ROHDE&SCHWARZ
Test and Measurement
Division

Operating Manual

SPECTRUM ANALYZER

FSU3
1129.9003.03

FSU8
1129.9003.08

Printed in the Federal
Republic of Germany

Tabbed Divider Overview

Contents

Data Sheet

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

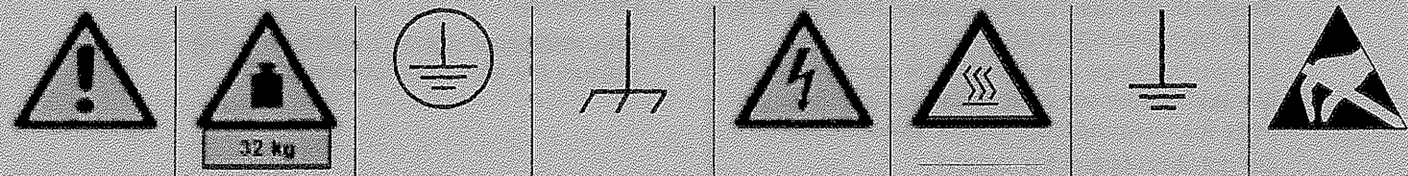
Manuals for Spectrum Analyzer FSP

Tabbed Divider

This unit has been designed and tested in accordance with the EC Certificate of Conformity and has left the manufacturer's plant in a condition fully complying with safety standards.

To maintain this condition and to ensure safe operation, the user must observe all instructions and warnings given in this operating manual.

Safety-related symbols used on equipment and documentation from R&S:



Observe operating instructions	Weight indication for units >18 kg	PE terminal	Ground terminal	Danger! Shock hazard	Warning! Hot surfaces	Ground	Attention! Electrostatic sensitive devices require special care

1. The unit may be used only in the operating conditions and positions specified by the manufacturer. Unless otherwise agreed, the following applies to R&S products:
   IP degree of protection 2X, Pollution severity 2, overvoltage category 2, altitude max. 2000 m.
   The unit may be operated only from supply networks fused with max. 16 A.
2. For measurements in circuits with voltages V_{rms} > 30 V, suitable measures should be taken to avoid any hazards.
   (using, for example, appropriate measuring equipment, fusing, current limiting, electrical separation, insulation).
3. If the unit is to be permanently wired, the PE terminal of the unit must first be connected to the PE conductor on site before any other connections are made. Installation and cabling of the unit to be performed only by qualified technical personnel.
4. For permanently installed units without built-in fuses, circuit breakers or similar protective devices, the supply circuit must be fused such as to provide suitable protection for the users and equipment.
5. Prior to switching on the unit, it must be ensured that the nominal voltage set on the unit matches the nominal voltage of the AC supply network.
   If a different voltage is to be set, the power fuse of the unit may have to be changed accordingly.
6. Units of protection class I with disconnectible AC supply cable and appliance connector may be operated only from a power socket with earthing contact and with the PE conductor connected.
7. It is not permissible to interrupt the PE conductor intentionally, neither in the incoming cable nor on the unit itself as this may cause the unit to become electrically hazardous.
   Any extension lines or multiple socket outlets used must be checked for compliance with relevant safety standards at regular intervals.
8. If the unit has no power switch for disconnection from the AC supply, the plug of the connecting cable is regarded as the disconnecting device. In such cases it must be ensured that the power plug is easily reachable and accessible at all times (length of connecting cable approx. 2 m). Functional or electronic switches are not suitable for providing disconnection from the AC supply.
   If units without power switches are integrated in racks or systems, a disconnecting device must be provided at system level.
9. Applicable local or national safety regulations and rules for the prevention of accidents must be observed in all work performed.
   Prior to performing any work on the unit or opening the unit, the latter must be disconnected from the supply network.
   Any adjustments, replacements of parts, maintenance or repair may be carried out only by authorized R&S technical personnel.
   Only original parts may be used for replacing parts relevant to safety (eg power switches, power transformers, fuses). A safety test must be performed after each replacement of parts relevant to safety.
   (visual inspection, PE conductor test, insulation-resistance, leakage-current measurement, functional test).

continued overleaf

10. Ensure that the connections with information technology equipment comply with IEC950 / EN60950.
11. Lithium batteries must not be exposed to high temperatures or fire.

    Keep batteries away from children.

    If the battery is replaced improperly, there is danger of explosion. Only replace the battery by R&S type (see spare part list).

    Lithium batteries are suitable for environmentally-friendly disposal or specialized recycling. Dispose them into appropriate containers, only.

    Do not short-circuit the battery.
12. Equipment returned or sent in for repair must be packed in the original packing or in packing with electrostatic and mechanical protection.
13. Electrostatics via the connectors may damage the equipment. For the safe handling and operation of the equipment, appropriate measures against electrostatics should be implemented.
14. Any additional safety instructions given in this manual are also to be observed.

Certified Quality System

ISO 9001

DQS REG. NO 1954-04

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 nach ISO 9001 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 ISO 9001.

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 conformément à la norme ISO 9001.

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Contents of Manuals for Spectrum Analyzer FSU

Operating Manual FSU

The operating manual describes the following models and options of spectrum analyzer FSU:

- FSU3 20 Hz to 3.6 GHz
- FSU8 20 Hz to 8 GHz

- Option FSU-B4 OCXO - reference oscillator
- Option FSP-B10 external generator control
- Option FSU-B16 LAN interface
- Option FSU-B25 electronic attenuator

This operating manual contains information about the technical data of the instrument, the setup functions and about how to put the instrument into operation. It informs about the operating concept and controls as well as about the operation of the FSU via the menus and via remote control. Typical measurement tasks for the FSU are explained using the functions offered by the menus and a selection of program examples.

Additionally the operating manual includes information about maintenance of the instrument and about error detection listing the error messages which may be output by the instrument. It is subdivided into 9 chapters:

Chapter 1 describes the control elements and connectors on the front and rear panel as well as all procedures required for putting the FSU into operation and integration into a test system.

Chapter 2 empty

Chapter 3 describes the operating principles, the structure of the graphical interface and offers a menu overview.

Chapter 4 forms a reference for manual control of the FSU and contains a detailed description of all instrument functions and their application. The chapter also lists the remote control command corresponding to each instrument function.

Chapter 5 describes the basics for programming the FSU, command processing and the status reporting system.

Chapter 6 lists all the remote-control commands defined for the instrument. At the end of the chapter a alphabetical list of commands and a table of softkeys with command assignment is given.

Chapter 7 contains program examples for a number of typical applications of the FSU.

Chapter 8 describes preventive maintenance and the characteristics of the instrument's interfaces.

Chapter 8 gives a list of error messages that the FSU may generate.

Chapter 9 contains a list of error messages.

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 FSU by exchanging modules.

Contents - Chapter 1 " Preparing for Operation "

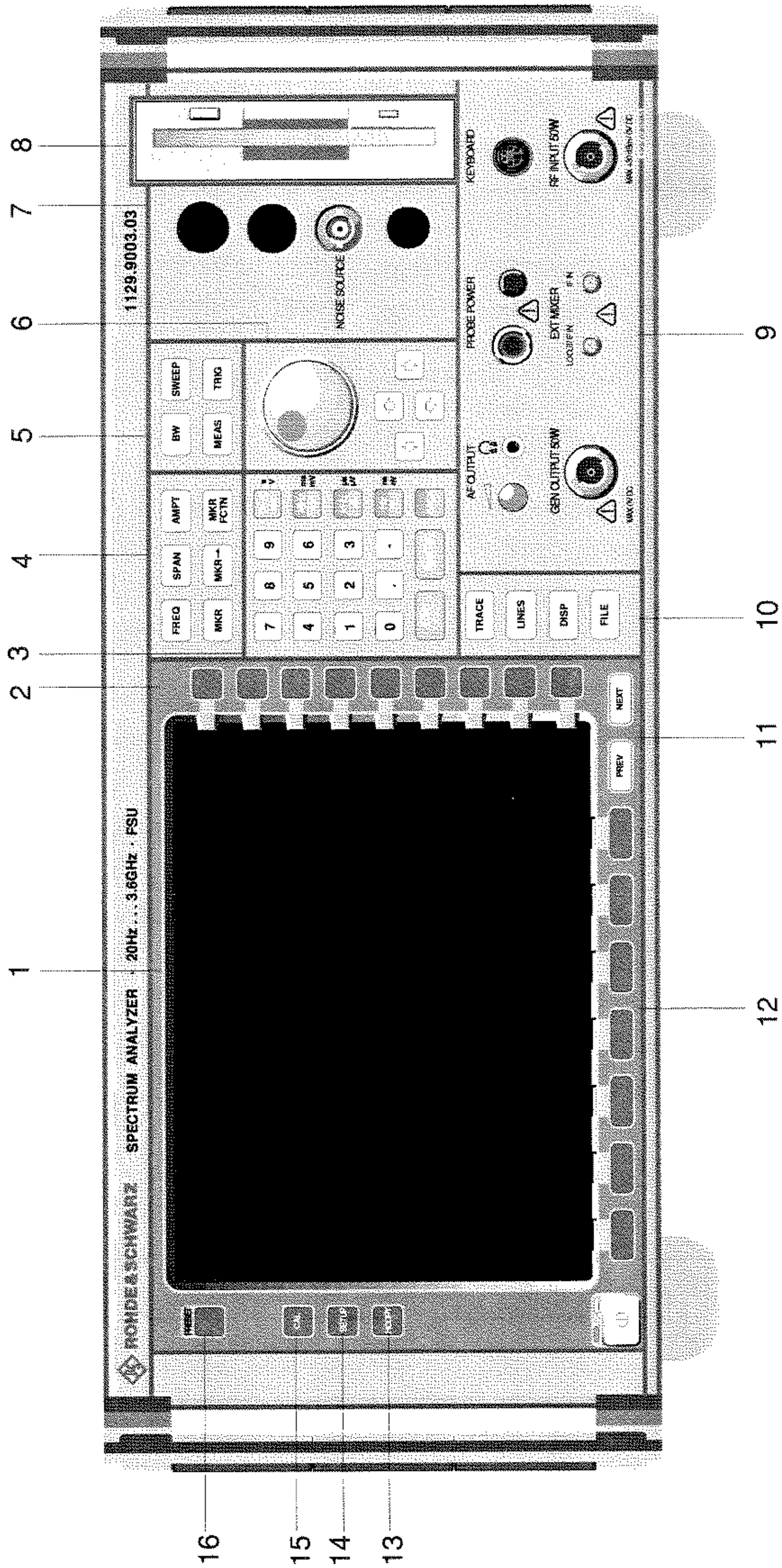


Fig. 1-1 Front View

1 Preparing for Operation

Chapter 1 describes the controls and connectors of the Spectrum Analyzer FSU by means of the front and rear view. Then follows all the information that is necessary to put the instrument into operation and connect it to the AC supply and to external devices.

