
10	+0.8	ON	20	+5.0	ON

CONFigure:MULTitone:AF1Channel:TONE<nr>:LIMit:LINE:ASYMmetric:LOWer
CONFigure:MULTitone:AF2Channel:TONE<nr>:LIMit:LINE:ASYMmetric:LOWer
<Limit>, <Enable> Lower Limit, Single Point

<Limit>	Description of parameters	Def. value	Def. unit	
–80 dB to +80 dB,	Lower limit line at tone <nr>	See below	dB	
<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | OFF	Enable lower limit line at tone <nr>	ON	–	V3.0

Description of command

This command configures the lower limit and enables the limit check at one of 20 test tones that can be defined via `CONFigure:MULTitone:AF1Channel:TONE<nr>`. The test tones are numbered by <nr> = 1 to 20. The default limits at all test points are quoted in the previous command.

DEFault:MULTitone:AF1Channel:LIMit:LINE *<Enable>* Default Settings
DEFault:MULTitone:AF2Channel:LIMit:LINE *<Enable>*

<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	–	V3.0

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 results in an error message).

If used as a query the command returns whether all parameters are set to their default values *(ON)* or not *(OFF)*.

DEFault:MULTitone:LIMit:LINE *<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	–	V3.0
Description of command				
If used as a setting command with the parameter *ON* this command sets all parameters of the subsystem (including `AF1Channel` and `AF2Channel`) to their default values (the setting OFF results in 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 Tones – Subsystem MULTitone:...TDEFinition

The subsystem *MULTitone:...TDEFinition* configures the audio test signal used for the *Multitone* measurement. The subsystem corresponds to the *Tone Def.* tab of the popup menu *Multitone Configuration.*

CONFigure:MULTitone:AF1Channel:TDEFinition **CONFigure:MULTitone:AF2Channel:TDEFinition** ***<Freq_1>, <Lev_1>, <Enable_1>, ... <Freq_20>, <Lev_20>, <Enable_20>***				Test Tones
<Freq_nr>	Description of parameters	Def. value	Def. unit	
10 Hz to 15999 Hz,	Frequency of test tone <nr>	See below	Hz	
<Lev_nr>	Description of parameters	Def. value	Def. unit	
1.0 µV to 5.0 V,	Level at test tone <nr>	See below	V	0
<Enable_nr>	Description of parameters	Def. value	Def. unit	FW vers.
ON | OFF	Switch on / off test tone <nr>	See below	–	V3.0
Description of command				

This command enables and configures up to 20 test tones. The minimum frequency spacing between two tones is 1 Hz. The sum of all test tones must not exceed the maximum AF generator level quoted in the data sheet.

The following default test tones are provided:

Tone <nr>	Frequency/[Hz]	Level/[V]	Enable	Tone <nr>	Frequency/[Hz]	Level/[V]	Enable
1	300	0.01	ON	11	1700	0.01	ON
2	440	0.01	ON	12	1840	0.01	ON
3	580	0.01	ON	13	1980	0.01	ON
4	720	0.01	ON	14	2120	0.01	ON
5	860	0.01	ON	15	2260	0.01	ON
6	1004	0.01	ON	16	2400	0.01	ON
7	1140	0.01	ON	17	2540	0.01	ON
8	1280	0.01	ON	18	2680	0.01	ON
9	1420	0.01	ON	19	2820	0.01	ON
10	1560	0.01	ON	20	3000	0.01	ON

Note: *If the level of all test tones is derived from a total level (TLEVel setting in the CONFigure:MULTitone:AF1Channel:TDEFinition:MODE command), the individual level settings are ignored. The* <Frequency> *and* <Enable> *parameter settings are still effective.*

CONFigure:MULTitone:AF1Channel:TDEFinition:TONE<nr> Test Tones
CONFigure:MULTitone:AF2Channel:TDEFinition:TONE<nr>
<Frequency>, <Level>, <Enable>

<Frequency>	Description of parameters	Def. value	Def. unit	
10 Hz to 15999 Hz,	Frequency of test tone <nr>	See below	Hz	
<Level>	Description of parameters	Def. value	Def. unit	
0.0 V to 5.0 V,	AF level test tone <nr>	See below	V	0
<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | OFF	Switch on / off test tone <nr>	See below	–	V3.0

Description of command

This command enables and configures one of up to 20 test tones (<nr> = 1 to 20). The default values for all test tones are given in the previous command.

Note: *If the level of all test tones is derived from a total level (TLEVel setting in the CONFigure:MULTitone:AF1Channel:TDEFinition:MODE command), the* <Level> *setting is ignored. The* <Frequency> *and* <Enable> *parameter setting is still effective.*

CONFigure:MULTitone:AF1Channel:TDEFinition:MODE *<Mode>* Level Selection
CONFigure:MULTitone:AF2Channel:TDEFinition:MODE *<Mode>*

<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
SEParate | **TLEVel**	Use separate levels for each tone Use total level	SEParate	–	V3.0

Description of command

This command defines how the voltage of each of the test tones is determined.

- In the default setting `SEParate`, the levels of all tones are defined separately and may differ from each other (see command `CONFigure:MULTitone:...:TDEFinition` above).
- In the setting `TLEV`, the total AF generator level of 200 mV (see command `CONFigure:MULTitone:...:TDEFinition:TLEVel below)` is evenly distributed among all 20 **enabled** test tones. Test tones can still be enabled or disabled and their frequency can be changed (see `CONF:MULT:...TDEF...` commands above), but level settings will be ignored as long as `TLEV` remains effective.

CONFigure:MULTitone:AF1Channel:TDEFinition:TLEVel *<Total_Level>* Total Level
CONFigure:MULTitone:AF2Channel:TDEFinition:TLEVel *<Total_Level>*

<Total_Level>	Description of parameters	Def. value	Def. unit	FW vers.
0.0 V to 5.0 V	Total level/voltage (sum of all test tones)	0.200	V	V3.0

Description of command

This command defines the total AF generator level that is evenly distributed among all enabled test tones. The total level setting comes into effect after the level selection mode is set to `TLEV` (see `CONFigure:MULTitone:...TDEFinition:MODe` command above). The total level must not exceed the maximum AF generator level quoted in the data sheet.

DEFault:MULTitone:AF1Channel:TDEFinition *<Enable>* DEFault:MULTitone:AF2Channel:TDEFinition *<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	–	V3.0
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 results in an error message). If used as a query the command returns whether all parameters are set to their default values *(ON)* or not *(OFF)*.				

DEFault:MULTitone:TDEFinition *<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	–	V3.0
Description of command				
If used as a setting command with the parameter *ON* this command sets all parameters of the subsystem (including `AF1Channel` and `AF2Channel`) to their default values (the setting OFF results in an error message). If used as a query the command returns whether all parameters are set to their default values *(ON)* or not *(OFF)*.				

Path Configuration – Subsystem MULTitone:AF1Channel:FILTer

The subsystem *MULTitone:AF1Channel:FILTer* configures the voice-processing equipment used for the *Multitone* measurement. The subsystem corresponds to the *Filters* tab of the popup menu *Multitone Configuration.*

CONFigure:MULTitone:AF1Channel:FILTer:BPASs:DCCoupling Band Pass, DC Coupling
CONFigure:MULTitone:AF2Channel:FILTer:BPASs:DCCoupling
<Bandpass>

<Bandpass>	Description of parameters	Def. value	Def. unit	FW vers.
	CMU band pass filter with a bandwidth of	BP17	–	V3.0
BP02 |	6 Hz to 250 Hz			
BP03 |	50 Hz to 250 Hz			
BP05 |	6 Hz to 3000 Hz			
BP06 |	50 Hz to 3000 Hz			
BP07 |	300 Hz to 3000 Hz			
BP09 |	6 Hz to 4000 Hz			
BP10 |	50 Hz to 4000 Hz			
BP11 |	300 Hz to 4000 Hz			
BP13 |	6 Hz to 15000 Hz			
BP14 |	50 Hz to 15000 Hz			
BP15 |	300 Hz to 15000 Hz			
BP17 |	6 Hz to 21000 Hz			
BP18	50 Hz to 21000 Hz			

Description of command

This command selects the band pass filter to be used if the AF path coupling is set to DC (see `CONFigure:AFANalyzer[:PRIMary]:COUPling` command).

CONFigure:MULTitone:AF1Channel:FILTer:BPASs:ACCoupling Band Pass, AC Coupling
CONFigure:MULTitone:AF2Channel:FILTer:BPASs:ACCoupling
<Bandpass>

<Bandpass>	Description of parameters	Def. value	Def. unit	FW vers.
	CMU band pass filter with a bandwidth of	BP16	–	V3.0
BP01 |	0 Hz to 250 Hz			
BP02 |	6 Hz to 250 Hz			
BP03 |	50 Hz to 250 Hz			
BP04 |	0 Hz to 3000 Hz			
BP05 |	6 Hz to 3000 Hz			
BP06 |	50 Hz to 3000 Hz			
BP07 |	300 Hz to 3000 Hz			
BP08 |	0 Hz to 4000 Hz			
BP09 |	6 Hz to 4000 Hz			
BP10 |	50 Hz to 4000 Hz			
BP11 |	300 Hz to 4000 Hz			
BP12 |	0 Hz to 15000 Hz			
BP13 |	6 Hz to 15000 Hz			
BP14 |	50 Hz to 15000 Hz			
BP15 |	300 Hz to 15000 Hz			
BP16 |	0 Hz to 21000 Hz			
BP17 |	6 Hz to 21000 Hz			
BP 18	50 Hz to 21000 Hz			

Description of command

This command selects the band pass filter to be used if the AF path coupling is set to AC (see `CONFigure:AFANalyzer[:PRIMary]:COUPling` command).

CONFigure:MULTitone:AF1Channel:FILTer:WEIGhting <*Weighting*>
CONFigure:MULTitone:AF2Channel:FILTer:WEIGhting <*Weighting*> — Weighting

<Weighting>	Description of parameters	Def. value	Def. unit	FW vers.
CME | **CCI |** **OFF**	Switch on C-message weighted filter Switch on CCITT weighting filter No weighting filter	OFF	–	V3.0

Description of command

This command selects the weighting filter to be included in the AF input signal path.

DEFault:MULTitone:AF1Channel:FILTer <*Enable*>
DEFault:MULTitone:AF2Channel:FILTer <*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	–	V3.0

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 results in an error message).

If used as a query the command returns whether all parameters are set to their default values *(ON)* or not *(OFF)*.

DEFault:MULTitone:FILTer <*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	–	V3.0

Description of command

If used as a setting command with the parameter *ON* this command sets all parameters of the subsystem (including `AF1Channel` and `AF2Channel`) to their default values (the setting OFF results in an error message).

If used as a query the command returns whether all parameters are set to their default values *(ON)* or not *(OFF)*.

Results – Subsystem MULTitone:...?

The subsystem *MULTitone:...?* measures the AF input level, returns the results and compares them with the tolerance values. The subsystem corresponds to the various output elements in the measurement menu *Multitone.*

READ[:SCALar]:MULTitone:AF1Channel:TONE<nr>? Multitone Results
READ[:SCALar]:MULTitone:AF2Channel:TONE<nr>?
Start single shot measurement and return results ⇒ *RUN*
FETCh[:SCALar]:MULTitone:AF1Channel:TONE<nr>?
FETCh[:SCALar]:MULTitone:AF2Channel:TONE<nr>? Read results (unsynchronized) ⇒ *RUN*
SAMPle[:SCALar]:MULTitone:AF1Channel:TONE<nr>?
SAMPle[:SCALar]:MULTitone:AF2Channel:TONE<nr>? Read results (synchronized) ⇒ *RUN*

Returned values	Description of parameters	Def. value	Def. unit	FW vers.
–100.0 dB to +20.0 dB	AF response at point <nr>	NAN	dB	V3.0

Description of command

These commands are always queries. They return the audio level at test tones <nr> (<nr> = 1 to 20) defined via `CONFigure:MULTitone:AF1Channel:TONE<nr>`.

Multitone Results
READ:ARRay:MULTitone:AF1Channel? Start single shot measurement and return results ⇒ *RUN*
READ:ARRay:MULTitone:AF2Channel?
FETCh:ARRay:MULTitone:AF1Channel? Read meas. results (unsynchronized) ⇒ *RUN*
FETCh:ARRay:MULTitone:AF2Channel?
SAMPle:ARRay:MULTitone:AF1Channel? Read results (synchronized) ⇒ *RUN*
SAMPle:ARRay:MULTitone:AF2Channel?

Returned values	Description of parameters	Def. value	Def. unit	FW vers.
–100.0 dB to +20.0 dB,	FreqResp[1], 1st value for AF response	NAN	dB	V3.0
...	...	...	...	
–100.0 dB to +20.0 dB	FreqResp[20], 20th value for AF resp.	NAN	dB	

Description of command

These commands are always queries. They return the audio level at the 20 test tones defined via `CONFigure:MULTitone:AF1Channel:TONE<nr>`.

READ:SUBarrays:MULTitone:AF1Channel?	Subarray Results Start single shot measurement and return results	⇒ *RUN*
READ:SUBarrays:MULTitone:AF2Channel?		
FETCh:SUBarrays:MULTitone:AF1Channel?	Read meas. results (unsynchronized)	⇒ *RUN*
FETCh:SUBarrays:MULTitone:AF2Channel?		
SAMPle:SUBarrays:MULTitone:AF1Channel?	Read results (synchronized)	⇒ *RUN*
SAMPle:SUBarrays:MULTitone:AF2Channel?		

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**	FreqResp[1], 1st value for AF response ... FreqResp[n], nth value for AF response	NAN ... NAN	dB ... dB	V3.0

Description of command

These commands are always queries. They return the audio level in the subranges defined by means of the `CONFigure:SUBarrays:MULTitone:AF1Channel` 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:MULTitone:AF1Channel` command defines a maximum of 32 subranges. If one of the statistical modes `(ARIThmetical, MINimum, MAXimum)` or `IVAL` is set, only one value is returned by subrange.

CALCulate[:SCALar]:MULTitone:AF1Channel:TONE<nr>:MATChing:LIMit? Limit Matching
CALCulate[:SCALar]:MULTitone:AF2Channel:TONE<nr>:MATChing:LIMit?

Returned result	Value range	Def. value	Def. unit	FW vers.
Limit matching at tone <nr>	NMAU | NMAL | INV | OK	INV	–	V3.0

Description of command

This command is always a query. It indicates whether and in which way the error limits at tone <nr> (<nr> = 1 to 20) have been exceeded.

The following messages may be returned for test tone <nr>:

NMAU	Underflow of tolerance value	*not matching, underflow*
NMAL	Tolerance value exceeded	*not matching, overflow*
INV	Measurement invalid	*invalid*
OK	all tolerances matched	

CALCulate[:SCALar]:MULTitone:AF1Channel:MATChing:LIMit? Limit Matching, Overall
CALCulate[:SCALar]:MULTitone:AF2Channel:MATChing:LIMit?

Returned result	Value range	Def. value	Def. unit	FW vers.
Limit matching at tone 1, **...,** **Limit matching at tone 20**	For tones 1 to 20: NMAU | NMAL | INV | OK	INV	–	V3.0

Description of command

This command is always a query. It indicates whether and in which way the error limits at all test tones 1 to 20 have been exceeded. The output string contains 20 values separated by commas.

CALCulate:ARRay:MULTitone:AF1Channel:MATChing:LIMit? **CALCulate:ARRay:MULTitone:AF2Channel:MATChing:LIMit?**				Limit Matching, Overall
Returned result	Value range	Def. value	Def. unit	FW vers.
20 bit field, **20 bit field**	Indicator for upper limit matching at tone 1 to 20 Indicator for lower limit matching at tone 1 to 20	NAN NAN	– –	V3.0
Description of command				
This command is always a query. Any bit of the two returned fields that is set indicates that the limits at the corresponding point are exceeded.				

List of Commands

In the following, all remote-control commands of function group *RF Non-Signalling* implemented in the CMU will be listed with their parameters and page numbers. Generally, they are arranged alphabetically according to the **second** keyword of the command so that related commands belong to the same group. For a list of common commands see Table 6-1 in section *Common Commands.*

Table 6-1 List of remote-control commands: CMU base system

Command	Parameters	Remarks	Page
Subsystem COMMunicate (interface parameters)			
SYSTem:COMMunicate:GPIB[:SELF]:ADDRess	0 to 30	with query	6.11
SYSTem:COMMunicate:SERial<1|2>:APPLication	–	query only	6.11
SYSTem:COMMunicate:SERial<1|2>:TRANsmit:PACE	XON|ACK|NONE	with query	6.12
SYSTem:COMMunicate:SERial<1|2>[:RECeive]:BAUD	110 to 115200	with query	6.11
SYSTem:COMMunicate:SERial<1|2>[:RECeive]:BITs	7|8	with query	6.12
SYSTem:COMMunicate:SERial<1|2>[:RECeive]:PARity[:TYPE]	NONE|ODD|EVEN	with query	6.12
SYSTem:COMMunicate:SERial<1|2>[:RECeive]:STOP	1|2	with query	6.12
Subsystem ERRor (error queue)			
SYSTem:ERRor?		query only	6.5
***GTL (Go to Local)**			
*GTL	–	no query	6.15
Subsystem GTRMode (go to remote)			
SYSTem:GTRMode:COMPatible	ON|OFF	with query	6.15
***LLO (local lockout)**			
*LLO	TRUE | FALSe	no query	6.17
Subsystem MISC (keyboard settings)			
SYSTem:MISC:KBEep	ON|OFF	with query	6.14
SYSTem:MISC:KEYBoard	US|GR	with query	6.14
Subsystem MMEMory (mass memory)			
MMEMory:CDIRectory	<DirectoryName>	no query	6.20
MMEMory:COMMent	<Comment>	with query	6.19
MMEMory:COPY	*<FileSource>, <msus1>, <FileDest>, <msus2>* | *<FileSource>, <FileDest>*	no query	6.20
MMEMory:DATA?	<FileName> ,<Data>	with query	6.22
MMEMory:DELete	<FileName> [,<msus>]	no query	6.20
MMEMory:DIRectory[:CURRent]?	<DirectoryName>	query only	6.19
MMEMory:INFO?	<FileName> [,<msus>]	query only	6.18
MMEMory:MKDir	<DirName> [,<msus>]	no query	6.20
MMEMory:MOVE	*<FileSource>, <msus1>, <FileDest>, <msus2>* | *<FileSource>, <FileDest>*	no query	6.21
MMEMory:MSIS	[<msus>]	with query	6.19
MMEMory:RECall:CURRent	<FileName> [,<msus>]	no query	6.23

Command	Parameters	Remarks	Page
MMEMory:RECall[:ALL]	<FileName> [,<msus>]	no query	6.22
MMEMory:REName	<FileSource>[,<msus1>], <FileDest> [,<msus2>]	no query	6.21
MMEMory:RMDir	<DirName> [,<msus>]	no query	6.20
MMEMory:SAVE:CURRent	<FileName> [,<msus>]	no query	6.22
MMEMory:SAVE[:ALL]	<FileName> [,<msus>]	no query	6.22
MMEMory:SCAN?	INT | EXT, D , <DirectoryName1>,<Directory Name2>,... ,F , <FileName1>,<FileName2>,.. . ,	query only	6.21
Subsystem MQueue (measurement queue)			
SYSTem:MQUeue[:COMPlete]:ITEM?	US|GR	query only	6.16
SYSTem:MQUeue[:COMPlete][:LIST]?	<Meas_Queue>	query only	6.15
Subsystem OPTions (options)			
SYSTem:OPTions:INFO:CURRent?		query only	6.25
SYSTem:OPTions:INFO?		query only	6.12
SYSTem:OPTions?		query only	6.13
Subsystem PRESet (general reset)			
SYSTem:PRESet[:ALL]		no query	6.16
SYSTem:RESet:CURRent		no query	6.16
SYSTem:RESet[:ALL]		no query	6.16
Subsystem REMote (remote control)			
SYSTem:REMote:ADDRess:PRIMary	0 to 30	with query	6.10
SYSTem:REMote:ADDRess:SECondary	1 to 29,<Remote-FGrp-Name> | NONe	with query	6.10
*SEC	1 to 29	no query	6.11
System STATus (status reporting system)			
STATus:OPERation:CMU:ALL	0 to 32767, ... , 0 to 32767	query only	6.7
STATus:OPERation:CMU:CLEar	–	no query	6.7
STATus:OPERation:CMU:SUM<nr>:CMU<nr_event>:ENABle	0 to 32767	with query	6.7
STATus:OPERation:CMU:SUM<nr>:CMU<nr_event>[EVENt]?	–	query only	6.6
STATus:OPERation:CMU:SUM<nr>:ENABle	0 to 32767	with query	6.6
STATus:OPERation:CMU:SUM<nr>[EVENt]?		query only	6.6
STATus:OPERation:ENABle	0 to 32767	with query	6.6
STATus:OPERation:EVENt:SADDress?	<SecAddr>,<Fgrp>	query only	6.9
STATus:OPERation:SYMBolic:ENABle	<Event>{,<Event>}	with query	6.9
STATus:OPERation:SYMBolic:ENABle	<Event>{,<Event>}	with query	6.63
STATus:OPERation:SYMBolic[:EVENt]?	NONE | <Event>{,<Event>}	query only	6.9
STATus:OPERation:SYMBolic[:EVENt]?	NONE | <Event>{,<Event>}	query only	6.63
STATus:OPERation[EVENt]?	–	query only	6.6
STATus:PRESet	–	No query	6.7
STATus:QUEStionable:ENABle	0 to 32767	with query	6.7
STATus:QUEStionable[EVENt]?		query only	6.7

Command	Parameters	Remarks	Page
Subsystem SYNChronize (reference frequency)			
CONFigure:SYNChronize:FREQuency:REFerence	10 kHz to 52 MHz	with query	6.23
[SENSe:]SYNChronize:FREQuency:REFerence:LOCKed?	ON | OFF	query only	6.23
CONFigure:SYNChronize:FREQuency:REFerence:MODE	INTernal | EXTernal	with query	6.23
SYSTem (system parameters)			
SYSTem:ERRor?		query only	6.5
SYSTem:NONVolatile:DISable		no query	6.5
SYSTem:VERSion?		query only	6.5
SYSTem:TIMe:DATe	YYYY,MM,DD	with query	6.14
SYSTem:TIMe:TZONe	-12 to +12,-59 to +59	with query	6.13
SYSTem:TIMe[:TIMe]	0 to 23,0 to 59,0 to 59	with query	6.13
TRACe (remote report)			
TRACe:REMote:MODE:DISPlay	ON | OFF	-	6.17
TRACe:REMote:MODE:ERRor	ON | OFF	-	6.17
TRACe:REMote:MODE:FILE	ON | OFF	-	6.17
TRACe:REMote:MODE:OUTLines	1 to 4	-	6.18
TRACe:REMote:MODE:SQR	ON | OFF	-	6.17

Table 6-2 List of remote-control commands: RF measurements

Command	Parameters	Remarks	Page
Subsystem CORRection:LOSS (Ext. Attenuation)			
[SENSe:]CORRection:LOSS:INPut<nr>[:MAGNitude]	–50 dB to 50 dB	with query	6.39
SOURce:CORRection:LOSS:INPut<nr>[:MAGNitude]	–50 dB to 50 dB	with query	6.39
[SENSe:]CORRection:LOSS:OUTPut<nr>:AUXTx[:MAGNitude]	–50 dB to 50 dB	with query	6.40
SOURce:CORRection:LOSS:OUTPut<nr>:AUXTx[:MAGNitude]	–50 dB to 50 dB	with query	6.40
[SENSe:]CORRection:LOSS:OUTPut<nr>[:TX][:MAGNitude]	–50 dB to 50 dB	with query	6.40
SOURce:CORRection:LOSS:OUTPut<nr>[:TX][:MAGNitude]	–50 dB to 50 dB	with query	6.40
SOURce:DM:CLOCk:STATe	ON | OFF	with query	6.40
Subsystem DM:CLOCk (Synchronization)			
SOURce:DM:CLOCk:FREQuency	1.250 MHz to 40.000 MHz	with query	6.41
SOURce:DM:CLOCk:STATe	ON | OFF	with query	6.40
Subsystem INPut, OUTput ( )			
INPut[:STATe]	ON | OFF	with query	6.39
OUTPut[:STATe]	ON | OFF	with query	6.39
Subsystem IQIF (I/Q-IF Signals)			
IQIF:DEFault	ON | OFF	with query	6.43
CONFigure:IQIF:RXPath	BYP | BYIQ | XOIO | IOIO | IOXO	with query	6.42
CONFigure:IQIF:RXTXcombined	BYP | BYIQ | XOIO | IOIO | IOXO | FPAT | UDEF	with query	6.42

Command	Parameters	Remarks	Page
CONFigure:IQIF:TXPath	BYP | BYIQ | XOIO | IOIO | IOXO	with query	6.42
Subsystem LEVel (Input Level)			
[SENSe:]LEVel:ATTenuation	NORMal | LNOise | LDIStortion	with query	6.27
[SENSe:]LEVel:DEFault	ON | OFF	with query	6.27
[SENSe:]LEVel:MAXimum	–37 dBm to +53 dBm	depending on input and ext. attenuation set	6.26
[SENSe:]LEVel:MODE	MANual | AUTO	with query	6.27
[SENSe:]LEVel:REFerence	–100 dBm to +53 dBm	depending on input and ext. attenuation set	6.27
Subsystem NPOWer (narrow-band power)			
INITiate:NPOWer	–	no query	6.59
ABORt:NPOWer	–	no query	6.59
STOP:NPOWer	–	no query	6.59
CONTinue:NPOWer	–	no query	6.59
[SENSe:]NPOWer:BWIDth[:RESolution]	10 Hz to 1 MHz	with query	6.61
CONFigure:NPOWer:CONTrol	1 to 1000 | NONE,CONTinuous | SINGleshot | 1 ... 10000, SONerror | NONE,STEP | NONE	with query	6.60
CONFigure:NPOWer:CONTrol:REPetition	CONTinuous | SINGleshot | 1 ... 10000, SONerror | NONE,STEP | NONE	with query	6.61
CONFigure:NPOWer:CONTrol:STATistics	1 to 1000 | NONE	with query	6.61
CONFigure:NPOWer:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.59
FETCh:NPOWer:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 1 to 10000 | NONE, 1 to 1000 | NONE	query only	6.60
READ[:SCALar]:NPOWer?	–30 dBm to +30 dBm	query only	6.62
FETCh[:SCALar]:NPOWer?	–30 dBm to +30 dBm	query only	6.62
SAMPle[:SCALar]:NPOWer?	–30 dBm to +30 dBm	query only	6.62
Test object POWer (Power)			
INITiate:POWer	–	no query	6.44
ABORt:POWer	–	no query	6.44
STOP:POWer	–	no query	6.44
CONTinue:POWer	–	no query	6.44
CONFigure:SUBarrays:POWer	ALL | ARIThmetical | MINimum | MAXimum | IVAL,<Start>,<Samples>{,<Start>,<Samples>}	with query	6.48
READ:ARRay:POWer:AVERage?	–128.0 dBm to +48.0 dBm	query only	6.49
FETCh:ARRay:POWer:AVERage?	–128.0 dBm to +48.0 dBm	query only	6.49
SAMPle:ARRay:POWer:AVERage?	–128.0 dBm to +48.0 dBm	query only	6.49
READ:SUBarrays:POWer:AVERage?	–128.0 dBm to +48.0 dBm	query only	6.50
FETCh:SUBarrays:POWer:AVERage?	–128.0 dBm to +48.0 dBm	query only	6.50
SAMPle:SUBarrays:POWer:AVERage?	–128.0 dBm to +48.0 dBm	query only	6.50
CONFigure:POWer:CONTrol	SCALar | ARRay	with query	6.45