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

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

For remote control of the FSU refer to the general description of the SCPI commands, the instrument model, the status reporting system, and command description in chapter 5 and 6.

Description of Front and Rear Panel Views

Front View

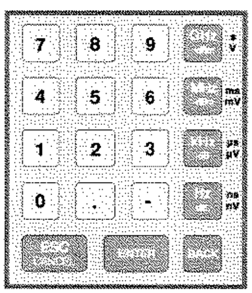
1

Display Screen — see Chapter 3

2

Softkeys — see Chapter 3

3



Keypad for data input — see Chapter 3

0...9 input numbers

. input decimal point

– change sign

ESC CANCEL
- close input field (for uncompleted or already closed inputs, the original entry is kept)
- erase the current entry in input field (beginning of an input)
- close message window (status, error and warning messages)

ENTER close the data input.

BACK
- erase last character input for uncompleted input
- restore previous input (undo)

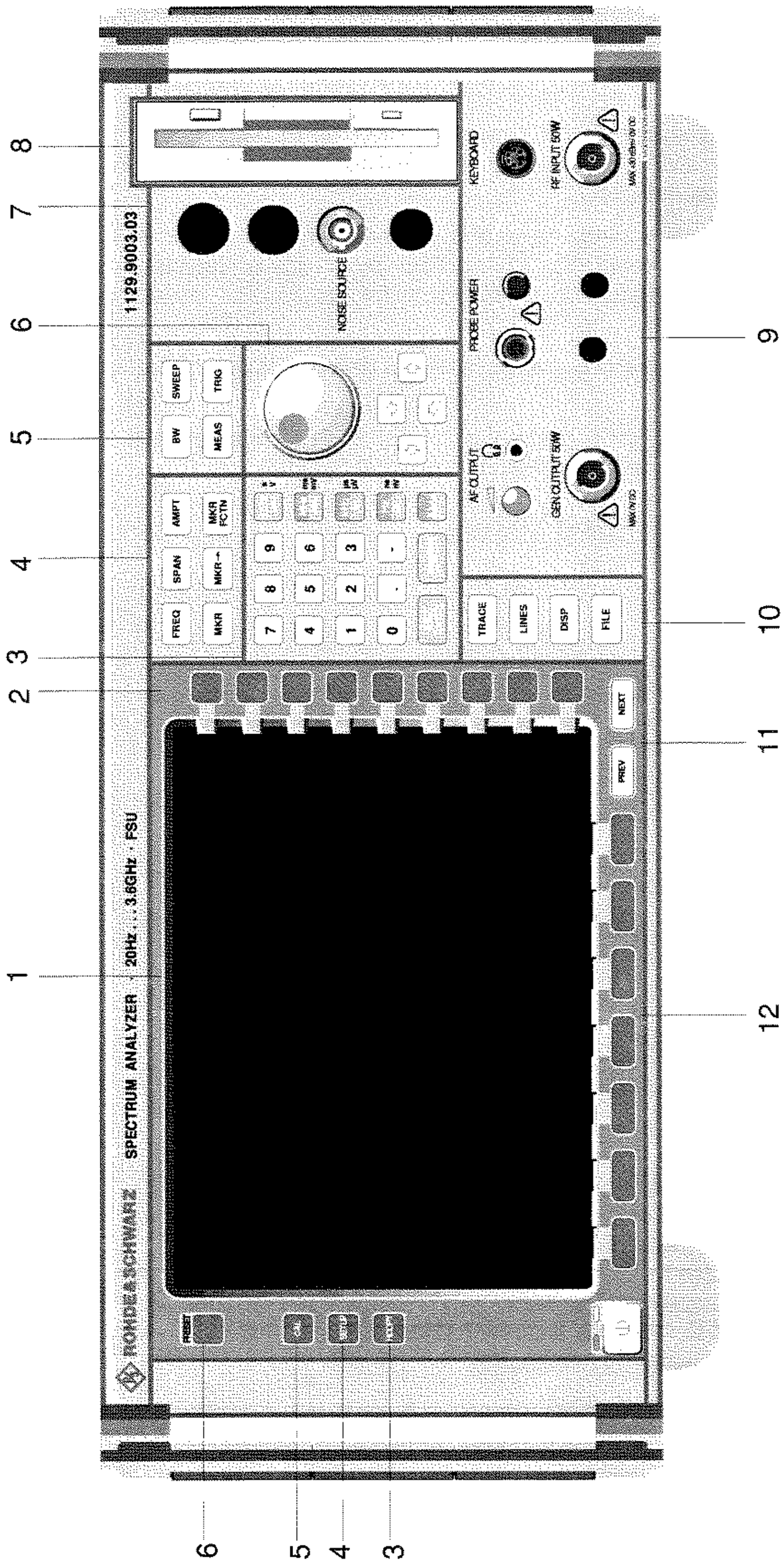
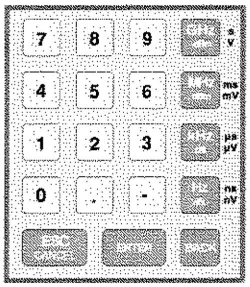


Fig. 1-1 Front View

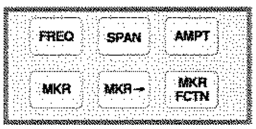


Keypad for data input

GHz s -dBm V	The units keys close the data input and define the multipli-cation factor for each basic unit.
MHz ms dBm mV	For dimension-less or alphanumeric inputs, the units keys have weight 1.
kHz µs dB µV	They behave, in this case, like the ENTER key.
Hz ns dB.. nV	

see Chapter 3

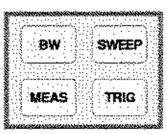
4



FREQ	Set frequency axis
SPAN	Set span
AMPT	Set level indication and configure RF input.
MKR	Select and set standard marker and delta marker functions.
MKR->	Change instrument settings via markers
MKR FCTN	Select further marker and delta marker functions

see Chapter 4

5



BW	– Set resolution bandwidth, video bandwidth and sweep time, – Set coupling of these parameters
SWEEP	Select sweep
MEAS	Select and set power measurements
TRIG	Set trigger sources

see Chapter 4

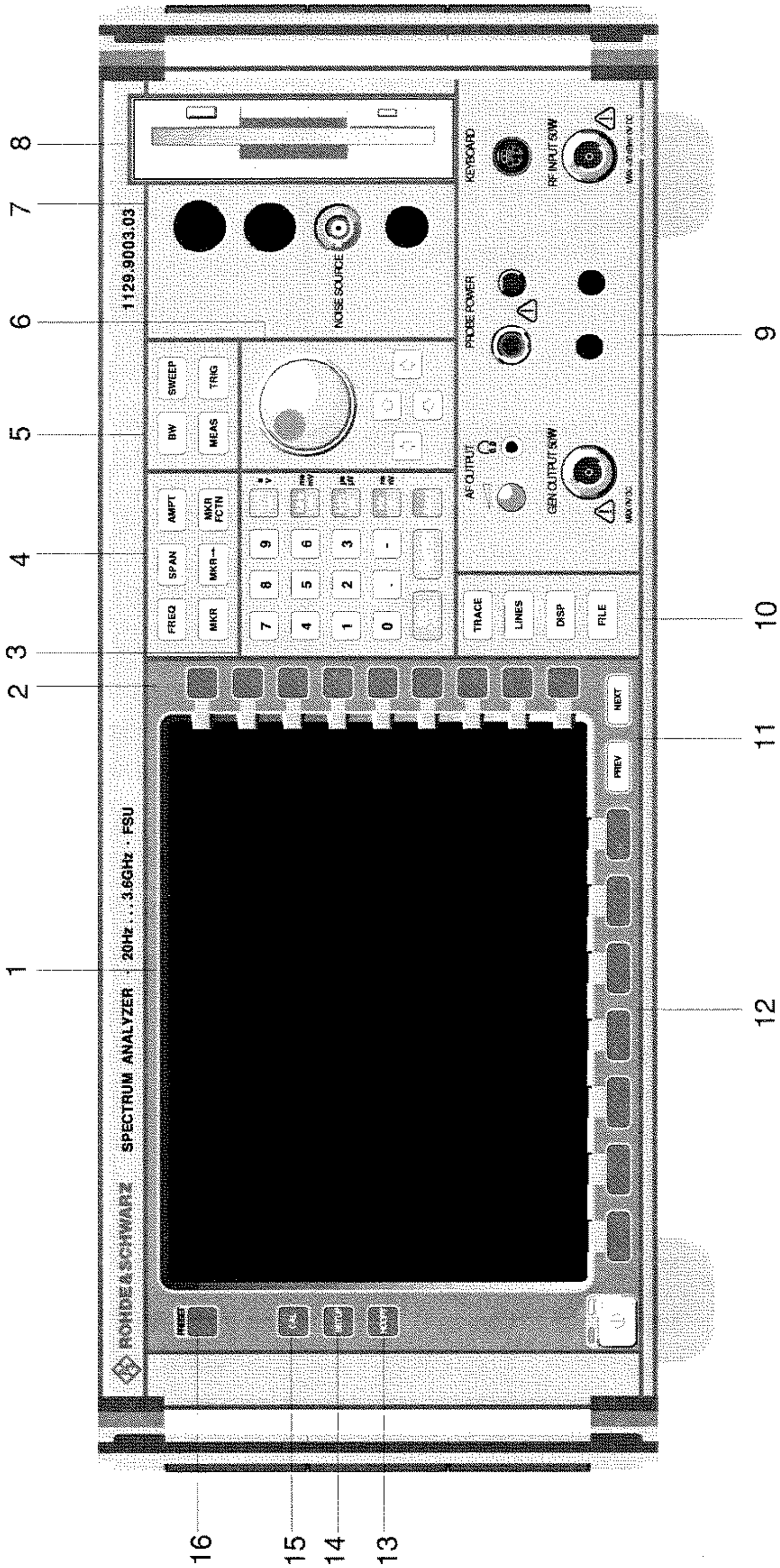
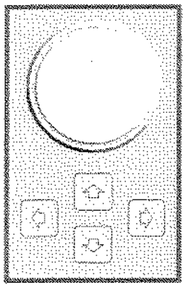


Fig. 1-1 Front View

6



Key group for entering data and for cursor movement — see Chapter 3

Cursor keys
- Move the cursor within the input fields and tables.
- Vary the input value.
- Define the direction of movement for the roll-key.