Command	Parameters	Remarks	Page
CONFigure:POWer:CONTrol:REPetition	CONTinuous | SINGleshot | 1 to 10000, NONE,STEP | NONE	with query	6.45
CONFigure:POWer:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.44
[SENSe:]POWer:FREQuency:BANDwidth[:RESolution]	10 Hz to 1 MHz	with query	6.46
[SENSe:]POWer:FREQuency:BWIDth[:RESolution]	10 Hz to 1 MHz	with query	6.46
[SENSe:]POWer:FREQuency:CENTer	10 kHz to 2.7 GHz	with query	6.46
[SENSe:]POWer:LEVel:RANGe	10.0 dB to 100.0 dB	with query	6.46
READ:ARRay:POWer:MAXimum?	–128.0 dBm to +48.0 dBm	query only	6.49
FETCh:ARRay:POWer:MAXimum?	–128.0 dBm to +48.0 dBm	query only	6.49
SAMPle:ARRay:POWer:MAXimum?	–128.0 dBm to +48.0 dBm	query only	6.49
READ:SUBarrays:POWer:MAXimum?	–128.0 dBm to +48.0 dBm	query only	6.50
FETCh:SUBarrays:POWer:MAXimum?	–128.0 dBm to +48.0 dBm	query only	6.50
SAMPle:SUBarrays:POWer:MAXimum?	–128.0 dBm to +48.0 dBm	query only	6.50
READ:ARRay:POWer:MINimum?	–128.0 dBm to +48.0 dBm	query only	6.49
READ:ARRay:POWer:MINimum?	–128.0 dBm to +48.0 dBm	query only	6.49
FETCh:ARRay:POWer:MINimum?	–128.0 dBm to +48.0 dBm	query only	6.49
FETCh:ARRay:POWer:MINimum?	–128.0 dBm to +48.0 dBm	query only	6.49
SAMPle:ARRay:POWer:MINimum?	–128.0 dBm to +48.0 dBm	query only	6.49
READ:SUBarrays:POWer:MINimum?	–128.0 dBm to +48.0 dBm	query only	6.50
READ:SUBarrays:POWer:MINimum?	–128.0 dBm to +48.0 dBm	query only	6.50
FETCh:SUBarrays:POWer:MINimum?	–128.0 dBm to +48.0 dBm	query only	6.50
FETCh:SUBarrays:POWer:MINimum?	–128.0 dBm to +48.0 dBm	query only	6.50
SAMPle:SUBarrays:POWer:MINimum?	–128.0 dBm to +48.0 dBm	query only	6.50
FETCh:POWer:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 0 to 10000 | NONE , 0 to 1000 | NONE	query only	6.44
[SENSe:]POWer:TIME:DELay	-1000.0 µs to +1000.0 µs	depending on span and bandwidth	6.47
[SENSe:]POWer:TIME:SPAN	10 µs to 10 s	depending on bandwidth	6.47
READ:ARRay:POWer[:CURRent]?	–128.0 dBm to +48.0 dBm	query only	6.49
FETCh:ARRay:POWer[:CURRent]?	–128.0 dBm to +48.0 dBm	query only	6.49
SAMPle:ARRay:POWer[:CURRent]?	–128.0 dBm to +48.0 dBm	query only	6.49
READ:SUBarrays:POWer[:CURRent]?	–128.0 dBm to +48.0 dBm	query only	6.50
FETCh:SUBarrays:POWer[:CURRent]?	–128.0 dBm to +48.0 dBm	query only	6.50
SAMPle:SUBarrays:POWer[:CURRent]?	–128.0 dBm to +48.0 dBm	query only	6.50
Subsystem OPTions (options)			
SYSTem:OPTions:INFO:CURRent?		query only	6.25
Save/Recall of settings			
MMEMory:RECall:CURRent	<FileName> [,<msus>]	no query	6.26
MMEMory:SAVE:CURRent	<FileName> [,<msus>]	no query	6.25
Partial reset			
SYSTem:RESet:CURRent	–	no query	6.26
Test object RFANalyzer (Power)			
INITiate:RFANalyzer	–	no query	6.30

Command	**Parameters**	**Remarks**	**Page**
ABORt:RFANalyzer	–	no query	6.30
STOP:RFANalyzer	–	no query	6.30
CONTinue:RFANalyzer	–	no query	6.30
[SENSe:]RFANalyzer:BANDwidth[:RESolution]	10 Hz to 1 MHz | WIDE	with query	6.30
[SENSe:]RFANalyzer:BWIDth[:RESolution]	10 Hz to 1MHz | WIDE	with query	6.30
CONFigure:RFANalyzer:CONTrol:REPetition	CONTinuous | SINGleshot | 1 to 10000, NONE,STEP | NONE	with query	6.32
CONFigure:RFANalyzer:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.31
[SENSe:]RFANalyzer:FREQuency	100 kHz to 2.7 GHz	with query	6.30
CONFigure:RFANalyzer:POWer:RTIMe	0 to xxx	with query	6.32
READ[:SCALar]:RFANalyzer:POWer?	-120.0 dBm to +47.0 dBm	query only	6.32
FETCh[:SCALar]:RFANalyzer:POWer?	-120.0 dBm to +47.0 dBm	query only	6.32
SAMPle[:SCALar]:RFANalyzer:POWer?	-120.0 dBm to +47.0 dBm	query only	6.32
FETCh:RFANalyzer:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 0 to 10000 | NONE , 0 to 1000 | NONE	query only	6.31
Generator object RFGenerator			
DEFault:RFGenerator	ON | OFF	with query	6.33
INITiate:RFGenerator	–	no query	6.33
ABORt:RFGenerator	–	no query	6.33
CONFigure:RFGenerator:APPLication	TX | AUXT | TXAT	with query	6.33
DEFault:RFGenerator:AUXTx	ON | OFF	with query	6.38
SOURce:RFGenerator:AUXTx: FREQuency	350 MHz to 550 MHz | 700 MHz to 1100 MHz | 1400 MHz to 2200 MHz	with query	6.38
SOURce:RFGenerator:AUXTx:LEVel	-137.0 dBm to + 13.0 dBm	restricted for RF1 / 2	6.38
SOURce:RFGenerator:BANDwidth	OFF | F30Khz | F300khz	with query	6.37
SOURce:RFGenerator:BWIDth	<Bandwidth>	with query	6.37
SOURce:RFGenerator:FHOPping:FREQuency	100.0 kHz to 2.7 GHz	with query	6.36
SOURce:RFGenerator:FHOPping:FREQuency:MODE	ABSolute | RELative	with query	6.36
SOURce:RFGenerator:FHOPping:STATe	OFF | ON	with query	6.36
SOURce:RFGenerator:MODulation	OFF | SSB | AM	with query	6.35
SOURce:RFGenerator:MODulation:SSB:FREQuency	-300 kHz to +300 kHz	with query	6.35
SOURce:RFGenerator:MODulation[:AM]:INDex	0% to 100%	with query	6.35
SOURce:RFGenerator:PULSe:STATe	OFF | ON	with query	6.37
FETCh:RFGenerator:STATus?	OFF | RUN | ERR	query only	6.34
DEFault:RFGenerator:TX	ON | OFF	with query	6.33
SOURce:RFGenerator[:TX]:FREQuency	100.0 kHz to 2.7 GHz	with query	6.34
SOURce:RFGenerator[:TX]:LEVel	-137.0 dBm to + 13.0 dBm	restricted for RF1 / 2	6.34
Test object SPECtrum			
INITiate:SPECtrum	–	no query	6.51
ABORt:SPECtrum	–	no query	6.51
STOP:SPECtrum	–	no query	6.51
CONTinue:SPECtrum	–	no query	6.51
CONFigure:SUBarrays:SPECtrum	ALL | ARIThmetical | MINimum	with query	6.54

Command	Parameters	Remarks	Page
	| MAXimum | IVAL,<Start>,<Samples>{,<Start>,<Samples>}		
READ:ARRay:SPECtrum:AVERage?	–128.0 dBm to +48.0 dBm	query only	6.55
FETCh:ARRay:SPECtrum:AVERage?	–128.0 dBm to +48.0 dBm	query only	6.55
SAMPle:ARRay:SPECtrum:AVERage?	–128.0 dBm to +48.0 dBm	query only	6.55
READ:SUBarrays:SPECtrum:AVERage?	–128.0 dBm to +48.0 dBm	query only	6.56
FETCh:SUBarrays:SPECtrum:AVERage?	–128.0 dBm to +48.0 dBm	query only	6.56
SAMPle:SUBarrays:SPECtrum:AVERage?	–128.0 dBm to +48.0 dBm	query only	6.56
CONFigure:SPECtrum:CONTrol	SCALar | ARRay, 1 to 1000 | NONE	with query	6.52
CONFigure:SPECtrum:CONTrol:REPetition	CONTinuous | SINGleshot | 1 to 10000, NONE, STEP | NONE	with query	6.53
[SENSe:]SPECtrum:DETector	PEAK | RMS	with query	6.52
CONFigure:SPECtrum:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.51
[SENSe:]SPECtrum:FREQuency:BANDwidth[:RESolution]	10 Hz to 1 MHz | AUTO	with query	6.53
[SENSe:]SPECtrum:FREQuency:BWIDth[:RESolution]	10 Hz to 1 MHz | AUTO	with query	6.53
[SENSe:]SPECtrum:FREQuency:CENTer	10.000005 MHz to 2.699999995 GHz	with query	6.53
[SENSe:]SPECtrum:FREQuency:SPAN	0.00001 MHz to 2.69999999 GHz	with query	6.53
[SENSe:]SPECtrum:FREQuency:STARt	10 MHz to 2.69999999 GHz	with query	6.53
[SENSe:]SPECtrum:FREQuency:STOP	10.00001 MHz to 2.7 GHz	with query	6.53
[SENSe:]SPECtrum:LEVel:RANGe	10 dB to 100 dB	with query	6.54
READ:ARRay:SPECtrum:MAXimum?	–128.0 dBm to +48.0 dBm	query only	6.55
FETCh:ARRay:SPECtrum:MAXimum?	–128.0 dBm to +48.0 dBm	query only	6.55
SAMPle:ARRay:SPECtrum:MAXimum?	–128.0 dBm to +48.0 dBm	query only	6.55
READ:SUBarrays:SPECtrum:MAXimum?	–128.0 dBm to +48.0 dBm	query only	6.56
FETCh:SUBarrays:SPECtrum:MAXimum?	–128.0 dBm to +48.0 dBm	query only	6.56
SAMPle:SUBarrays:SPECtrum:MAXimum?	–128.0 dBm to +48.0 dBm	query only	6.56
READ:ARRay:SPECtrum:MINimum?	–128.0 dBm to +48.0 dBm	query only	6.55
READ:ARRay:SPECtrum:MINimum?	–128.0 dBm to +48.0 dBm	query only	6.55
FETCh:ARRay:SPECtrum:MINimum?	–128.0 dBm to +48.0 dBm	query only	6.55
FETCh:ARRay:SPECtrum:MINimum?	–128.0 dBm to +48.0 dBm	query only	6.55
SAMPle:ARRay:SPECtrum:MINimum?	–128.0 dBm to +48.0 dBm	query only	6.55
READ:SUBarrays:SPECtrum:MINimum?	–128.0 dBm to +48.0 dBm	query only	6.56
READ:SUBarrays:SPECtrum:MINimum?	–128.0 dBm to +48.0 dBm	query only	6.56
FETCh:SUBarrays:SPECtrum:MINimum?	–128.0 dBm to +48.0 dBm	query only	6.56
FETCh:SUBarrays:SPECtrum:MINimum?	–128.0 dBm to +48.0 dBm	query only	6.56
SAMPle:SUBarrays:SPECtrum:MINimum?	–128.0 dBm to +48.0 dBm	query only	6.56
FETCh:SPECtrum:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 0 to 10000 | NONE , 0 to 1000 | NONE	query only	6.51
READ:ARRay:SPECtrum[:CURRent]?	–128.0 dBm to +48.0 dBm	query only	6.55
FETCh:ARRay:SPECtrum[:CURRent]?	–128.0 dBm to +48.0 dBm	query only	6.55
SAMPle:ARRay:SPECtrum[:CURRent]?	–128.0 dBm to +48.0 dBm	query only	6.55
READ:SUBarrays:SPECtrum[:CURRent]?	–128.0 dBm to +48.0 dBm	query only	6.56
FETCh:SUBarrays:SPECtrum[:CURRent]?	–128.0 dBm to +48.0 dBm	query only	6.56

Command	Parameters	Remarks	Page
SAMPle:SUBarrays:SPECtrum[:CURRent]?	–128.0 dBm to +48.0 dBm	query only	6.56
System STATus (status reporting system)			
STATus:OPERation:SYMBolic[:EVENt]?	NONE | <Event>{,<Event>}	query only	6.63
STATus:OPERation:SYMBolic:ENABle	<Event>{,<Event>}	with query	6.63
Subsystem TRIGger			
TRIGger[:SEQuence]:DEFault	ON | OFF	with query	6.29
TRIGger[:SEQuence]:SLOPe	POSitive | NEGative	with query	6.28
TRIGger[:SEQuence]:SOURce	IMMediate | RFPower | IFPower | EXTern	with query	6.28
TRIGger[:SEQuence]:SOURce:EXTernal	PIN6 | PIN7 | PIN8	with query	6.29
TRIGger[:SEQuence]:THReshold:IFPower	<Threshold>	with query	6.28
TRIGger[:SEQuence]:THReshold:RFPower	LOW | MEDium | HIGH	with query	6.28
TRIGger[:SEQuence]:DEFault	ON | OFF	with query	6.31
TRIGger[:SEQuence]:SLOPe	POSitive | NEGative	with query	6.30
TRIGger[:SEQuence]:SOURce	IMMediate | RFPower | IFPower | EXTern	with query	6.30
TRIGger[:SEQuence]:SOURce:EXTernal	PIN6 | PIN7 | PIN8	with query	6.31
TRIGger[:SEQuence]:THReshold:IFPower	<Threshold>	with query	6.30
TRIGger[:SEQuence]:THReshold:RFPower	LOW | MEDium | HIGH	with query	6.30
Subsystem WPOWer (wideband power)			
INITiate:WPOWer	–	no query	6.57
ABORt:WPOWer	–	no query	6.57
STOP:WPOWer	–	no query	6.57
CONTinue:WPOWer	–	no query	6.57
CONFigure:WPOWer:CONTrol:REPetition	CONTinuous | SINGleshot | 1 ... 10000, SONerror | NONE,STEP | NONE	with query	6.58
CONFigure:WPOWer:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.57
FETCh:WPOWer:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 1 ... 10000 | NONE	query only	6.57
READ[:SCALar]:WPOWer?	<Result>	query only	6.58
FETCh[:SCALar]:WPOWer?	<Result>	query only	6.58
SAMPle[:SCALar]:WPOWer?	<Result>	query only	6.58

Table 6-3 List of remote-control commands: Audio Measurements

Command	Parameters	Remarks	Page
Subsystem AFANalyzer			
INITiate:AFANalyzer:SECondary	–	no query	6.68
STOP:AFANalyzer:SECondary	–	no query	6.68
STOP:AFANalyzer:SECondary	–	no query	6.68
ABORt:AFANalyzer:SECondary	–	no query	6.68
CONTinue:AFANalyzer:SECondary	–	no query	6.68

Command	Parameters	Remarks	Page
CONFigure:AFANalyzer:SECondary:CONTrol:COUPling	AC | DC	with query	6.70
CONFigure:AFANalyzer:SECondary:CONTrol:DISTortion [:FREQuency]	100 Hz to 10000 Hz	with query	6.70
CONFigure:AFANalyzer:SECondary:CONTrol:REPetition	CONTinuous | SINGleshot | 1 to 10000, SONerror | NONE, STEP | NONE	with query	6.69
CONFigure:AFANalyzer:SECondary:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.68
CONFigure:AFANalyzer:SECondary:FILTer:BPASs:ACCoupling	BP01 to BP18	with query	6.71
CONFigure:AFANalyzer:SECondary:FILTer:BPASs:DCCoupling	BP01 to BP18	with query	6.72
CONFigure:AFANalyzer:SECondary:FILTer:VBPass:BWIDth	10 Hz to 1000 Hz	with query	6.71
CONFigure:AFANalyzer:SECondary:FILTer:VBPass :CFRequency	20 Hz to 20000 Hz	with query	6.70
CONFigure:AFANalyzer:SECondary:FILTer:WEIGhting	CME | CCI | OFF	with query	6.71
CONFigure:AFANalyzer:SECondary:MTReduce	LOWF | EXPF, <Frequency>	with query	6.69
FETCh:AFANalyzer:SECondary:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 1 to 10000 | NONE	query only	6.68
READ[:SCALar]:AFANalyzer:SECondary?	–	query only	6.73
FETCh[:SCALar]:AFANalyzer:SECondary?	–	query only	6.73
SAMPle[:SCALar]:AFANalyzer:SECondary?	–	query only	6.73
INITiate:AFANalyzer[:PRIMary]	–	no query	6.68
ABORt:AFANalyzer[:PRIMary]	–	no query	6.68
CONTinue:AFANalyzer[:PRIMary]	–	no query	6.68
CONFigure:AFANalyzer[:PRIMary]:CONTrol:COUPling	AC | DC	with query	6.70
CONFigure:AFANalyzer[:PRIMary]:CONTrol:DISTortion [:FREQuency]	100 Hz to 10000 Hz	with query	6.70
CONFigure:AFANalyzer[:PRIMary]:CONTrol:REPetition	CONTinuous | SINGleshot | 1 to 10000, SONerror | NONE, STEP | NONE	with query	6.69
CONFigure:AFANalyzer[:PRIMary]:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.68
CONFigure:AFANalyzer[:PRIMary]:FILTer:BPASs:ACCoupling	BP01 to BP18	with query	6.71
CONFigure:AFANalyzer[:PRIMary]:FILTer:BPASs:DCCoupling	BP01 to BP18	with query	6.72
CONFigure:AFANalyzer[:PRIMary]:FILTer:VBPass:BWIDth	10 Hz to 1000 Hz	with query	6.71
CONFigure:AFANalyzer[:PRIMary]:FILTer:VBPass:CFRequency	20 Hz to 20000 Hz	with query	6.70
CONFigure:AFANalyzer[:PRIMary]:FILTer:WEIGhting	CME | CCI | OFF	with query	6.71
CONFigure:AFANalyzer[:PRIMary]:MTReduce	LOWF | EXPF, <Frequency>	query only	6.69
FETCh:AFANalyzer[:PRIMary]:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 1 to 10000 | NONE	query only	6.68
READ[:SCALar]:AFANalyzer[:PRIMary]?	–	query only	6.73
FETCh[:SCALar]:AFANalyzer[:PRIMary]?	–	query only	6.73
SAMPle[:SCALar]:AFANalyzer[:PRIMary]?	–	query only	6.73
Subsystem AFGenerator			
INITiate:AFGenerator:SECondary	–	no query	6.73
ABORt:AFGenerator:SECondary	–	no query	6.73
SOURce:AFGenerator:SECondary:FREQuency	20 Hz to 20 kHz	with query	6.74
SOURce:AFGenerator:SECondary:LEVel	0 µV to 5 V	with query	6.74
SOURce:AFGenerator:SECondary:SMODe	20 Hz to 20 kHz	with query	6.74
FETCh:AFGenerator:SECondary:STATus?	OFF | RUN | ERR	query only	6.74

Command	Parameters	Remarks	Page
INITiate:AFGenerator[:PRIMary]	–	no query	6.73
ABORt:AFGenerator[:PRIMary]	–	no query	6.73
SOURce:AFGenerator[:PRIMary]:FREQuency	20 Hz to 20 kHz	with query	6.74
SOURce:AFGenerator[:PRIMary]:LEVel	0 µV to 5 V	with query	6.74
SOURce:AFGenerator[:PRIMary]:SMODe	20 Hz to 20 kHz	with query	6.74
FETCh:AFGenerator[:PRIMary]:STATus?	OFF | RUN | ERR	query only	6.74
Subsystem AFLevel (AF input level)			
[SENSe:]AFLevel:DEFault	ON | OFF	with query	6.67
[SENSe:]AFLevel:SECondary:MAXimum	<Level>	with query	6.67
[SENSe:]AFLevel:SECondary:MODE	MANual | AUTO	with query	6.66
[SENSe:]AFLevel[:PRIMary]:MAXimum	<Level>	with query	6.67
[SENSe:]AFLevel[:PRIMary]:MODE	MANual | AUTO	with query	6.66
Save/Recall of settings			
MMEMory:RECall:CURRent	<FileName> [,<msus>]	no query	6.65
MMEMory:SAVE:CURRent	<FileName> [,<msus>]	no query	6.66
Subsystem MULTitone			
INITiate:MULTitone:AF1Channel	–	no query	6.75
ABORt:MULTitone:AF1Channel	–	no query	6.75
STOP:MULTitone:AF1Channel	–	no query	6.75
CONTinue:MULTitone:AF1Channel	–	no query	6.75
CONFigure:SUBarrays:MULTitone:AF1Channel	ALL | ARITHmetical | MINimum | MAXimum | IVAL,<Range>{,<Range>}	with query	6.78
CONFigure:MULTitone:AF1Channel:AFGLead	0 s to 0.1 s	with query	6.77
CONFigure:MULTitone:AF1Channel:CONTrol	AC | DC	with query	6.76
CONFigure:MULTitone:AF1Channel:CONTrol:REPetition	CONTinuous | SINGleshot | 1 to 1000, SONerror | NONE, STEP | NONE	with query	6.77
CONFigure:MULTitone:AF1Channel:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.75
DEFault:MULTitone:AF1Channel:FILTer	ON | OFF	with query	6.85
CONFigure:MULTitone:AF1Channel:FILTer:BPASs:ACCoupling	*<Bandpass>*	with query	6.84
CONFigure:MULTitone:AF1Channel:FILTer:BPASs:DCCoupling	*<Bandpass>*	with query	6.84
CONFigure:MULTitone:AF1Channel:FILTer:WEIGhting	*<Weighting>*	with query	6.85
DISPlay:MULTitone:AF1Channel:GRID	ON | OFF	with query	6.76
DEFault:MULTitone:AF1Channel:LIMit:LINE	ON | OFF	with query	6.80
CONFigure:MULTitone:AF1Channel:LIMit:LINE:ASYMmetric :LOWer	*<Limit_1>, <Enable_1>, ... <Limit_20>, <Enable_20>*	with query	6.80
CONFigure:MULTitone:AF1Channel:LIMit:LINE:ASYMmetric :UPPer	*<Limit_1>, <Enable_1>, ... <Limit_20>, <Enable_20>*	with query	6.79
CALCulate[:SCALar]:MULTitone:AF1Channel:MATChing:LIMit?	<Result>	query only	6.87
CALCulate:ARRay:MULTitone:AF1Channel:MATChing:LIMit?	<Result>	query only	6.88
CONFigure:MULTitone:AF1Channel:RLEVel	0.001 V to 5.000 V	with query	6.76
CONFigure:MULTitone:AF1Channel:RMODe	RLEV | TON1 | ... | TON20	with query	6.77
FETCh:MULTitone:AF1Channel:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 1 to 10000 | NONE	query only	6.76
CONFigure:MULTitone:AF1Channel:TDEFinition	*<Freq_1>, <Lev_1>,*	with query	6.81

Command	Parameters	Remarks	Page
	<Enable_1>, ... <Freq_20>, <Lev_20>, <Enable_20>		
DEFault:MULTitone:AF1Channel:TDEFinition	ON | OFF	with query	6.83
CONFigure:MULTitone:AF1Channel:TDEFinition:MODE	<Total_Level>	with query	6.82
CONFigure:MULTitone:AF1Channel:TDEFinition:TLEVel	<Total_Level>	with query	6.82
CONFigure:MULTitone:AF1Channel:TDEFinition:TONE<nr>	<Frequency>, <Level>, ON | OFF	with query	6.82
CONFigure:MULTitone:AF1Channel:TONE<nr>:LIMit:LINE :ASYMmetric:LOWer	*<Limit>, <Enable>*	with query	6.80
CONFigure:MULTitone:AF1Channel:TONE<nr>:LIMit:LINE :ASYMmetric:UPPer	*<Limit>, <Enable>*	with query	6.79
CALCulate[:SCALar]:MULTitone:AF1Channel:TONE<nr> :MATChing:LIMit?	<Result>	query only	6.87
READ[:SCALar]:MULTitone:AF1Channel:TONE<nr>?	–100.0 dB to +20.0 dB	query only	6.86
FETCh[:SCALar]:MULTitone:AF1Channel:TONE<nr>?	–100.0 dB to +20.0 dB	query only	6.86
SAMPle[:SCALar]:MULTitone:AF1Channel:TONE<nr>?	–100.0 dB to +20.0 dB	query only	6.86
READ:ARRay:MULTitone:AF1Channel?	–100.0 dB to +20.0 dB	query only	6.86
FETCh:ARRay:MULTitone:AF1Channel?	–100.0 dB to +20.0 dB	query only	6.86
SAMPle:ARRay:MULTitone:AF1Channel?	–100.0 dB to +20.0 dB	query only	6.86
READ:SUBarrays:MULTitone:AF1Channel?	–100.0 dB to +20.0 dB	query only	6.87
FETCh:SUBarrays:MULTitone:AF1Channel?	–100.0 dB to +20.0 dB	query only	6.87
SAMPle:SUBarrays:MULTitone:AF1Channel?	–100.0 dB to +20.0 dB	query only	6.87
INITiate:MULTitone:AF2Channel	–	no query	6.75
ABORt:MULTitone:AF2Channel	–	no query	6.75
STOP:MULTitone:AF2Channel	–	no query	6.75
CONTinue:MULTitone:AF2Channel	–	no query	6.75
CONFigure:SUBarrays:MULTitone:AF2Channel	ALL | ARITHmetical | MINimum | MAXimum | IVAL,<Range>{,<Range>}	with query	6.78
CONFigure:MULTitone:AF2Channel:AFGLead	0 s to 0.1 s	with query	6.77
CONFigure:MULTitone:AF2Channel:CONTrol	AC | DC	with query	6.76
CONFigure:MULTitone:AF2Channel:CONTrol:REPetition	CONTinuous | SINGleshot | 1 to 1000, SONerror | NONE, STEP | NONE	with query	6.77
CONFigure:MULTitone:AF2Channel:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.75
DEFault:MULTitone:AF2Channel:FILTer	ON | OFF	with query	6.85
CONFigure:MULTitone:AF2Channel:FILTer:BPASs:ACCoupling	*<Bandpass>*	with query	6.84
CONFigure:MULTitone:AF2Channel:FILTer:BPASs:DCCoupling	*<Bandpass>*	with query	6.84
CONFigure:MULTitone:AF2Channel:FILTer:WEIGhting	*<Weighting>*	with query	6.85
DISPlay:MULTitone:AF2Channel:GRID	ON | OFF	with query	6.76
DEFault:MULTitone:AF2Channel:LIMit:LINE	ON | OFF	with query	6.80
CONFigure:MULTitone:AF2Channel:LIMit:LINE:ASYMmetric :LOWer	*<Limit_1>, <Enable_1>, ... <Limit_20>, <Enable_20>*	with query	6.80
CONFigure:MULTitone:AF2Channel:LIMit:LINE:ASYMmetric :UPPer	*<Limit_1>, <Enable_1>, ... <Limit_20>, <Enable_20>*	with query	6.79
CALCulate[:SCALar]:MULTitone:AF2Channel:MATChing:LIMit?	<Result>	query only	6.87
CALCulate:ARRay:MULTitone:AF2Channel:MATChing:LIMit?	<Result>	query only	6.88
CONFigure:MULTitone:AF2Channel:RLEVel	0.001 V to 5.000 V	with query	6.76
CONFigure:MULTitone:AF2Channel:RMODe	RLEV | TON1 | ... | TON20	with query	6.77
FETCh:MULTitone:AF2Channel:STATus?	OFF | RUN | STOP | ERR |	query only	6.76