Roll-key
- Vary input values.
- Move markers and limits.
- Select letters in the help line editor.
- Move cursor in the tables
- Close data input (ENTER)

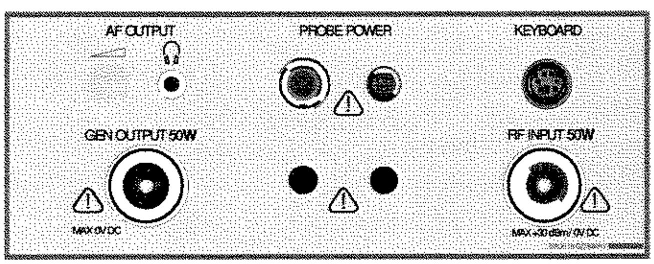
7

Output connector for an external noise source

8

3 1/2" diskette drive; 1.44 MByte

9



AF OUTPUT — s. Chapter 8

(volume symbol)	Volume control
(headphone symbol)	Head phone connector
PROBE POWER	Power supply and coded socket (+15 V/ -12 V) for accessories
KEYBOARD	Connector for an external keyboard
RF INPUT	RF input

see Chapter 8

Caution:

The maximum DC voltage is 50 V, the maximum power is 1 W (≙ 30 dBm) at ≥ 10 dB attenuation.

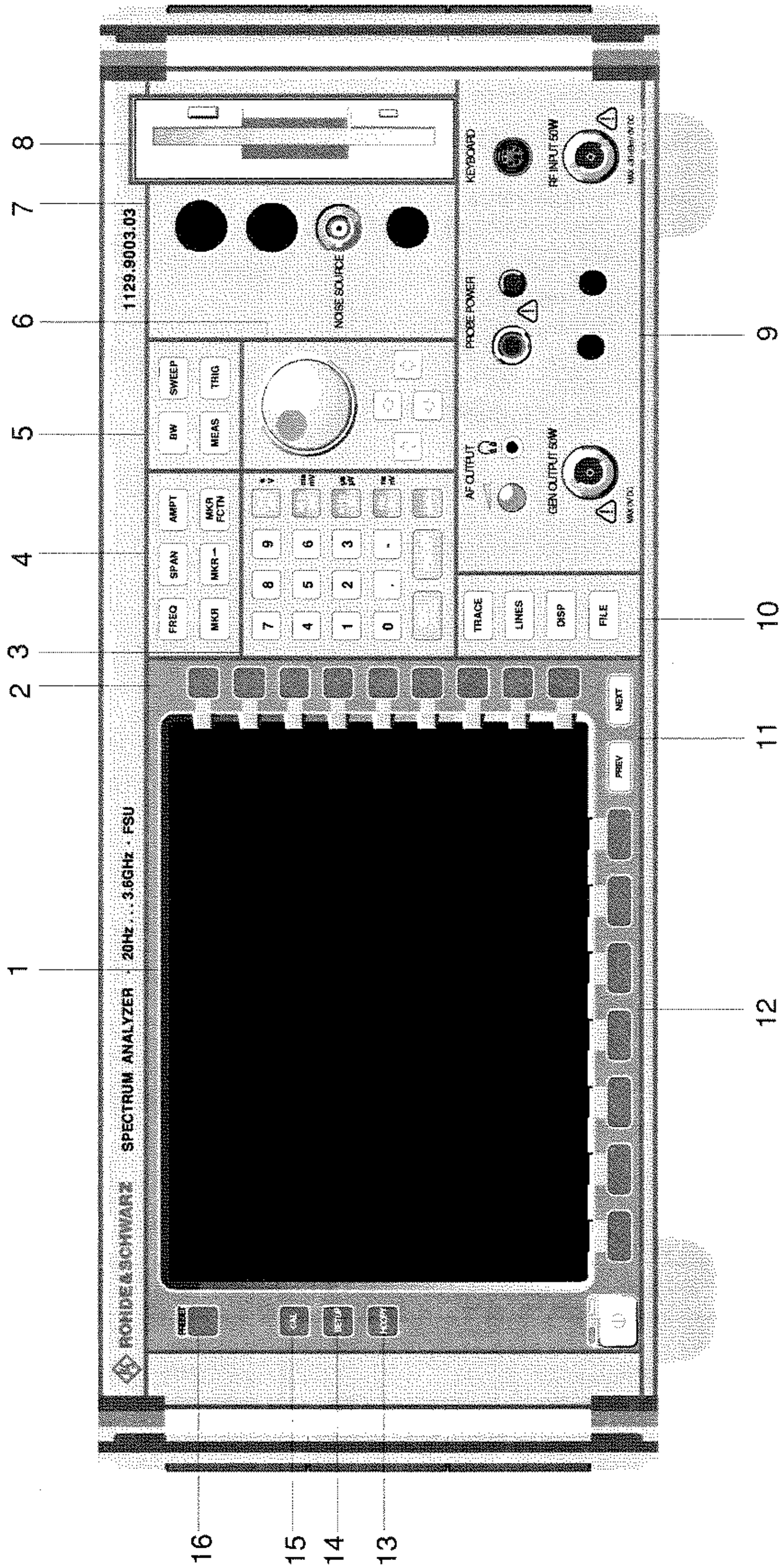
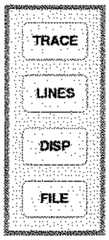


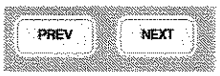
Fig. 1-1 Front View

9



TRACE	Select and activate traces and detectors	see Chapter 4
LINES	Set limit lines	
DISP	Configure display	
FILE	– Save and recall instrument data – Configuration of memory media and data	

10



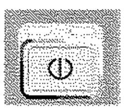
Menu-change keys see Chapter 3

NEXT	Change to side menu
PREV	Call main menu

11

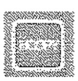
Hotkeys see Chapter 3

12



ON/STANDBY switch see Chapter 1

13



Configure and start a print job see Chapters 1 and 4

14

Define general configuration see Chapter 4

15

Record correction data see Chapter 4

16

Call default settings see Chapter 4

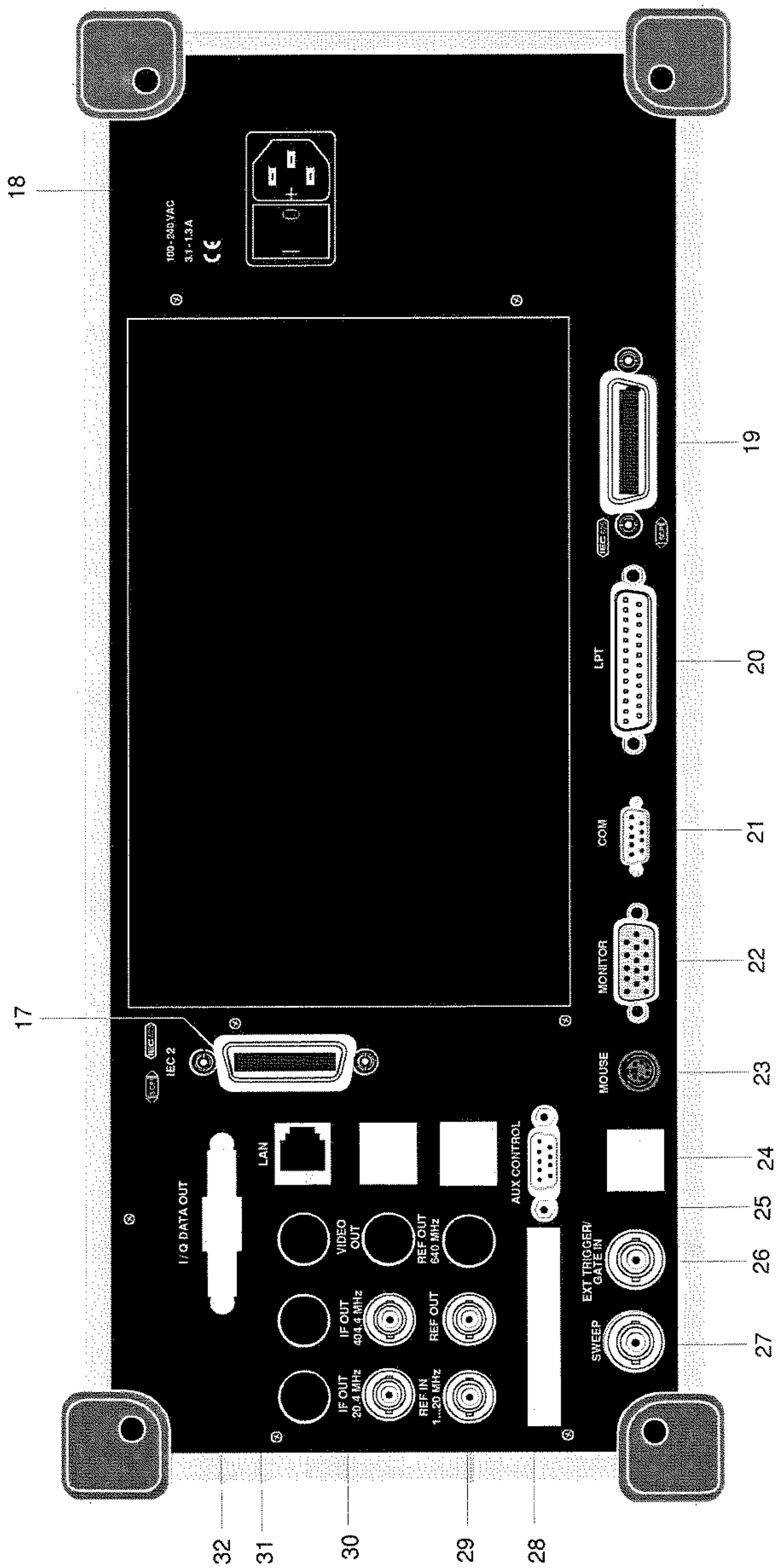


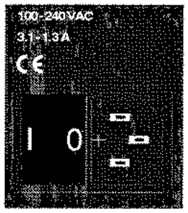
Fig. 1-1 Rear View

Rear View

17

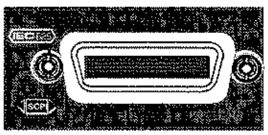
2^{nd} IEC/IEEE bus-connector — see Chapter 8

18



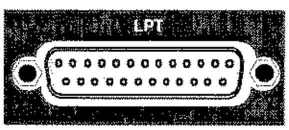
Power switch and AC power connector — see Chapter 1

19



IEC/IEEE bus-connector — see Chapter 8

20

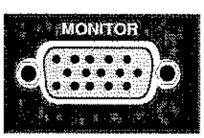


Parallel interface connector
(printer connector) — see Chapter 8

21

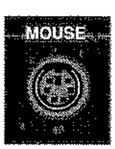
Connector for a serial interface
(9-pin socket; COM) — see Chapter 8