Command	Parameters	Remarks	Page
	STEP | RDY, 1 to 10000 | NONE		
CONFigure:MULTitone:AF2Channel:TDEFinition	*<Freq_1>, <Lev_1>, <Enable_1>, ... <Freq_20>, <Lev_20>, <Enable_20>*	with query	6.81
DEFault:MULTitone:AF2Channel:TDEFinition	ON | OFF	with query	6.83
CONFigure:MULTitone:AF2Channel:TDEFinition:MODE	<Total_Level>	with query	6.82
CONFigure:MULTitone:AF2Channel:TDEFinition:TLEVel	<Total_Level>	with query	6.82
CONFigure:MULTitone:AF2Channel:TDEFinition:TONE<nr>	<Frequency>, <Level>, ON | OFF	with query	6.82
CONFigure:MULTitone:AF2Channel:TONE<nr>:LIMit:LINE :ASYMmetric:LOWer	*<Limit>, <Enable>*	with query	6.80
CONFigure:MULTitone:AF2Channel:TONE<nr>:LIMit:LINE :ASYMmetric:UPPer	*<Limit>, <Enable>*	with query	6.79
CALCulate[:SCALar]:MULTitone:AF2Channel:TONE<nr> :MATChing:LIMit?	<Result>	query only	6.87
READ[:SCALar]:MULTitone:AF2Channel:TONE<nr>?	–100.0 dB to +20.0 dB	query only	6.86
FETCh[:SCALar]:MULTitone:AF2Channel:TONE<nr>?	–100.0 dB to +20.0 dB	query only	6.86
SAMPle[:SCALar]:MULTitone:AF2Channel:TONE<nr>?	–100.0 dB to +20.0 dB	query only	6.86
READ:ARRay:MULTitone:AF2Channel?	–100.0 dB to +20.0 dB	query only	6.86
FETCh:ARRay:MULTitone:AF2Channel?	–100.0 dB to +20.0 dB	query only	6.86
SAMPle:ARRay:MULTitone:AF2Channel?	–100.0 dB to +20.0 dB	query only	6.86
READ:SUBarrays:MULTitone:AF2Channel?	–100.0 dB to +20.0 dB	query only	6.87
FETCh:SUBarrays:MULTitone:AF2Channel?	–100.0 dB to +20.0 dB	query only	6.87
SAMPle:SUBarrays:MULTitone:AF2Channel?	–100.0 dB to +20.0 dB	query only	6.87
DEFault:MULTitone:FILTer	ON | OFF	with query	6.85
DEFault:MULTitone:LIMit:LINE	ON | OFF	with query	6.81
DEFault:MULTitone:TDEFinition	ON | OFF	with query	6.83
Subsystem OPTions (options)			
SYSTem:OPTions:INFO:CURRent?		query only	6.65
Partial reset			
SYSTem:RESet:CURRent		no query	6.66

Alphabetical Command Lists

Table 6-4 Alphabetical list of remote-control commands: Base system

Command (Base System, alphabetical) Page

Table 6-5 Alphabetical list of remote-control commands: RF

Command (RF, alphabetical) **Page**

Command (RF, alphabetical) **Page**

Table 6-6 Alphabetical list of remote-control commands: Audio

Command (Audio, alphabetical) **Page**

Command (Audio, alphabetical) **Page**

Contents

7 Remote Control – Program Examples

The program examples in this chapter are intended to give a short introduction to GPIB bus programming of the CMU illustrating some of the concepts discussed in Chapter 5. For examples involving optional function groups (network tests) refer to the relevant manuals, e.g. *CMU-K21/-K22/-K23*.

Secondary Address Handling

The following example explains how to handle primary and secondary addressing and how to perform a simple measurement with the CMU. In the example, remote control via the *National Instruments* GPIB bus driver (NI-488.2) and the programming language C is used. Once the addresses are assigned, the same commands can be used in different function groups.

```
// Include header files
#include <string.h>

/*  NI488.2 header file */
#include <decl.h>

// GPIB board index
#define BdIndx                   0

// Primary address
#define pad                      20

// Secondary address for Base Definition (National Instruments specific)
#define sad_BASE                 96

// Secondary  Address for function groups definition
// (conforming to IEEE488.2)
#define _RF_NSig                  1
#define _GSM900MS_Sig             2
#define _GSM900MS_NSig            3
#define _GSM1800MS_Sig            4

#define sad_RF_NSig             sad_BASE + _RF_NSig
#define sad_GSM900MS_Sig        sad_BASE + _GSM900MS_Sig
#define sad_GSM900MS_NSig       sad_BASE + _GSM900MS_NSig
#define sad_GSM1800MS_Sig       sad_BASE + _GSM1800MS_Sig

// Timeout
#define tmo                     (int) 10

// EOT
#define eot                     (int) 1

// EOS
#define eos                     (int) 0

// Command definition for secondary address mapping
```

```
#define Map_Command             "SYST:REM:ADDR:SEC %d,\"%s\""

#define IdStr_RF_NSig                "RF_NSig"
#define IdStr_GSM900MS_Sig      "GSM900MS_Sig"
#define IdStr_GSM900MS_NSig     "GSM900MS_NSig"
#define IdStr_GSM1800MS_Sig    "GSM1800MS_Sig "

// Variable declarations
int h_BASE;
int h_RF_NSig;
int h_GSM900MS_Sig;
int h_GSM900MS_NSig;
int h_GSM1800MS_Sig;

char InBuffer [100];
char Command [100];

// Request of the basesystem handle
h_BASE = ibdev (BdIndx, pad, sad_BASE, tmo, eot, eos);

// Mapping of secondary addresses for the function groups
sprintf (Command, Map_Command, _RF_NSig,IdStr_RF_NSig);
ibwrt(h_BASE, Command, strlen(Command));
sprintf (Command, Map_Command, _GSM900MS_Sig, IdStr_GSM900MS_Sig);
ibwrt(h_BASE,Command, strlen(Command));
sprintf (Command, "Map_Command _GSM900MS_NSig, IdStr_GSM900MS_NSig);
ibwrt(h_BASE,Command, strlen(Command));
sprintf (Command, "Map_Command _GSM1800MS_Sig, IdStr_GSM1800MS_Sig);
ibwrt(h_BASE,Command, strlen(Command));

// Request of function group handles
h_RF_NSig = ibdev (BdIndx, pad, sad_RF_NSig, tmo, eot, eos);
h_GSM900MS_Sig = ibdev (BdIndx, pad, sad_GSM900MS_Sig, tmo, eot, eos);
h_GSM900MS_NSig = ibdev (BdIndx, pad, sad_GSM900MS_NSig, tmo, eot, eos);
h_GSM1800MS_Sig = ibdev (BdIndx, pad, sad_GSM1800MS_Sig, tmo, eot, eos);
```

Simple Measurements

The following measurement examples require option CMU-K21/-K22/-K23 to be installed – see separate operating manual for GSM900/1800/1900 mobile tests.

```
// Example for a GSM900 mobile with power and
// modulation measurement at PCL 5 and PCL 10


ibwrt(h_GSM900MS_Sig, "PROC:SIGN:MS:PCL 5", 18);
ibwrt(h_GSM900MS_Sig, "READ:SCAL:POW:RES?", 18);
ibrd (h_GSM900MS_Sig, InBuffer, sizeof (InBuffer));
...
ibwrt(h_GSM900MS_Sig, "READ:SCAL:MOD:RES?",18);
ibrd (h_GSM900MS_Sig, InBuffer, sizeof (InBuffer));
...
ibwrt(h_GSM900MS_Sig, "PROC:SIGN:MS:PCL 10",19);
```

```
ibwrt(h_GSM900MS_Sig, "READ:SCAL:POW:RES?",18);
ibrd (h_GSM900MS_Sig, InBuffer,sizeof (InBuffer));
...
ibwrt(h_GSM900MS_Sig, "READ:SCAL:MOD:RES?",18);
ibrd (h_GSM900MS_Sig, InBuffer,sizeof (InBuffer));
...

// Example for a GSM1800 mobile with a power and
// modulation measurement at PCL 5 and PCL 10


ibwrt(h_GSM1800MS_Sig, "PROC:SIGN:MS:PCL 5",18);
ibwrt(h_GSM1800MS_Sig, "READ:SCAL:POW:RES?",18);
ibrd (h_GSM1800MS_Sig, InBuffer,sizeof (InBuffer));
...
ibwrt(h_GSM1800MS_Sig, "READ:SCAL:MOD:RES?",18);
ibrd (h_GSM1800MS_Sig, InBuffer,sizeof (InBuffer));
...
ibwrt(h_GSM1800MS_Sig, "PROC:SIGN:MS:PCL 10",19);
ibwrt(h_GSM1800MS_Sig, "READ:SCAL:POW:RES?",18);
ibrd (h_GSM1800MS_Sig, InBuffer,sizeof (InBuffer));
...
ibwrt(h_GSM1800MS_Sig, "READ:SCAL:MOD:RES?",18);
ibrd (h_GSM1800MS_Sig, InBuffer,sizeof (InBuffer));
```

Measuring the I/Q Spectrum of a Mobile

GSM uses the GMSK modulation scheme with a symbol rate of 270.833 kBit/s and four different phases that can be occupied during one symbol interval. If a constant series of zeros or ones is transmitted, the rotation of the I/Q vector causes a side band at 270.833/4 Hz = 667.70825 Hz from the carrier. Compared to the side band, the original carrier frequency is suppressed by –30 dB to –40 dB. The following example program measures the carrier signal, the upper and the lower side band using the *RF Spectrum* and the *RF Power vs Time* measurement groups. No additional options are needed.

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. Program examples utilizing these statements can be found in the manuals for network tests, e.g. *GSM900/1800/1900-MS*. For the following example, configure your *Winbatch* settings such that *CMUBASE* is the device name for the CMU *BASE* system and *CMURF* denotes function group *RF (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 function group RF Non Signalling; the CMU Base
                                            system is always assigned secondary address 0

FPRINT ...............................................................................
FPRINT   CONNECTORS
FPRINT ...............................................................................

CMURF: INP:STAT RF2                     Define input connector RF2
CMURF: OUTP:STAT RF2                    Define output connector RF2

FPRINT ...............................................................................
FPRINT   RF GENERATOR SETTINGS
FPRINT ...............................................................................

CMURF: SOUR:RFG:FREQ 900 MHZ            Set RF generator frequency
CMURF: SOUR:RFG:MOD SSB                 Switch on frequency offset (single side band modulation)
CMURF: SOUR:RFG:MOD:SSB:FREQ 67.7 KHZ   Set offset frequency
CMURF: INIT:RFG;*OPC?                   Switch on RF generator


FPRINT ...............................................................................
FPRINT   SPECTRUM ANALYZER SETTINGS
FPRINT   REFERENCE LEVEL ONLY EXISTS IN THE MANUAL MODE (Defines display area)
FPRINT ...............................................................................

CMURF: SENS:SPEC:FREQ:CENT 900 MHZ      Set center frequency for spectrum measurement
CMURF: SENS:SPEC:FREQ:SPAN 500 KHZ      Set frequency span
CMURF: SENS:SPEC:FREQ:BAND 20 KHZ       Set resolution bandwidth of the spectrum analyzer
CMURF: CONF:SPEC:CONT:REP SING,NONE,NONE  Single shot measurement, no stop on error

FPRINT ...............................................................................
FPRINT   SPECTRUM MEASUREMENT AT 900 MHZ + OFFSET 67.7 KHZ, 1 POINT
FPRINT ...............................................................................

CMURF: CONF:ARR:SPEC:RANG 900.0677 MHZ,1  Select single measurement point at 900.0677 MHz
CMURF: READ:ARR:SPEC?                   Start single shot spectrum measurement, wait until it is
                                            terminated, and return result (1 value)

FPRINT ...............................................................................
FPRINT   HAVE A LOOK AT SPECIFIC OFFSETS (SUPPRESSED CARRIER AT 900 MHZ)
FPRINT ...............................................................................

CMURF: CONF:ARR:SPEC:RANG 900 MHZ,1     Select single measurement point
CMURF: READ:ARR:SPEC?                   Start single shot spectrum measurement, wait until it is
                                            terminated, and return result (1 value)

FPRINT ...............................................................................
FPRINT   HAVE A LOOK AT SPECIFIC OFFSETS (THE OTHER SIDEBAND 900 MHZ - 67.7 KHZ)
FPRINT ...............................................................................