22



Connector for an external monitor — see Chapter 8

23



Connector for a PS/2 mouse — see Chapter 8

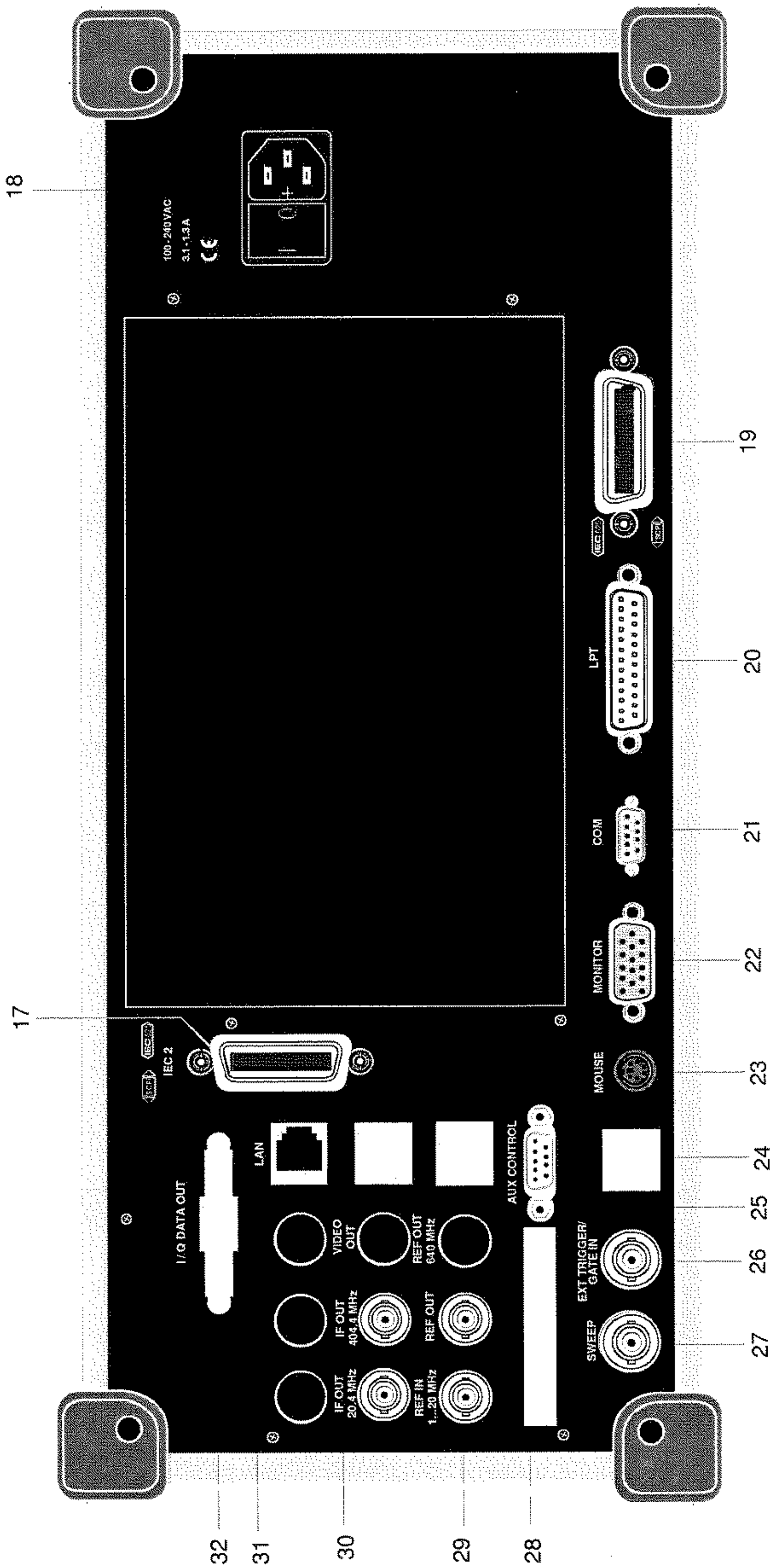
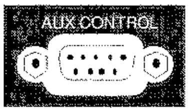


Fig. 1-2 Rear View

24

Reserved for options

25



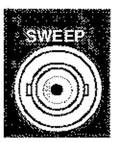
Eingangsbuchse für externe Generatorsteuerung (Option FSP-B10)

26

Input connector for an external trigger or an external gate signal

see Chapter 8

27



Output connector

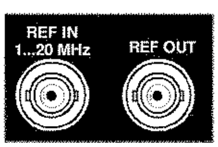
During a sweep sawtoth voltage is output which is proportional to frequency

s. Kap. 8

28

Reserved for options

29



REF IN	Input connector for an external reference (1 to 20 MHz)
REF OUT	Output connector for an internal reference (10 MHz)

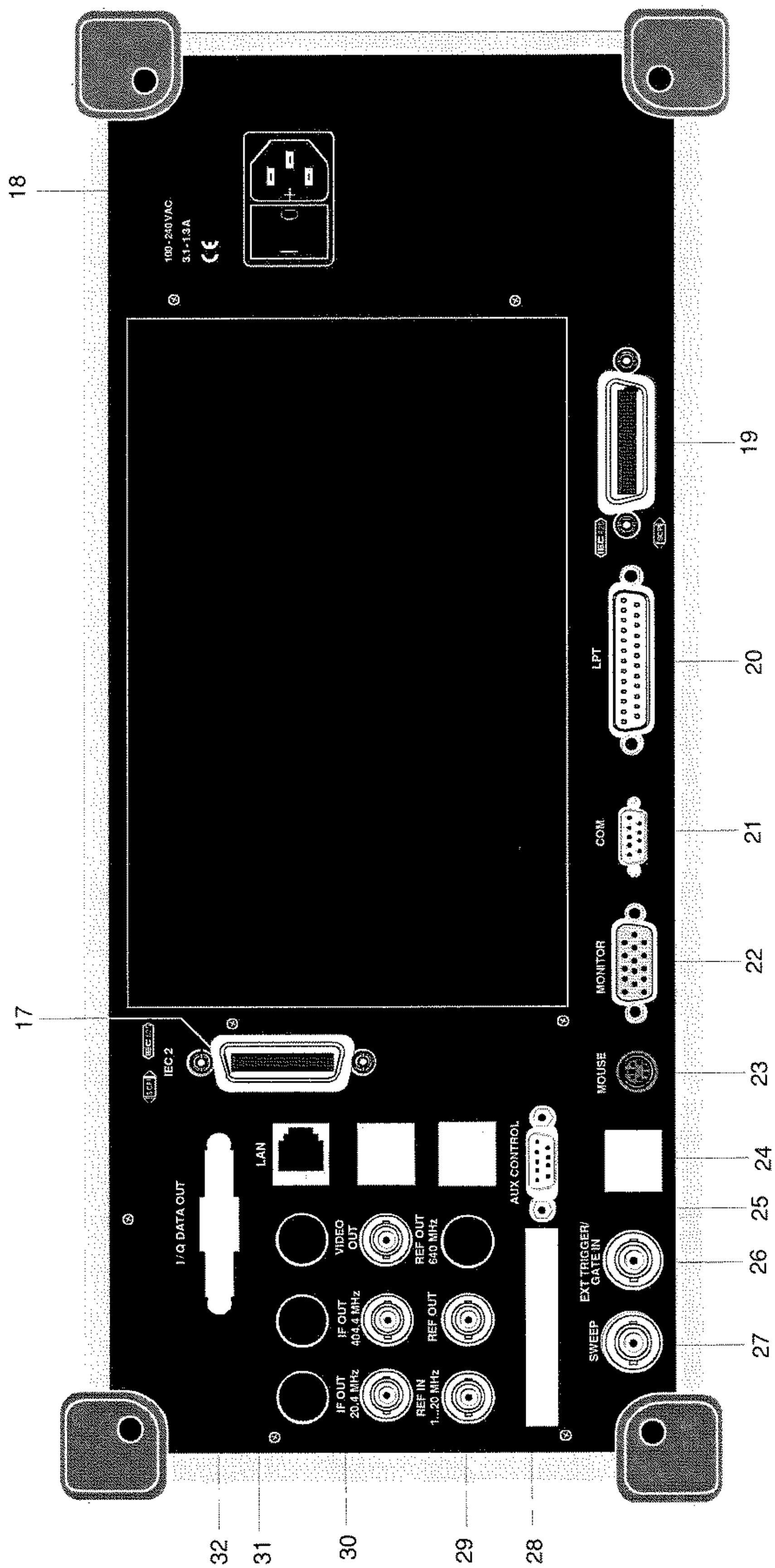
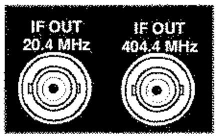


Fig. 1-2 Rear View

30



IF 20.4 MHz OUT	Output connector for 20.4 MHz IF	see Chapter 8
IF 404.4 MHz OUT	Output connector for 404.4 MHz IF	

31

LAN-Interface (FSU-B16)

32

Reserved for options

Getting Started with the instrument

The following section describes how to activate the instrument and how to connect external devices like eg printer and monitor.

Chapter 2 explains the operation of the instrument using simple measurement examples.

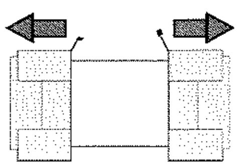
Important note:

Before turning the instrument on, care should be taken that the following conditions are fulfilled:

- *instrument covers are in place and tightened by the corresponding screws,*
- *fan openings are free from obstructions,*
- *signal levels at the input connectors are all within specified limits,*
- *signal outputs are connected correctly and not overloaded.*

Ignoring these conditions may cause damage to the instrument .

Preparing the instrument for Operation



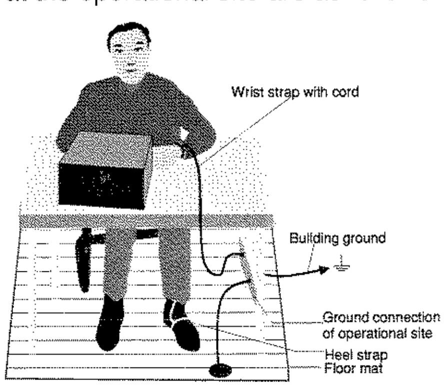
remove protective caps

- ➢ Take the instrument out of the shipping box and check whether the items listed in the packing list and in the lists of accessories are all included.
- ➢ Remove the two protective caps from the front and rear of the FSU and carefully check the instrument for damage.
- ➢ Should the instrument be damaged, immediately notify the transportation company that shipped the instrument to you and keep the box and packing material.
- ➢ For further transport or shipment of the FSU the original packing should also be used. 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.

Setting up the Instrument

Stand-alone Operation

The instrument is designed for use under general laboratory conditions. The ambient conditions required at the operational site are as follows:



- The ambient temperature must be in the range indicated in the data sheet.
- All fan openings must be unobstructed and the air flow at the rear panel and at the side-panel perforations must not be obstructed. The distance to the wall should be at least 10 cm.
- The mounting surface should be flat.
- In order to avoid damage of electronic components of the device under test due to electrostatic discharge on manual touch, protection of the operational site against electrostatic discharge is recommended.

Rackmounting

Important Note:

For rack installation, ensure that the air flow at the side-panel perforations and the air exhaust at the rear panel are not obstructed.

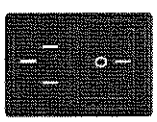
The instrument may be mounted in a 19" rack by using a rack adapter kit (order number see data sheet). The installation instructions are included in the adapter kit.

EMI Protection Measures

In order to avoid electromagnetic interference (EMI), the instrument may be operated only when all covers are correctly in place. Only adequately shielded signal and control cables may be used (see recommended accessories).

Connecting the Instrument to the AC Supply

The FSU is equipped with an AC voltage selection feature and will automatically adapt itself to the applied AC voltage (range: 100 to 240 VAC, 40 to 400 Hz). External voltage selection or adaptation of the fuses are not necessary. The AC power connector is located on the rear panel (see below).



Power connector

➢ Connect the instrument to the AC power source using the AC power cable delivered with the instrument.

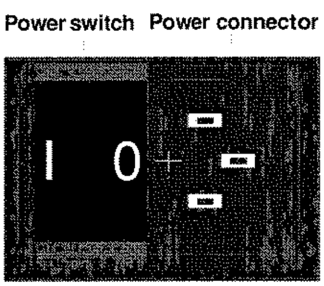
As the instrument is designed according to the regulations for safety class EN61010, it must be connected to a power outlet with earthing contact.

Switching the Instrument on/off

Caution:

Do not power down during booting. *Such a switch-off may lead to corruption of the hard disk files.*

AC power switch on the rear panel



Power switch

Position I = ON

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.

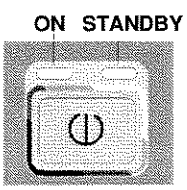
Note:

The AC power switch may remain ON continuously. Switching to OFF is only required when the instrument must be completely removed from the AC power source.

Position O = OFF

The 0 position implies an all-pole disconnection of the instrument from the AC power source.

ON/STANDBY switch on the front panel



Caution:

In standby mode, the AC power voltage is present within the instrument

Standby switch

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

Operation ON - ON/STANDBY is depressed

The green LED (ON) is illuminated. The instrument is ready for operation. All modules within the instrument are supplied with power.

STANDBY - ON/STANDBY switch is not pressed.

The yellow LED (STANDBY) is illuminated. Only the power supply is supplied with power and the quartz oven is maintained at normal operating temperature.

Switching on the Instrument

- ➢ In order to switch on the FSU, set the power switch on the rear panel to position I.
- ➢ Set the FSU to operating mode by pressing the *ON/STANDBY* key on the front panel. The green LED must be illuminated.

Startup Menu and Booting

After switching on the instrument, a message indicating the installed BIOS version (eg Analyzer BIOS Rev. 1.2) appears on the screen for a few seconds.

Subsequently Windows NT is booted first and after that the instrument firmware will boot. As soon as the boot process is finished the instrument will start measuring. The settings used will be the one that was active when the instrument was previously switched off, provided no other device configuration than *FACTORY* had been selected with *STARTUP RECALL* in the *FILE* menu.

Switching off the FSU

➢ Switch the ON/STANDBY key on the front panel to standby mode by pressing it once.

The FSU will write the current instrument settings to disk before performing a Windows NT shutdown. At the end of the shutdown procedure the power supply will be switched to STANDBY mode.

The yellow LED must be illuminated.

Only when removing the FSU completely from the AC power source:

➢ Set the power switch at the rear panel to position 0.

Power-Save Mode

Display:

The FSU offers the possibility of switching on a power-save mode for the screen display. The screen is blanked out if no entry is made on the front panel (key, softkey or hotkey and rollkey) during the selected response time.

In order to switch on the power-save mode:

1. Call the *DISPLAY - CONFIG DISPLAY* submenu to configure the screen display:
   - ➢ Press *DISP* key
   - ➢ Press *CONFIG DISPLAY* softkey

2. Activate the save mode
   - ➢ Press *DISPLAY PWR SAVE* softkey.
     The softkey is highlighted in color, thus indicating that the power-save mode is on. At the same time the data entry for the delay time is opened.

3. Define the delay time
   - ➢ Enter the required response time in minutes and confirm the entry using the *ENTER* key.
     The screen will be blanked out after the selected time period has elapsed.

Harddisk:

A power-save mode is preset for the built-in harddisk which is automatically closed down 15 minutes after the last access.

Recalling the most recent instrument settings

The FSU stores its current instrument settings onto the harddisk every time it is switched off via the ON/STANDBY key. After each power-on, the FSU is reloaded with the operational parameters which were active just prior to the last power-off (STANDBY or AC power OFF) or were set with STARTUP RECALL (see Chapter 4 "Saving and Recalling Data Sets").

Note:
Storing the current instrument settings is not possible if the instrument is switched off using the POWER ON switch at the rear panel or when unplugging the mains cord. After power-on the instrument settings stored previously on the harddisk will be loaded in this case.

Functional Test

After turning on the AC power, the FSU will display the following message on the display screen:

Rohde & Schwarz GmbH & Co. KG
Analyzer BIOS Vx.y

After appearance of the above message, a self-test of the digital hardware is performed. Subsequently, the Windows NT controller boots and the measurement screen will appear.

The system self-alignment is actived via *CAL* key, *CAL TOTAL* softkey. The individual results of the self-alignment (PASSED / FAILED) can be displayed in the *CAL* menu (*CAL RESULTS).*
With the aid of the built-in self-test functions (*SETUP* key, *SERVICE, SELFTEST* soft keys), the functional integrity of the instrument can be verified and/or defective modules can be localized.

Windows NT

Caution:

The drivers and programs used under Windows NT are adapted to the measuring instrument. In order to prevent the instrument functions from damage, the settings should only be modified as described below. Existing software may only be modified using update software released by Rohde&Schwarz. Additionally only programs authorized by Rohde&Schwarz for use on the FSU *may be run on the instrument.*

Do not power down during booting. *Such a switch-off may lead to corruption of the hard disk files.*

The instrument runs under the operating system Windows NT. The computer can be used to install and configure device drivers that were authorized by Rohde&Schwarz. Any further use of the computer function is only allowed under the conditions described in this operating manual.

Login

Windows NT requires a login process, during which the user is asked for identification by entering his name and password. As a factory default the instrument is configured for *Auto Login*, ie the login is performed automatically and in the background. The user name used for this is "instrument" and the password is also "instrument" (in small letters).

Administrator Level

The NT user account used for the autologin function has administrator access rights.

After a software installation that requires administrator rights (eg the installation of new printer drivers), Service Pack 5 of Windows NT has to be re-installed. The necessity to re-install the service pack is indicated in the corresponding operating manual chapters. The installation of the Service Pack is described in the section "Installing Windows NT Software".

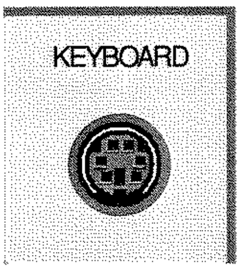
Calling the Windows NT start menu

The Windows NT start menu is called using the key combination <CTRL> <ESC>. It is possible to access the required submenus from the start menu by means of the mouse or the cursor keys. In order to return to the measurement screen the button "R&S Analyzer Interface" in the Windows NT task bar can be used.

Connecting an External Keyboard

Caution:
The keyboard may only be connected when the instrument is switched off (STANDBY). Otherwise, correct operation of the keyboard cannot be guaranteed.

The FSU offers a 6-contact PS/2-connector KEYBOARD on the instrument's front panel for the connection of an external PC. It is recommended to use keyboard PSP-Z2 (Order No. 1091.4100.02, English). This keyboard is equipped with a trackball for mouse control.



During measurement operations, the keyboard simplifies the input of commentary text, filenames, etc.

The section "Instrument Interfaces" in Chapter 8 contains the interface description of the connector.

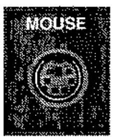
After connection of the keyboard and subsequent power-on, the keyboard will be automatically recognized. The default language used is "US keyboard". Special settings such as repetition rate etc. can be performed in the Windows NT menu START - SETTINGS - CONTROL PANEL - KEYBOARD.

Connecting a Mouse

Caution:
The mouse may only be connected when the instrument is switched off (STANDBY). Otherwise, correct operation of the mouse and instrument cannot be guaranteed.

In order to ease up operation of Windows NT, the FSU provides an option for connecting a mouse to the PS/2 mouse connector (MOUSE) at the rear panel of the instrument.
The mouse type supported is "Microsoft mouse". It is available as option PS-B1 (order number 1006.6359.02).

Note. *The recommended keyboard PSP-Z2 is equipped with a trackball for mouse control. Connecting an additional mouse will cause interface conflicts and lead to malfunctions of the instrument.*



The section "Instrument Interfaces" in Chapter 8 contains the interface description of the connector.

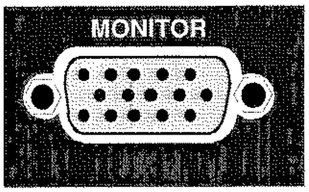
After connection and subsequent power-on the mouse is automatically recognized. Special settings such as mouse cursor speed etc., can be performed in the Windows NT menu START - SETTINGS - CONTROL PANEL - MOUSE.

Connecting an External Monitor

Caution:
The monitor may only be connected when the instrument is switched off (STANDBY). Otherwise, the monitor may be damaged.

Do not modify the screen driver (display type) and display configuration since this will severely affect instrument operation.

The instrument is equipped with a rear-panel connector MONITOR for the connection of an external monitor.



After connecting the external monitor the instrument needs to be rebooted in order to recognize the monitor. After that the measurement screen is displayed on both the external monitor and the instrument. Further settings are not necessary.

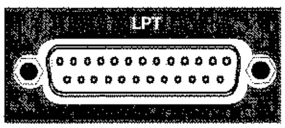
Connecting a Printing Device

Caution:
The printing device may be connected only when the instrument is switched off (STANDBY)

Note: *When installing printer drivers that are not pre-installed on the instrument, the operator is requested to insert the disk with the new driver into drive A.*
After installation the Service Pack needs to be re-installed (see section "Installing Windows NT Software")

The instrument is prepared for connecting printing devices to two different interfaces in order to create hard copies of the display screen. The *DEVICE* table in menu *HCOPY – DEVICE1/2* indicates the available selection of installed printing devices (see also Chapter 4, section "Documentation of Test Results").

The interface connectors are located on the rear panel:



Chapter 8 contains the interface descriptions of the connectors.

After connection of the printing device to the appropriate interface connector, the interface needs to be configured, the printer driver has to be installed and assigned to an interface.

1. Connecting keyboard and mouse

For the installation and configuration of printer drivers on the FSU, it is necessary to connect a keyboard to the front panel and a PS/2 mouse to the rear panel (only in case of using a keyboard without trackball, see sections "Connecting a Mouse" and "Connecting a Keyboard").

2. Switching to Windows NT start menu and opening the system control

The combination of keys <CTRL><ESC> is used to switch to the Windows NT start menu. The system control panel is then opened in the NT start menu using the sequence SETTINGS - CONTROL PANEL.

3. Configuration of the interface

LPT — Interface LPT needs no configuration.