CMURF: CONF:ARR:SPEC:RANG 899.9323 MHZ,1  Select single measurement point
CMURF: READ:ARR:SPEC?                   Start single shot spectrum measurement, wait until it is
                                            terminated, and return result (1 value)

FPRINT ...............................................................................
```

`CMURF: ABOR:SPEC`	Abort spectrum measurement and free resources

```
FPRINT .............................................................................
FPRINT   PRODUCE A RAMPED SIGNAL
FPRINT .............................................................................
```

`CMURF: SOUR:RFG:PULS:STAT ON;*OPC?`	Select pulsed signal (as opposed to CW)

```
FPRINT .............................................................................
FPRINT   CONFIGURE THE POWER/T MEASUREMENT
FPRINT .............................................................................
```

`CMURF: SENS:POW:FREQ:CENT 900.0677 MHZ`	Set center frequency for power vs. time measurement
`CMURF: SENS:POW:FREQ:BAND 20 KHZ`	Set resolution bandwidth of the RF analyzer
`CMURF: SENS:POW:TIME:SPAN 1MS`	Set evaluation time of power measurement
`CMURF: TRIG:SOUR IFP`	Trigger meas. by IF signal level (recommended)
`CMURF: LEV:MAX –10`	Set expected maximum input level
`CMURF: CONF:ARR:POW:RANG 3E-4,1`	Select single measurement point at 0.3 ms
`CMURF: CONF:POW:CONT:REP SING,NONE,NONE`	Single shot measurement, no stop on error
`CMURF: SYST:ERR?`	Read error queue
`CMURF: INIT:POW`	Initiate power vs. time measurement
`CMURF: READ:ARR:POW?`	Start single shot measurement, wait until it is terminated, and return result (1 value)

```
FPRINT .............................................................................
FPRINT   HAVE A LOOK AT SPECIFIC OFFSETS (SUPPRESSED CARRIER AT 900 MHZ)
FPRINT .............................................................................
```

`CMURF: SENS:POW:FREQ:CENT 900 MHZ`	Set center frequency for power vs. time measurement
`CMURF: READ:ARR:POW?`	Start single shot measurement, wait until it is terminated, and return result (1 value)

```
FPRINT .............................................................................
FPRINT   HAVE A LOOK AT SPECIFIC OFFSETS (THE OTHER SIDEBAND 900 MHZ - 67.7 KHZ)
FPRINT .............................................................................
```

`CMURF: SENS:POW:FREQ:CENT 899.9323 MHZ`	Set center frequency for power vs. time measurement
`CMURF: READ:ARR:POW?`	Start single shot measurement, wait until it is terminated, and return result (1 value)
`SETLOCAL`	Quit remote control mode

Symbolic Status Event Register Evaluation

The following example program shows how the EVENt part of the `STATus:OPERation` registers can be read using the commands for symbolic status register evaluation typed in boldface. The program provokes and evaluates the event *Reference Frequency Not Locked (RFNL)* which is reported by bit no. 6 of the `STATus:OPERation:CMU:SUM1:CMU1` sub-register assigned to the CMU base system (see sections *Symbolic Status Event Register Evaluation* and *STATus:OPERation Register* in chapter 5).

`CMUBASE: *RST;*OPC?`	Reset the instrument; prevent the following command from being executed before *RST is complete
`CMUBASE: *CLS`	Clear output buffer, set status byte
`CMUBASE: CONF:SYNC:FREQ:REF:MODE?`	
`CMUBASE: CONF:SYNC:FREQ:REF:MODE EXT`	Provoke event -> Reference Frequency Not Locked (external reference frequency selected but no external input signal available)

CMUBASE: TRACE:REMOTE:MODE:FILE ON	Remote trace to file
CMUBASE: TRACE:REMOTE:MODE:DISPLAY ON	Remote trace display ON
CMUBASE: TRACE:REMOTE:MODE:SRQ ON	Display SRQ event on remote trace window
CMUBASE: STATUS:PRESET	Reset status register system
CMUBASE: *STB?	Check status byte
CMUBASE: *SRE?	Check service request enable
CMUBASE: *SRE 128	Service request for OPERATION register
CMUBASE: *STB?	Check status byte
CMUBASE: STAT:OPER:SYMB:ENAB?	Check symbolic status register enable --> NONE
CMUBASE: STAT:OPER:SYMB:ENAB RFNL	Enable symbolic status register evaluation (event Reference Frequency Not Locked = RFNL)
[l_LOOP]	
if CMUBASE: *STB? <> 0 goto read_event	Read STB Bit 7 is set (that is SRQ)
PAUSE 2000	Wait 2 seconds
goto l_LOOP	
[read_event]	
CMUBASE: STAT:OPER:EVENT:SADD?	Eval. which SecAddr causes the Event? --> CMUBASE
CMUBASE: STAT:OPER:SYMB?	Eval. which bit (event) causes SRQ --> RFNL
CMUBASE: *STB?	
CMUBASE: *STB?	
goto l_LOOP	

Tips and Tricks for CMU Programming

The following section is intended to give hints for efficient programming and to point out frequent mistakes that may impair the system performance.

1. Avoid Frequent DLL Swapping

Many CMU function groups use the same commands enabling program parts to be reused in different contexts. As a consequence, commands may be repeated several times within a program that addresses several function groups. The CMU is designed for multi-mode operation, however, changing from one function group to another generally absorbs system capacity for loading new software modules. It is therefore advisable to group the commands so that the number of function group swaps is minimized.

Instead of

```
GSM900MS_Sig: <Setting_A>
GSM400MS_Sig: <Setting_A>
...
GSM900MS_Sig: <Setting_B>
GSM400MS_Sig: <Setting_B>
```

write