COM — The COM interface must first be assigned to the operating system (owner = OS) in menu SETUP - GENERAL SETUP. The configuration of the serial interface can then be performed either in the Windows NT menu START - SETTINGS - CONTROL PANEL - PORTS or in the FSU SETUP - GENERAL SETUP menu. The parameters *Baud Rate, Data Bits, Parity, Stop Bits, Flow Control* determine the transmission parameters of the interface. They must correspond to the specifications of the printing device (see the operating manual for the printer).

Note: *The settings made for the serial interface in the menu SETUP - GENERAL SETUP overwrite the settings in the NT menu. However, settings in the Windows NT menu do not overwrite those of the SETUP menu. This means that the settings are only valid as long as the interface is assigned to the operating system.*

4. Selection and installation of the printer driver

The selection and installation of the printer driver, the assignment to the interface and the setting of most of the printer-specific parameters (eg paper size) is performed under Windows NT in the START - SETTINGS - PRINTER menu.

5. Configuration of the connected output device

The configuration of the connected output device and the assignment to the interface takes place in the *HCOPY DEVICE1/2* menu (see in Chapter 4, the section "Measurement Documantation"). The instrument supports the configuration of up to two output devices (DEVICE1 and DEVICE2), one of which must be activated for printing.

- The parameter *DEVICE* determines which output device is to be used.
- The parameter *PRINT TO FILE* determines if the output is in the form of a file.
- The parameter *ORIENTATION* sets the page format to horizontal or vertical (portrait).

Selecting the type of printer automatically sets the parameters *PRINT TO FILE* and *ORIENTATION* to values which correspond to a standard operating mode with this output device. Other printer-dependent parameters such as *FORMFEED*, *PAPERFEED* etc., can be modified under Windows NT in the printer properties window (START/SETTINGS/PRINTER/SETTINGS/....).

Table 1-1 shows the standard factory settings for the two output devices.

The factory settings for DEVICE 1 correspond to output format "WMF" (Windows Metafile); printing is performed in a file. WMF is a common format which is used for the import of hardcopies (eg measurement windows) in other Windows applications that support this format (eg WinWord).

The factory settings for DEVICE 2 are "Clipboard". In this setting the printout is copied to the Windows NT clipboard. Most of Windows applications support the clipboard. The clipboard contents can be directly inserted into a document via EDIT - PASTE.

Table 1-1 Factory settings for *DEVICE 1* and *DEVICE 2* in the *HCOPY* menu.

Setting	**Selection in the configuration table**	***DEVICE 1* Settings**	***DEVICE 2* Settings**
Output Device	DEVICE/LANGUAGE	WINDOWS METAFILE	CLIPBOARD
Output	PRINT TO FILE	YES	---
Page Orientation	ORIENTATION	---	---

In the following example, a HP DeskJet 660C printer is connected to the LPT interface and configured as *DEVICE2* for hardcopies of the screen contents.

Switch off the FSU.

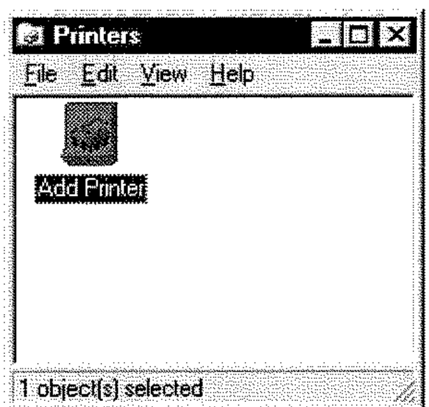
Connect the printer to interface LPT.

Switch on both FSU and printer.

Select the printer driver under Windows NT

➢ Press key combination <CTRL> <ESC>

The Windows NT start menu is displayed.

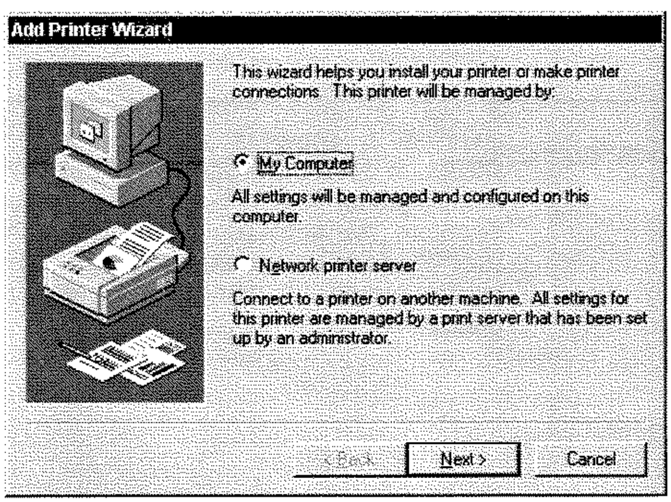


➢ In the Start menu press "Setting" and then "Printers".

The printer window is opened.

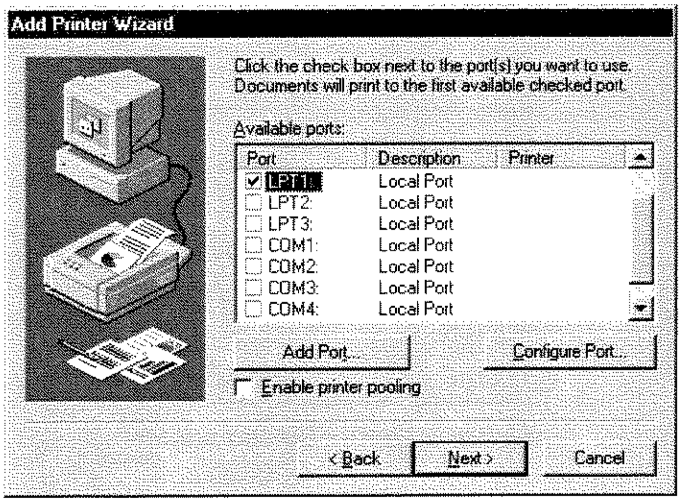
➢ Double-click symbol "Add Printer".

The "Add Printer Wizard" window is opened. This window leads through the following printer driver installation.



➢ Click "My computer" and then "Next".

The available printer ports are displayed.

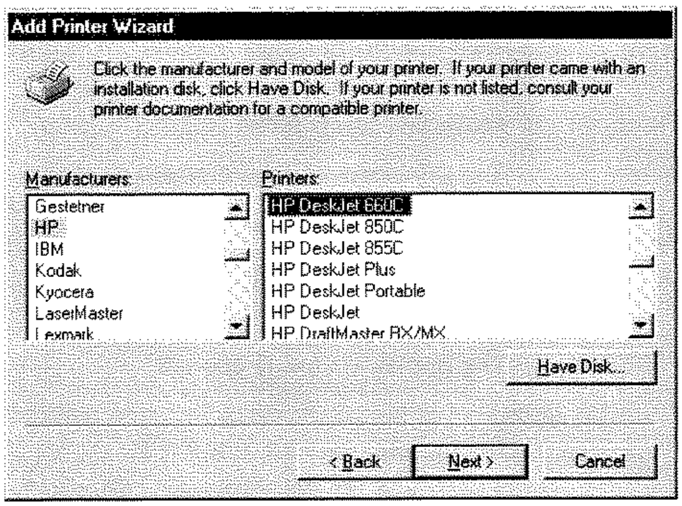


- ➢ Select LPT1.

  The selection is marked by a tick.

- ➢ "Click "Next".

  The available printer drivers are displayed. The left-hand selection table indicates the manufacturers and the right-hand one the available printer drivers.

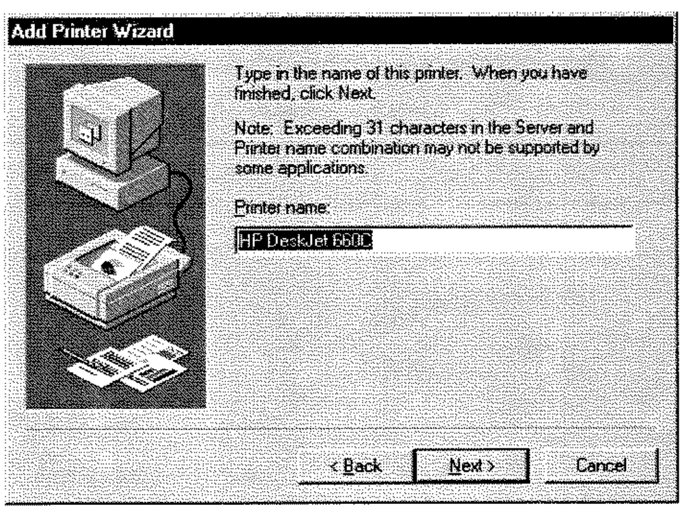


- ➢ Mark "HP" in selection table "Manufacturers" and "HP DeskJet 660C" in selection table "Printers".

Note:
If the required type of output device is not included in the list, the driver has not yet been installed. In this case click on button "HAVE DISK". A message box requesting to insert a disk with the corresponding printer driver will be displayed. Insert the disk, press OK and select the required printer driver. After installation, Service Pack 5 must be re-installed (see section "Installing Windows NT Software").

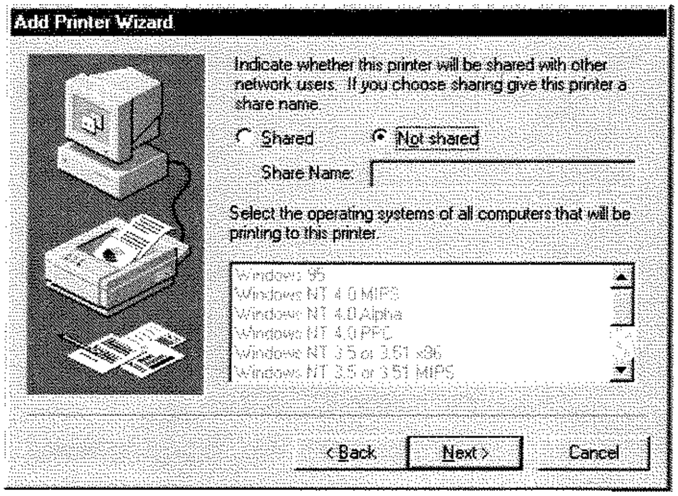
- ➢ Click "Next".

  The entry field for the printer name is displayed.



- ➢ The printer name can be modified in the entry field "Printer name" (max. 60 characters).

  If one or more printers are already installed, a query is displayed in this window to ask if the printer last installed as default printer should be selected for the Windows NT applications (Do you want your Windows-based programs to use this printer as default printer?). The default selection is "No".

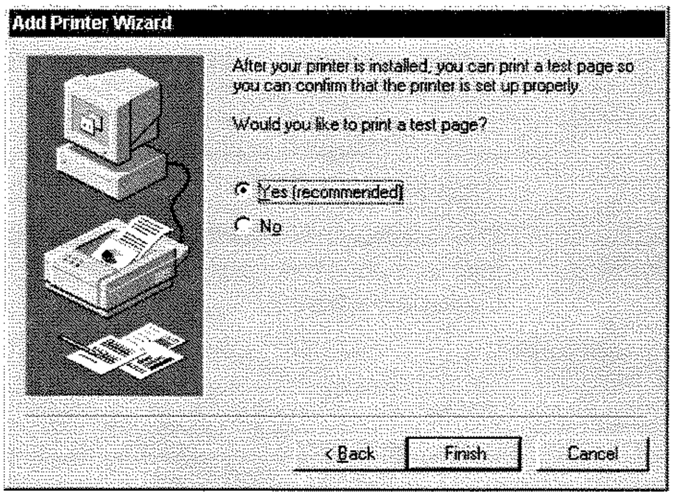


➢ "Click "Next".

A query is displayed for providing the printer in the network. This query is irrelevant when installing a local printer. The default selection is "Not shared".

➢ Click "Next".

The window for starting a test page print is displayed. The test page is helpful for checking if the installation was successful.



➢ Click Yes (recommended)".

➢ Click "Finish".

A test page is printed if the installation was successful.
If the test page is not printed or not printed completely, the Windows NT online help offers troubleshooting instructions under the topic "Printer Trouble Shooting".

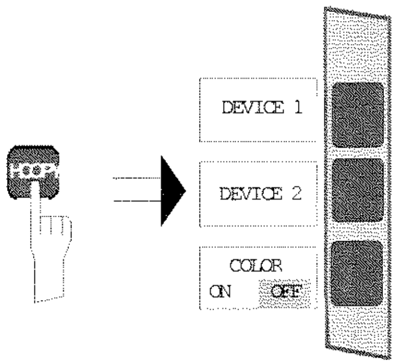
Note:
If a prompt for the printer driver path appears after pressing "Finish", the Service Pack must be re-installed after this printer installation (see Chapter 1, section "Installing Windows NT Software").

Now the instrument needs to be configured for creating hardcopies of the measurement screen using this printer.

Configuring HP DeskJet 660C.

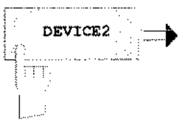
➢ Click button "R&S Analyzer Interface".

The measurement screen is displayed.



➢ Press the *HCOPY* key.

The *HCOPY* menu is opened.

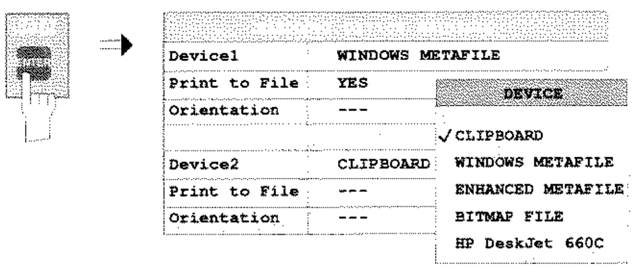


Device1	WINDOWS METAFILE
Print to File	YES
Orientation	---
Device2	CLIPBOARD
Print to File	---
Orientation	---

➢ Press softkey *DEVICE2.*

DEVICE 2 is activated as printing device.

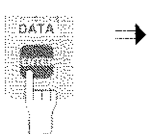
The *HARDCOPY DEVICE SETTINGS*-table is opened and the current settings of the two output devices are displayed. The current selection in line DEVICE2 is highlighted by the selection bar.



➢ Press the *ENTER* key.

The selection box *DEVICE* is displayed on the screen. The current selection is marked by a tick.

➢ Press cursor key ⇩ until the entry *HP DeskJet 660C* is highlighted by the selection bar.

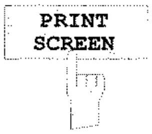


Device1	WINDOWS METAFILE
Print to File	YES
Orientation	---
Device2	HP Deskjet 660C
Print to File	NO
Orientation	PORTRAIT

➢ Press the *ENTER* key.

The selection box *DEVICE* is closed and *HP DeskJet 660C* is entered in line *DEVICE2.*

Note:
The selection of the printer type automatically sets the parameters PRINT TO FILE and ORIENTATION to values which correspond to a standard mode with this output device. Other printer-dependent parameters such as PAPERSIZE, can be modified under Windows NT in the printer properties window (START / SETTINGS / PRINTER / SETTINGS).



Start print of measurement results

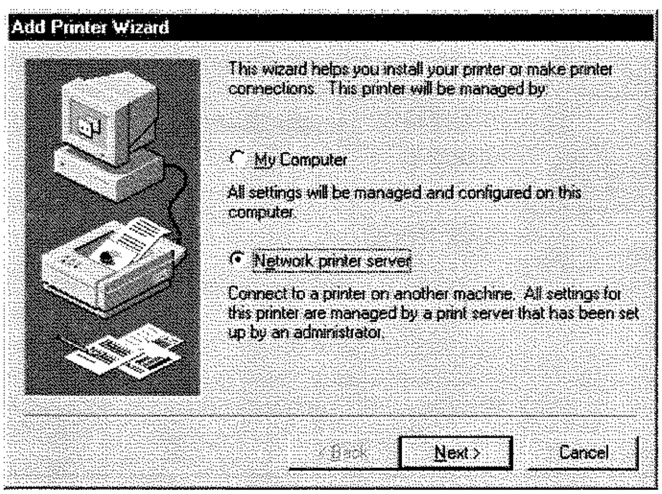
➢ Press Softkey *PRINT SCREEN* to start the print job.

Installation of a Network Printer (with option FSU-B16 only)

After opening the "Printers" dialog window proceed with the installation as follows:

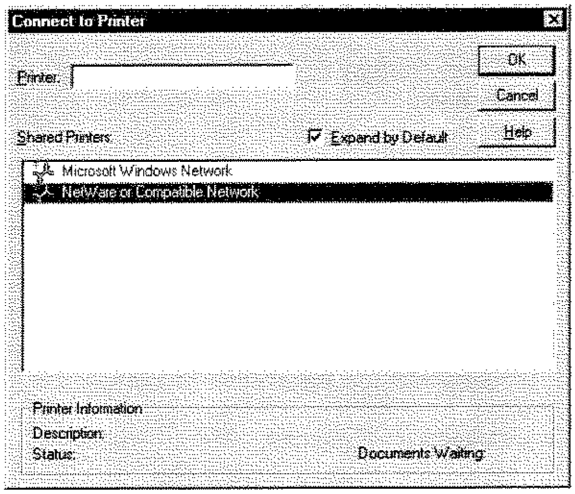
➢ Double-click the "Add Printer" line.

The "Add Printer Wizard" window is opened. This window guides the user through the printer driver installation.



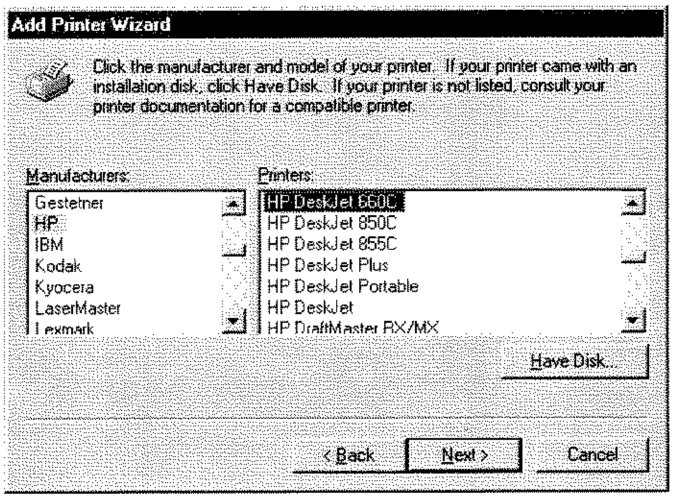
➢ Click "Network printer server" and then "Next".

A list of selectable printers is displayed.



- Mark the desired printer and select it with OK.
- Confirm the following request for the installation of a suitable printer driver with OK.

  The list of printer drivers is displayed. The manufacturers are listed in the window at the left, the available printer drivers at the right.

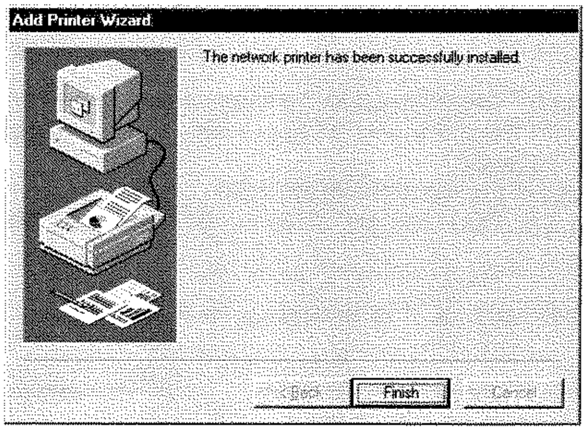


- Select the manufacturer in the "Manufacturers" window and then the printer driver in the "Printers" window.

Note:
If the required type of output device is not included in the list, the driver has not yet been installed. In this case click on button "HAVE DISK". A message box requesting to insert a disk with the corresponding printer driver will be displayed. Insert the disk, press OK and select the required printer driver. After installation, Service Pack 5 must be re-installed (see section "Installing Windows NT Software").

- Click "Next"

  If one or more printers are already installed, a prompt is displayed in this window to ask if the printer last installed as default printer should be selected for the Windows NT applications ("Do you want your Windows-based programs to use this printer as default printer?"). The default selection is "No".



➢ Start the printer driver installation with "Finish".

Note:
If a prompt for the printer driver path appears after pressing "Finish", the Service Pack must be re-installed after this printer installation (see Chapter 1, section "Installing Windows NT Software").

Finally, the instrument has to be configured for printout with this printer using the DEVICE 1 and DEVICE 2 softkeys in the hardcopy menu.

Installing Windows NT Software

The driver software and the system settings of Windows NT are adapted to the measurement functions of the instrument. Correct operation of the instrument can therefore only be guaranteed if the software and hardware used is authorized or offered by Rohde & Schwarz.
The use of other software or hardware may cause failures in the functions of the FSU.
A current list of the software authorized for use on the FSU can be obtained from your nearest Rohde&Schwarz agency (see list of addresses).

After installing any software of other manufacturers from a disk, it is necessary to re-install Service Pack 5 of Windows NT:

Re-installing Service Pack 5

➢ In the Start menu press "Run".

A data entry window is opened.

➢ Enter "C:\SP\SP5I386E.EXE" into the command line and start the installation with "OK".

The following window leads through the installation.

Contents - Chapter 3 "Manual Operation"

3 Manual Operation

Chapter 3 provides an overview of the operating concept and the basic steps of manual operation of the FSU. This includes a description of the screen, of the control of menus and of the setting of parameters. An overview of the menus will be listed at the end of this chapter.

The functions of the menus are described in dtail in Chapter 4. Chapter 2 contains a short introduction on step-by-step simple measurements. The remote control of the instrument is described in Chapters 5, 6 and 7

The operation of the spectrum analyzer is menu-controlled via keys, hotkeys and softkeys. The setting of the instrument and test parameters in the menus is made either directly via softkeys or by entry of values in entry fields and by selection in tables. The operating mode and the screen mode is selected via the hotkeys.
If required, data entry windows and tables are superimposed on the screen.