```
GSM900MS_Sig: <Setting_A>
GSM900MS_Sig: <Setting_B>
...
GSM400MS_Sig: <Setting_A>
GSM400MS_Sig: <Setting_B>
```

Contents

8 Maintenance and Interfaces

The following chapter contains information on the maintenance of the CMU.

Please follow the instructions in the service manual when exchanging modules or ordering spares. The order no. for spare parts can be found in the service manual.

The address of our support center and a list of all Rohde & Schwarz service centers can be found at the beginning of this manual.

The service manual includes further information particularly on troubleshooting, repair, exchange of modules (including battery exchange, adjustment of the OCXO oscillator) and calibration.

Maintenance

The CMU does not require any special maintenance. Remove any contamination on the instrument by means of a soft cloth. Make sure that the air vents are not obstructed.

Cleaning the Outside

The outside of the instrument is suitably cleaned using a soft, line-free dust cloth.

Caution!
Never use solvents such as thinners, acetone and similar things, as they may damage the front panel labeling or plastic parts.

Storing and Packing

The CMU can be stored at the temperature range quoted in the data sheet. When stored for an extended period of time the instrument should be protected against dust.

The original packing should be used, particularly the protective covers at the front and rear, when the instrument is to be transported or dispatched. If the original packing is no longer available, use a sturdy cardboard box of suitable size and carefully wrap the instrument to protect it against mechanical damage.

Hardware Interfaces

GPIB Bus Interface

The standard instrument is equipped with an GPIB bus (IEC/IEEE-bus) connection. The interface connector labeled *IEEE 488 / IEC 625* is located on the rear panel of the instrument. A controller for remote control can be connected via the GPIB bus interface using a shielded cable.

Characteristics of the Interface

- 8-bit parallel data transfer
- Bidirectional data transfer
- Three-line handshake
- High data transfer rate of max. 1 MByte/s
- Up to 15 devices can be connected
- Maximum length of the connecting cables 15 m. The length of a single connecting cable should not exceed 2 m, if many devices are used, it should not exceed 1 m.
- Wired OR if several instruments are connected in parallel

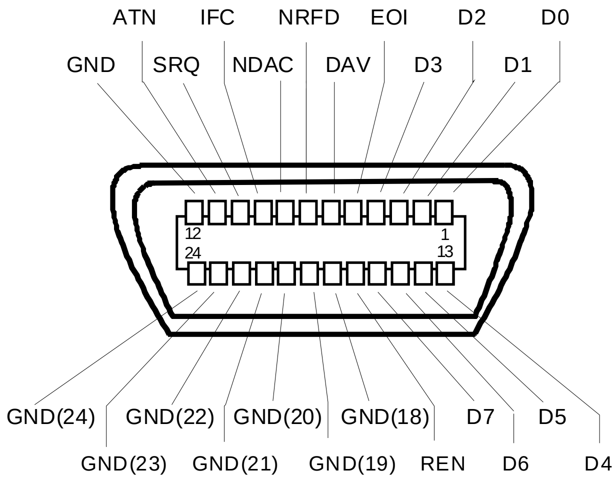


Fig. 8-1 Pin Assigment of the GPIB bus interface

Bus Lines

1. Data bus with 8 lines D0 to D7

The transmission is bit-parallel and byte-serial in the ASCII/ISO code. D0 is the least significant bit, D7 the most significant bit.

2. Control bus with 5 lines

IFC (Interface Clear),
active LOW resets the interfaces of the instruments connected to the default setting.

ATN (Attention),
active LOW signals the transmission of interface messages
inactive HIGH signals the transmission of device messages.

SRQ (Service Request),
active LOW enables the connected device to send a service request to the controller.

REN (Remote Enable),
active LOW permits switchover to remote control.

EOI (End or Identify),
has two functions in connection with ATN:

ATN=HIGH	active LOW marks the end of data transmission.
ATN=LOW	active LOW triggers a parallel poll.

3. Handshake bus with three lines

DAV (Data Valid),
active LOW signals a valid data byte on the data bus.

NRFD (Not Ready For Data),
active LOW signals that one of the connected devices is not ready for data transfer.

NDAC (Not Data Accepted),
active LOW signals that the instrument connected is accepting the data on the data bus.

Interface Messages

Interface messages are transmitted to the instrument on the data lines, with the attention line being active (LOW). They serve to communicate between controller and instrument.

Universal Commands

Universal commands are encoded in the range 10 through 1F hex. They are effective for all instruments connected to the bus without pervious addressing.

Table 8-1 Universal Commands

Command	QuickBASIC command	Effect on the instrument
DCL (Device Clear)	IBCMD (controller%, CHR$(20))	Aborts processing of the commands just received and sets the command processing software to a defined initial state. Does not change the instrument setting.
IFC (Interface Clear)	IBSIC (controller%)	Resets the interfaces to the default setting.
LLO (Local Lockout)	IBCMD (controller%, CHR$(17))	Locks switchover from remote control to *Local* (manual control) by means of the front panel keys

Addressed Commands

Addressed commands are encoded in the range 00 through 0F hex. They are only effective for instruments addressed as listeners.

Table 8-2 Addressed Commands

Command	QuickBASIC command	Effect on the instrument
GTL (Go to Local)	IBLOC (device%)	Transition to the *Local* state (manual control).

Note: *The CMU can not be configured as a high-speed HS488 listener; the commands CFE (Configure Enable) and CFGn (Configure) are not supported.*

Serial Interfaces (COM 1, COM 2)

The CMU is equipped with two serial RS-232-C interfaces. The two assigned 9-pin standard Sub-D male connectors are designated with COM 1 and COM 2 and located on the rear panel. A controller can be connected via this interface for remote control.

The two RS-232 interfaces provide two independent channels which can be active simultaneously. However, setting commands and queries act on the same device hardware. The interfaces are activated and configured in the *Setup - Remote* menu or via remote control using the commands `SYSTem:COMMunicate`...

Interface characteristics

- Serial data transmission in asynchronous mode,
- Bidirectional data transmission via two separate lines,
- Transmission rate selectable from 110 to 115200 baud,
- Logic 0 signal from +3 V to +15 V,
- Logic 1 signal from -15 V to -3 V,
- An external instrument (controller) can be connected,
- Hardware handshake RTS/CTS or software handshake XON/XOFF can be selected.

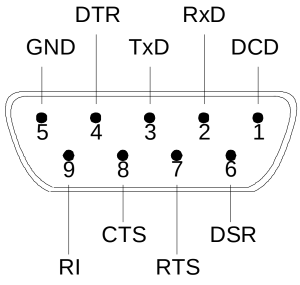


Fig. 8-2 Pin assignment of the RS-232-C interface

Designation	**Abbreviation**	**Pin (9-pin male)**	**Pin (25-pin male)**
Data Carrier Detect	DCD	1	8
Receive Data	RxD	2	3
Transmit Data	TxD	3	2
Data Terminal Ready	DTR	4	20
Signal Ground	GND	5	7
Data Set Ready	DSR	6	6
Request To Send	RTS	7	4
Clear To Send	CTS	8	5
Ring Indicator	RI	9	22

Signal lines

1. Data lines

RxD (Receive Data)
Input data.

Data transfer is bit-serial in the ASCII code, starting with the least significant bit (LSB).

TxD (Transmit Data)
Output data.

Data transfer is bit-serial in the ASCII code, starting with the least significant bit (LSB). The two data lines RxD and TxD are a minimum requirement for data transfer. The following control lines are necessary in addition if a hardware handshake is to be used.

2. Control and message lines

DCD (Data Carrier Detect)
active LOW.
Input; using this signal the data terminal recognizes that the modem of the remote station receives valid data with a sufficient signal level. DCD is used to disable the receiver in the data terminal and prevent reading of false data if the modem cannot interpret the signals of the remote station.

DTR (Data Terminal Ready)
active LOW,
Output; with DTR, the instrument indicates that it is ready to receive data.

DSR (Data Set Ready)
active LOW,
Input; DSR indicates to the instrument that the remote station is ready to receive data.

RTS (Request To Send)
active LOW.
Output; with RTS, the instrument indicates that it is ready to receive data. The RTS line controls whether the instrument is ready to receive data or not.

CTS (Clear To Send)
active LOW.
Input; CTS tells the instrument that the remote station is ready to receive data.

RI (Ring Indicator)
active LOW.
Input; RI is used by a modem to indicate that a remote station wants to set up a connection.

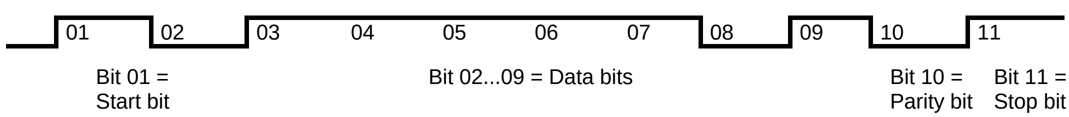
Transmission Parameters

In order to ensure error-free and correct data transmission, the parameters of the instrument and the controller must be set identically. The parameters of the RS-232 interface can be set via the *Setup - Remote* menu or the command group `SYSTem:COMMunicate...`

Table 8-3 Transmission parameters of the RS-232 interface

Parameter	**Default**	**Description / Parameter Range**
Baud rate	9600 baud[1]	The instrument allows baud rates between 110 and 115200 baud to be set, see chapter 4, *Setup - Remote* menu.
Data bits	8	Data transmission is in the 7- or 8-bit ASCII code, starting with the least significant bit (LSB).
Start bit	1	Each data byte begins with a start bit. The falling edge of the start bit indicates the beginning of the data byte.
Parity bit	None	A parity bit can be transmitted for error protection. The settings *No parity*, *even* or *odd* parity are allowed.
Stop bit	1	Transmission of a data byte is terminated by one or two stop bits. The sum of data bits and stop bits must be equal to 9.

Example: Transmission of character 'A' (41 Hex) in 8-bit ASCII code with even parity and one stop bit:



Interface functions

For interface control, some control characters from the ASCII code range of 0 to 20 hex are predefined and can be transmitted via the interface.

Table 8-4 Control strings or control characters of the RS-232-C interface

Control Character	**Function**
Break (at least 1 character only log 0)	Reset instrument
0Dhex, 0Ahex	Terminator <CR>, <LF> Switchover between local / remote

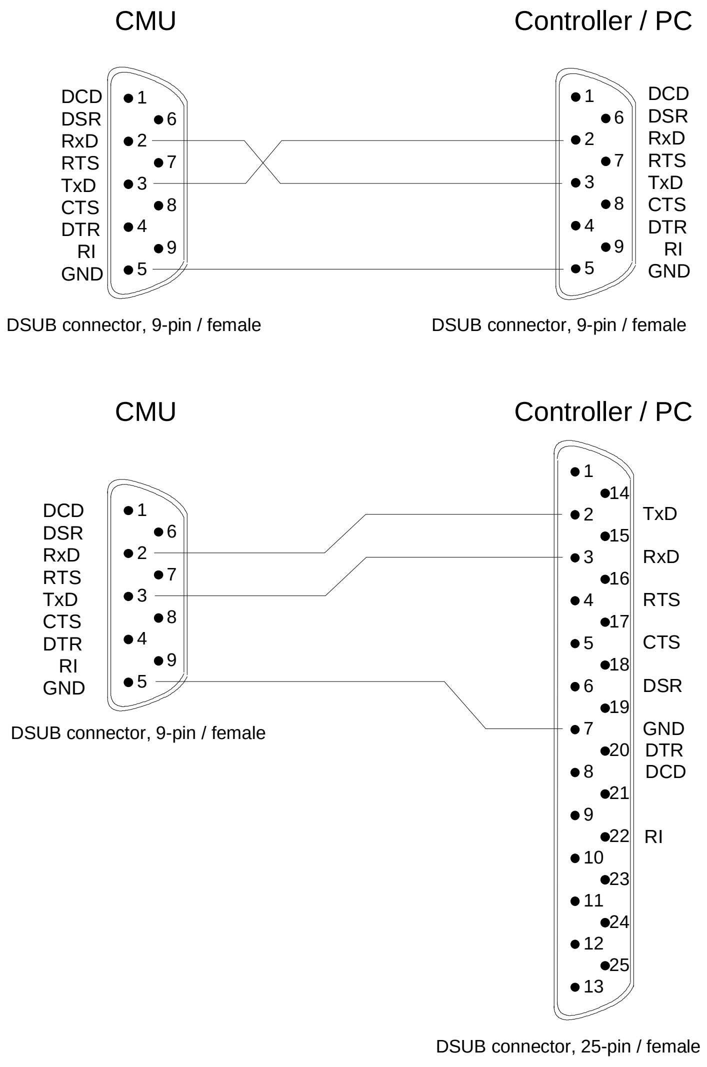
[1] The default baud rate is 19200 baud for COM ports that are used as GPIB connectors.

Handshake

Software handshake

In case of a software handshake data transfer is controlled using the two control characters XON / XOFF:

- The CMU uses the control character XON to indicate that it is ready to receive data.
- If the receive buffer is full it sends the XOFF character via the interface to the controller. The controller interrupts data output until it receives another XON from the CMU.
- In the same way the controller indicates to the CMU that it is ready to receive data.



Connection between instrument and controller (Null-modem cable)

The connection of the instrument to a controller is made with a so-called null-modem cable. Here, the data, control and signalling lines must be crossed. The wiring diagram on the left applies to a controller with a 9-pin or 25-pin configuration.

Fig. 8-3 Wiring of the data lines for software handshake

Hardware handshake

In case of a hardware handshake, the instrument signals that it is ready for reception via line DTR and RTS. A logic '0' means "ready" and a '1' means "not ready". The RTS line is always active (logical '0'), provided that the serial interface is switched on. The DTR line controls whether the analyzer is ready for reception or not.

The CTS or DSR lines (see signal lines) tell the instrument whether the remote station is ready for reception or not. A logical '0' on both lines switches on data transmission, a logical '1' on both lines stops data transmission of the generator. The TxD line is used for data transfer.

Connection between instrument and controller (Null-modem cable)

The connection of the instrument to a controller is made with a so-called null-modem cable. Here, the data, control and signalling lines must be crossed. The wiring diagram on the left applies to a controller with a 9-pin or 25-pin configuration.

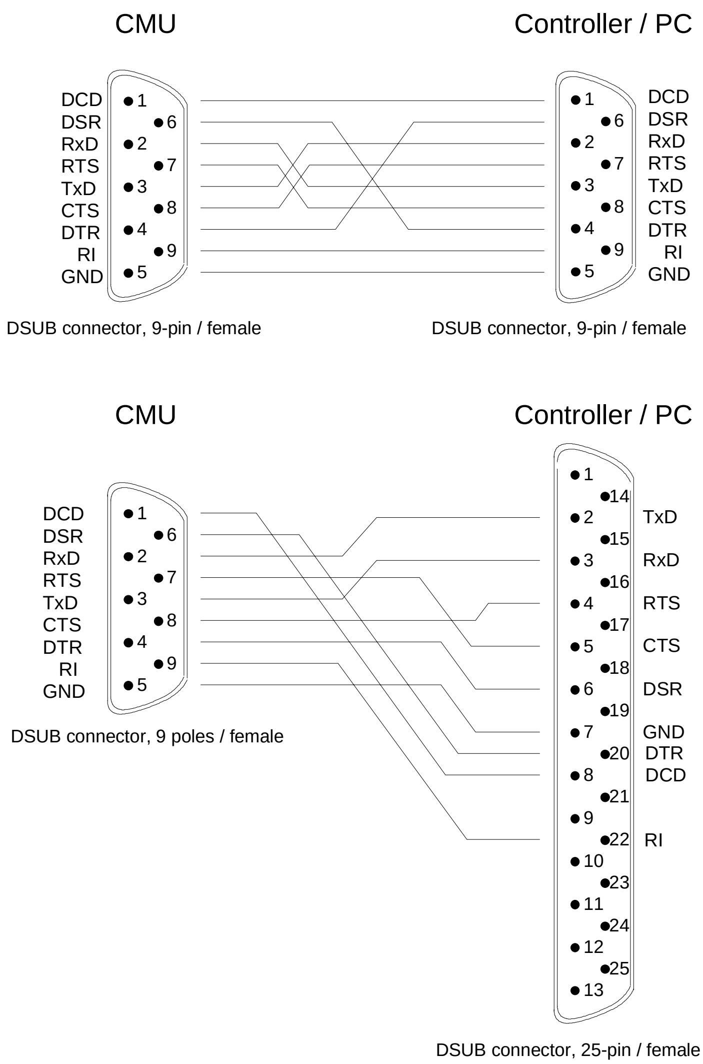


Fig. 8-4 Wiring of the data, control and message lines for hardware handshake

Connectors for Peripherals

Printer Connector (LPT)

The 25-pin standard Sub-D female connector LPT on the rear panel of the CMU is intended for connecting a printer. The interface is CENTRONICS compatible.

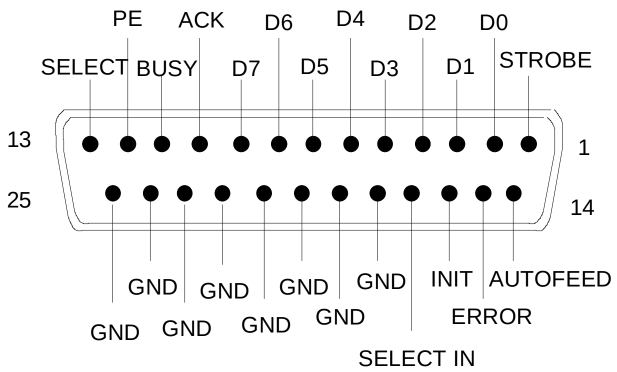


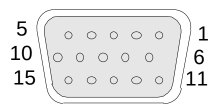
Fig. 8-5 Pin assignment of the LPT connector

Pin	**Signal**	**Input (I) Output (O)**	**Description**
1	STROBE	O	Impulse for transfer of a data byte, 1µs pulse width at minimum (active LOW)
2	D0	O	Data line 0
3	D1	O	Data line 1
4	D2	O	Data line 2
5	D3	O	Data line 3
6	D4	O	Data line 4
7	D5	O	Data line 5
8	D6	O	Data line 6
9	D7	O	Data line 7
10	ACK	I	Indicates that the printer is ready to receive the next byte (active LOW)
11	BUSY	I	Signal active if the printer is unable to receive data
12	PE	I	The signal is activated if no printer paper is available (active HIGH).
13	SELECT	I	The signal is activated when the printer is selected (active HIGH).
14	AUTOFEED	O	If the signal is active the printer inserts a line feed after each line (active LOW).
15	ERROR	I	The signal is activated if no printer paper is available or an error occurred (active LOW).
16	INIT	O	Initializing the printer (active LOW)
17	SELECT IN	O	If the signal is active the codes DC1/DC3 are ignored by the printer (active LOW).
18 - 25	GND		Connected to ground

Monitor Connector (MONITOR)

The 15-pin Sub-D female connector MONITOR at the rear panel of the CMU is intended for connecting an external VGA monitor.

MONITOR



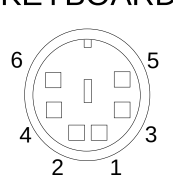
Pin No.	Signal
1	RED (output)
2	GREEN (output)
3	BLUE (output)
4	MID2 (NC)
5	NC
6	R-GND
7	G-GND
8	B-GND
9	NC
10	GND
11	MID0 (NC)
12	MID1 (NC)
13	HSYNC (output)
14	VSYNC (output)
15	NC

Fig. 8-6 Pin assignment of the MONITOR connector

Keyboard Connector (KEYBOARD)

The 6-pole Mini DIN female connector KEYBOARD at the rear of the instrument is intended for connecting an external keyboard. .

KEYBOARD



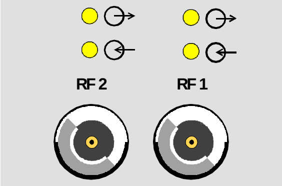
Pin No.	Signal
1	Keyboard data (input)
2	Msdata
3	GND
4	+5 V keyboard power supply (output, max. 0.1 A)
5	Keyboard clock (output)
6	Msclock
Shield	GND

Fig. 8-7 Pin assignment of the KEYBOARD socket

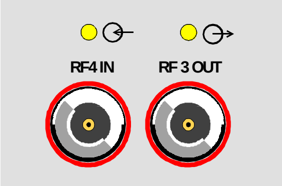
Signal Inputs and Outputs

RF Connectors

The N sockets on the front panel labeled RF1, RF 2, RF 3 OUT and RF4 IN are used as inputs and outputs for RF signals.



Bidirectional RF connectors

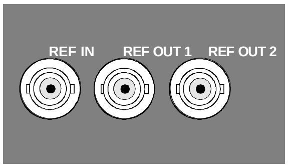


Unidirectional RF connectors

Fig. 8-8 RF connectors

Inputs and Outputs for the Reference Frequency (REF...)

The BNC sockets on the rear panel labeled REF IN, REF OUT 1 and REF OUT2 are used for synchronization of the CMU with external devices.



REF IN — This input is used to synchronize the CMU to other instruments. The frequency of the external reference signal fed in at REF IN must be set in the *Sync.* index card of the *Connection Control* menu or via the `CONFigure:SYNChronize:FREQuency:REFerence` command.

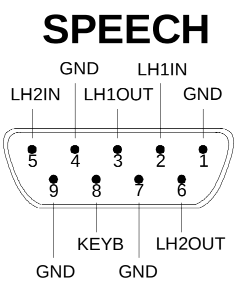
REF OUT 1 — A signal for synchronization of other instruments is available at this output connector. This signal is either the reference frequency of the CMU or the signal applied to the input REF IN (see *Sync.* index card of the *Connection Control* menu).

REF OUT 2 — A clock signal applied to this output and can be used for synchronizing external devices. The clock frequency can be selected from a list of network-specific frequencies in the *Sync.* index card of the *Connection Control* menu.

Fig. 8-9 Inputs and outputs for reference frequency

AF Connector SPEECH (Optional)

The 9-pin Sub-D female connector *SPEECH* on the front panel of the instrument can be used for connecting a handset to the signalling unit.

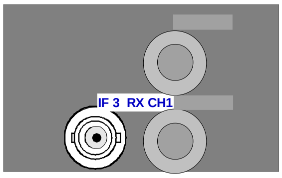


Pin No.	Signal	Input (I) / Output (O) / Bidirectional (B)	Description
1	GND	B	
2	LH1HAND SETIN	I	AF signals to signalling unit 1
3	LH1HAND SETOUT	O	AF signals from signalling unit 1
4	GND	B	
5	LH2HAND SETIN	I	Signals to signalling unit 2
6	LH2HAND SETOUT	O	Signals from signalling unit 2
7	GND	B	
8	+5VKEYB	O	Power supply +5.2 V, max. 100 mA
9	GND	B	

Fig. 8-10 AF connector SPEECH

IF Signal

One BNC connector providing an IF signal is located on the rear panel of the CMU.



IF3 RX CH1 connector (BNC socket), provides an IF signal from the RXTX board 1 for monitoring purposes.

Fig. 8-11 IF signal output

Service and Auxiliary Connectors

A 9-pin Sub-D female connector *SERVICE* for the modules RXTX Boards is located on the rear panel. This connector is intended for internal tests only and must not be used as a signal input or output.

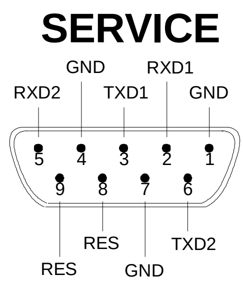
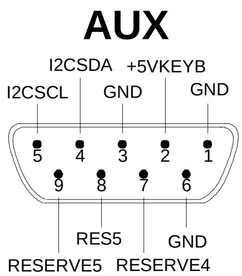


Fig. 8-12 SERVICE connector

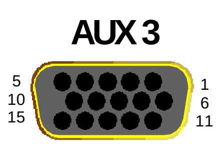
A 9-pin SUB-D female connector AUX on the rear panel provides a +5.2 V power supply. The pin assignment is as follows:



Pin	Signal	Input (I) / Output (O) / Bidirectional (B)	Description
1	GND	B	GND
2	+5VKEYB	O	Power supply +5.2 V, max. 100 mA
3	GND	B	GND
4	I2CSDA	B	For future extensions
5	I2CSCL	O	For future extensions
6	GND	B	GND
7	RESERVE4	B	
8	RESERVE5	B	
9	RESERVE6	B	

Fig. 8-13 AUX connector

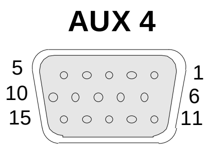
The 15-pin SUB-D female connector AUX 3 on the front panel is used as an input or output for status, control, and trigger signals. These signals are applied to particular (in some function groups: selectable) pins of the AUX 3 connector (refer to the corresponding menu).
The pin assignment of the AUX 3 connector is as follows:



Pin	Signal	Input (I) / Output (A) / Bidirectional (B)	Description
1	GND	B	
2	TBUS1	O	Timing output A Test signal CH1 GSMxxx-MS Signalling: Frame trigger (see GSMxxx-MS operating manual)
3	TBUS2	O	Timing output B
4	TBUS3	O	Timing output C
5	TBUS4	O	Timing output D
6	TBUS5	I	External trigger input CMU300: External trigger signal for wired synchronization
7	TBUS6	I	External trigger B
8	TBUS7	I	External trigger A External trigger signal CH1 input for *Spectrum* and *Power* measurements
9	GND	B	GND
10	GND	B	GND
11	GND	B	GND
12	GND	B	GND
13	GND	B	GND
14	GND	B	GND
15	GND	B	GND

Fig. 8-14 AUX 3 connector

The 15-pin SUB-D female connector AUX 4 on the rear panel is used as an input or output for status, control, and trigger signals. These signals are applied to definite pins of the AUX 4 connector (refer to the corresponding menu).
The pin assignment of the AUX 4 connector is as follows:

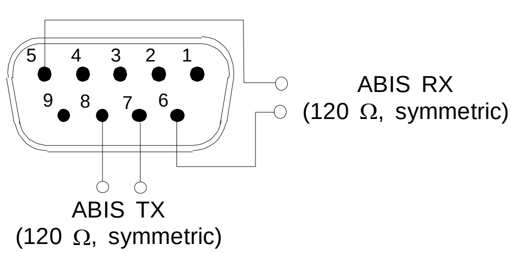


Pin	Signal	Input (I) / Output / Bidirectional (B)	Description
1	GND	B	GND
2	GND	B	GND
3	GND	B	GND
4	GND	B	GND
5	GND	B	GND
6	GND	B	GND
7	GND	B	GND
8	GND	B	GND
9	TBUS8	B	Status/control/trigger signal
10	TBUS9	B	Status/control/trigger signal
11	TBUS10	B	Status/control/trigger signal
12	TBUS11	B	Status/control/trigger signal
13	TBUS12	B	Status/control/trigger signal
14	TBUS13	B	Status/control/trigger signal
15	TBUS14	B	Status/control/trigger signal

Fig. 8-15 AUX 4 connector

Abis Connector (CMU300 with Option CMU-B71 only)

A 9-pin SUB-D female connector ABIS on the rear panel provides a symmetric (balanced) input of the *Abis Interface Unit for CMU* (option CMU.B71; for CMU300 only). The pin assignment is as follows:

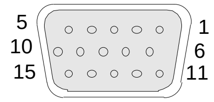


Pin	Signal	Input (I) / Output (O) / Bidirectional (B)	Description
1	–	–	Not connected
2	–	–	Not connected
3	–	–	Not connected
4	–	–	Not connected
5	ABIS RX	I	Symmetric Abis input
6	ABIS RX	I	Symmetric Abis input
7	ABIS TX	O	For future extensions
8	ABIS TX	O	For future extensions
9	GND	B	GND

Fig. 8-16 ABIS connector

I/Q CH1 Connector (CMU200 with Option CMU-B17 only)

A 15-pin SUB-D female connector I/Q CH1 provides the inputs and outputs for I/Q signals (option CMU-B17). The pin assignment is as follows:

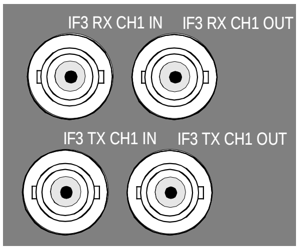


Pin	Signal	Input (I) / Output (O) / Bidirectional (B)	Description
1	GND	–	–
2	MOD_ I_ IN	I	I input, TX path, max ±0.5 V, impedance 50 Ohm
3	MOD_Q_IN	I	Q input, TX path, max ±0.5 V, impedance 50 Ohm
4	GND	–	–
5	MOD_I_OUT	O	I output, TX path, max ±0.5 V, impedance 50 Ohm
6	MOD_Q_OUT	O	Q output, TX path, max ±0.5 V, impedance 50 Ohm
7	GND	–	–
8	DEMOD_I_IN	I	I input, RX path, max ±0.5 V, impedance 50 Ohm
9	DEMOD_Q_IN	I	Q input, RX path, max ±0.5 V, impedance 50 Ohm
10	GND	–	–
11	DEMOD_I_OUT	O	I output, RX path, max ±0.5 V, impedance 50 Ohm
12	DEMOD_Q_OUT	O	Q output, RX path, max ±0.5 V, impedance 50 Ohm
13	GND	–	–
14	–	–	–
15	–	–	–

Fig. 8-17 I/Q CH1 connector

IF3 Connectors (CMU200 with Option CMU-B17 only)

Four BNC connectors provide the inputs and outputs for IF signals (option CMU-B17). The BNC shield of all these connectors is connected to GND. The remaining specifications are as follows:



Connector	Function
IF3 RX CH1 IN	IF input, RX path, f= 7,68 MHz or 10,7 MHz; max level +2 dBm PEP; impedance 50 Ohm
IF3 RX CH1 OUT	IF output, RX path, f= 7,68 MHz or 10,7 MHz; max level +4 dBm PEP; impedance 50 Ohm
IF3 TX CH1 IN	IF input, TX path, f= 15,36 MHz or 13,85 MHz; max level +3 dBm PEP for WCDMA, max level –5 dBm for GSM; impedance 50 Ohm
IF3 TX CH1 OUT	IF output, TX path, f= 15,36 MHz or 13,85 MHz; max level +3 dBm PEP for WCDMA, max level –5 dBm for GSM; impedance 50 Ohm

Fig. 8-18 IF3 connectors

Contents

9 Error Messages

SCPI Error Messages

SCPI error messages are the same in all SCPI instruments. The errors are assigned negative numbers. The standard text of the error message is often supplemented by a comment from the CMU which provides more detailed information (device-dependent information). Since this part depends on the individual situation, it often contains more relevant information than the standard text.

No error

Error code	Explanation
0	**No error** This message is output when there are no entries in the error queue.

Command error

The following errors cause bit 5 in the ESR register to be set.

Error code	Explanation
-100	**Command error** Generic error message that cannot detect a more specific error.
-101	**Invalid character** The command contains a character which is invalid for that type.
-102	**Syntax error** The data type received is not accepted at this position.
-103	**Invalid separator** The semicolon was omitted after a program message unit.
-104	**Data type error** The recognized data element is of the wrong type (e.g. character data instead of numeric data)
-105	**GET not allowed** A GET was received within a program message.
-108	**Parameter not allowed** The command contains parameters at a position where they are not accepted.
-109	**Missing parameter** The command does not contain the required parameters.

Error code	Explanation
-111	**Header separator error** A character which is not a legal header separator was encountered while parsing the header; for example, no white space followed the header.
-112	**Program mnemonic too long** The header contains more than 12 characters.
-113	**Undefined header** The sent command header has not been defined.
-114	**Header suffix out of range** The command contains an illegal numeric suffix.
-120	**Numeric data error** An invalid character for the data type being parsed was encountered.
-121	**Invalid character in number** The command contains an illegal numeric suffix.
-123	**Exponent too large** The magnitude of the exponent is too large.
-124	**Too many digits** The decimal numeric data element contains too many digits.
-128	**Numeric data not allowed** The command contains a numeric data element the device does not accept in this position.
-131	**Invalid suffix** The suffix is not appropriate for this command.
-134	**Suffix too long** The suffix contains more than 12 characters.
-138	**Suffix not allowed** A suffix is not allowed for this command or at this point of the command.
-141	**Invalid character data** The character data element contains an invalid character or the element is not valid for this command.
-144	**Character data too long** The character data element contains more than 12 characters.
-148	**Character data not allowed** The character data is prohibited for this command or at this point of the command.
-151	**Invalid string data** A string data element was expected, but was invalid for some reason.

Error code	Explanation
-158	**String data not allowed** The command contains a legal string data element which is not allowed at this point.
-161	**Invalid block data** The command contains illegal block data, e.g. no numeric data element is sent after the introductory #.
-168	**Block data not allowed** The command contains legal block data which are not allowed at this point.
-171	**Invalid expression** The expression data element was invalid; for example, unmatched parentheses or an illegal character.
-178	**Expression data not allowed** A legal expression data was encountered but was not allowed by the device at this point in parsing.
-180	**Macro error** An error occurred when defining a macro or executing a macro.

Execution error

The following errors cause bit 4 in the ESR register to be set.

Error code	Explanation
-200	**Execution error** An execution error as defined in IEEE 488.2, has occurred.
-203	**Command protected**
-211	**Trigger ignored** A triggering signal was received and recognized by the device but was ignored because of timing considerations.
-212	**Arm ignored** An arming signal was received and recognized by the device but was ignored.
-213	**Init ignored** A request for a measurement initiation was ignored as another measurement was already in progress.
-221	**Settings conflict** A setting contradicts another setting. The last attempted setting was not executed.
-222	**Data out of range** A value of the transmitted command was outside the legal range.
-223	**Too much data** More data were sent by the host than the CMU can handle.

Error code	Explanation
-224	**Illegal parameter value** An exact value, from a list of possible values, was expected but not received.
-225	**Out of memory** The CMU software has insufficient memory to perform the requested operation.
-230	**Data corrupt or stale** Possibly invalid data; new reading started but not completed since last access.
-240	**Hardware error** A legal program command or a query could not be executed because of a hardware problem in the device.
-241	**Hardware missing** A legal program command or a query could not be executed because of a missing device hardware.
-250	**Mass storage error** A mass storage error occurred.
-251	**Missing mass storage** A legal program command or a query could not be executed because of missing mass storage.
-252	**Missing media** A legal program command or a query could not be executed because of missing media; for example, no floppy disk.
-253	**Corrupt media** A legal program command or a query could not be executed because of corrupt media; for example, bad floppy disk or wrong format.
-254	**Media full** A legal program command or a query could not be executed because of the media was full; for example, no room on the floppy disk.
-255	**Directory full** The specified directory is full – no more files can be written.
-256	**File name not found** A file with the specified name does not exist.
-257	**File name error** The specified file name cannot be used, e.g. because the file does not exist (reading, clearing) or already exists (writing, generation).
-258	**Media protected** A legal program command or a query could not be executed because the media was protected.

Device-specific error

The following errors cause bit 3 in the ESR register to be set.

Error code	Explanation
-300	**Device-specific error**
-310	**System error** An unspecified system error has occurred.
-311	**Memory error** An error was detected in the device's memory.
-313	**Calibration memory lost** Nonvolatile calibration data have been lost.
-314	**Save/recall memory lost** Nonvolatile saved data have been lost.
-315	**Configuration memory lost** Nonvolatile configuration data saved by the device have been lost.
-330	**Self-test failed** An error occurred during the internal self test.
-350	**Queue overflow** Error code entered in the queue in lieu of the code when the queue is full. It indicates that an error occurred but was not recorded in the queue. The original error message is lost.
-360	**Communication error** An unspecified communication error was detected.
-361	**Parity error in program message** Parity bit was not correct when data were received on a serial port.
-362	**Framing error in program message** No stop bit was detected when data were received on a serial port.
-363	**Input buffer overrun** Software or hardware input buffer on serial port overflows with data caused by improper or nonexistent pacing.

Query error - error upon data request

When the following error codes are output, bit 2 is set in the ESR register.

Error code	Explanation
-400	**Query error**
-410	**Query INTERRUPTED** The query was interrupted. Example: a query is followed by new data before a response was completely sent.
-420	**Query UNTERMINATED** An incomplete query was received. Example: the device is addressed to talk although the received query was incomplete.
-430	**Query DEADLOCKED** A condition causing a DEADLOCKED query error occurred. Example: both input and output buffer are full and the device can not continue.
-440	**Query UNTERMINATED after indefinite response** A query was received in the same program message after a query requesting an indefinite response was execute.

Index

D

E

F

G

H

I

K

L

M

N

O

P

Q

R

S

T

U

V

W