The Screen

The screen informs continuously on the results and parameters of the selected measuring functions. It shows the assignment of the softkeys and menus, which are required for setting the measuring parameters. The display of test results, the softkey labeling and the type of menu depend on the selected measuring function.
The screen is subdivided into three areas:

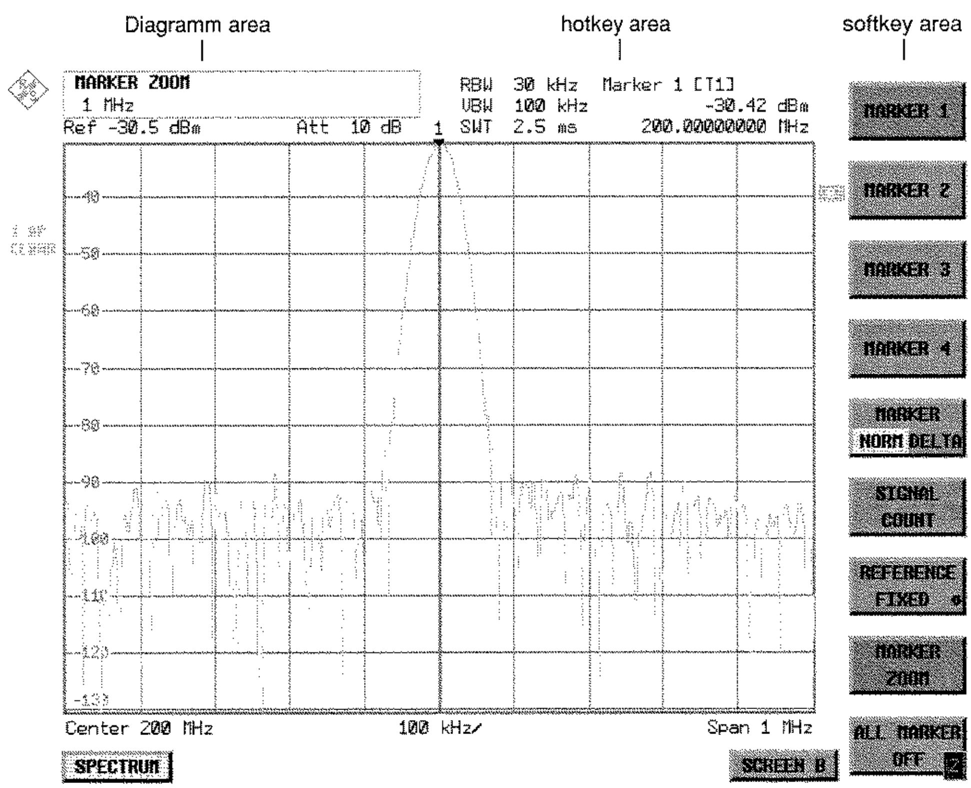


Fig. 3-1 Subdivision of screen

Diagram area This area contains the measuring diagrams and other measured-value information as well as the parameters and status information which are important for analysis of the results.
In addition, message fields, entry windows and tables may be shown in this area.

Softkey area This area contains the instrument functions which can be selected via the softkeys. The softkey area is not superimposed by other graphics.

Hotkey area This area contains the available operating modes and screen modes. The hotkey area is not superimposed by other graphics.

Diagram Area

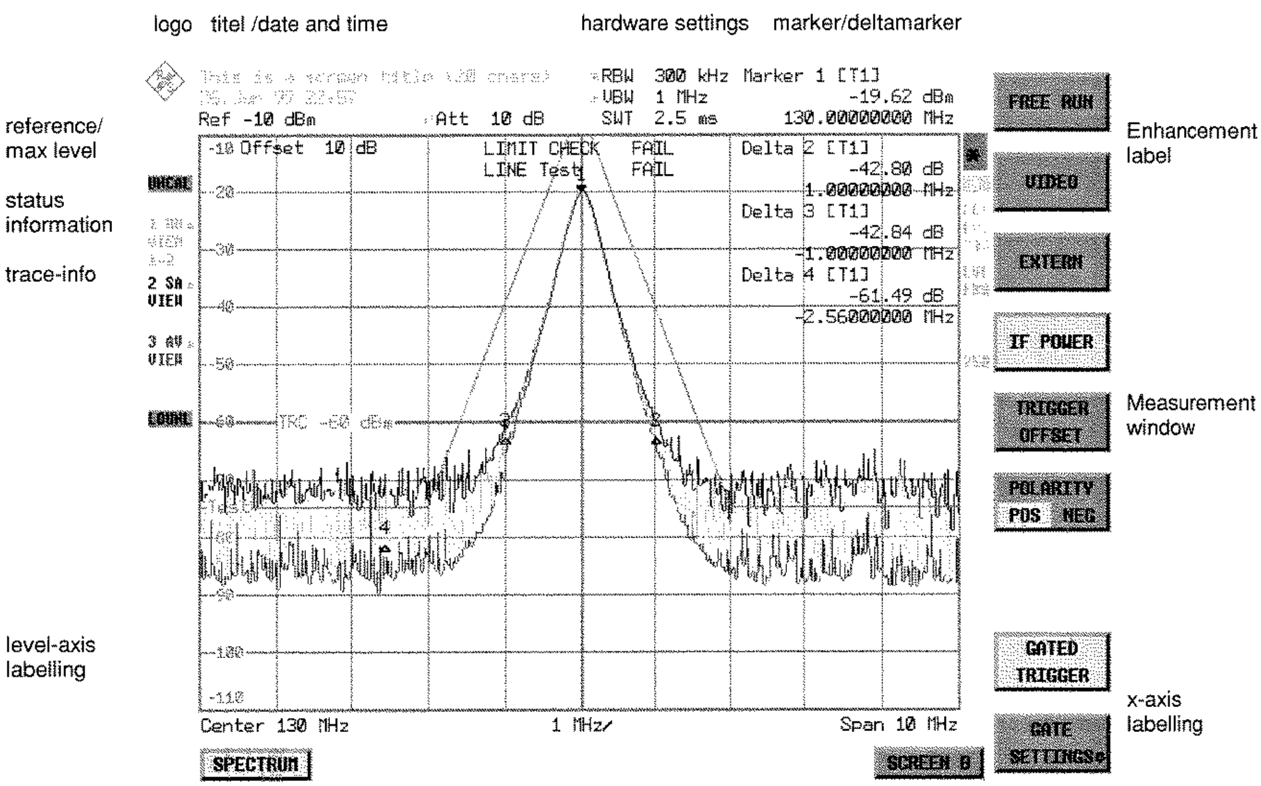


Fig. 3-2 Subdivision of the FSU screen in analyzer mode (without measuring diagram)

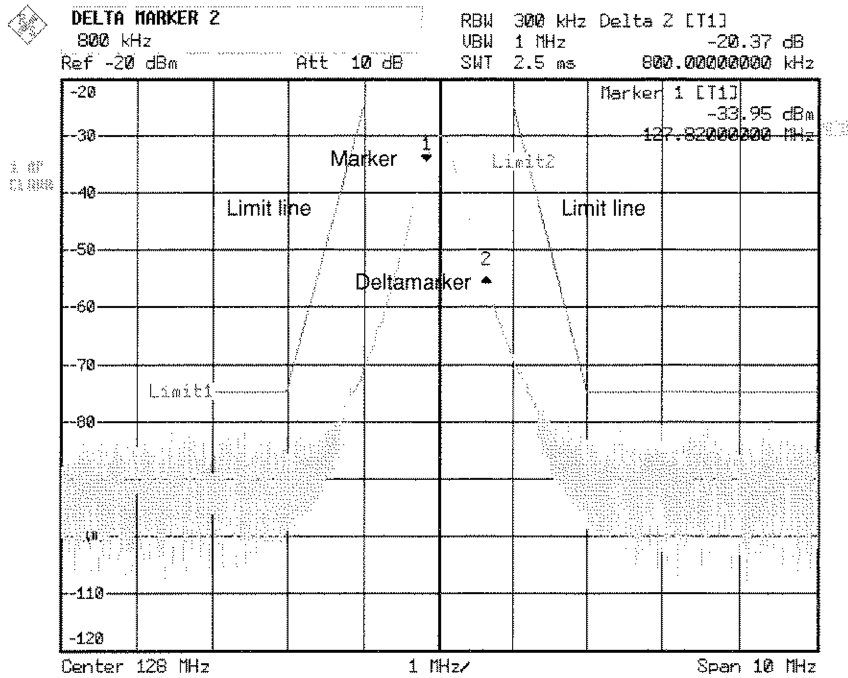


Fig.3-3 Measuring diagram

Indications in the Diagram Area

The following graphic elements are displayed in the diagram area:

General indications Indication of the logo

Logo

Screen title Indication of selected screen title

Date / time Indication of date and time

Hardware settings

Ref Indication of the reference level

Offset Indication of the offset of reference level.

Att Indication of the set RF attenuation.

RBW Indication of the set resolution bandwidth.
If the bandwidth does not correspond to the value of the automatic coupling, a green asterisk "*" is prefixed to the field.

VBW Indication of the set video bandwidth.
If the bandwidth does not correspond to the value of the automatic coupling, a green asterisk "*" is prefixed to the field.

SWT Indication of the set sweep time.
If the sweep time does not correspond to the value of the automatic coupling an asterisk "*" is prefixed to the field. The colour of the asterisk turns red as soon as the sweep time falls below the value of the automatic coupling.

Marker/deltamarker

This label displays the position of the last selected marker or deltamarker in the x and y-directions and the marker/deltamarker index. The square brackets contain the curve which the marker is assigned to and the active measuring function of the marker indicated. The measuring function of the markers in the second field is indicated by the following abbreviations:

FXD	reference fixed active
PHN	phase noise measurement active
CNT	frequency counter active
TRK	signal track active
NOI	noise measurement active
MOD	measurement of AM modulation depth active
TOI	TOI measurement active (3rd order intercept)

Limit check

Indication of the result of the limit check.

X-axis labelling

Display of the x-scaling.

`10 MHz/DIV`

The distance between two grid lines is displayed in this label.

`Center 1.2345678901234 GHz`

`Start 1.2345678901234 GHz`

The set center frequency or start frequency is displayed in this label depending on whether the keys FREQ/SPAN or the softkeys START/STOP were last pressed.
If span = 0 Hz, the center frequency is always displayed.

`Span 1.2345678901234 GHz`

`Stop 1.2345678901234 GHz`

`Trigger 1.234 ms`

The set frequency range (*SPAN*) or the stop frequency is displayed, depending on whether the keys FREQ/SPAN or the softkeys START/STOP were last pressed.
If span = 0 Hz, the trigger moment (*PRETRIGGER*) is displayed.

Status information

The status information on the left side of the diagram hint at irregularity (e.g. UNCAL)

UNCAL

"UNCAL" is indicated under the following circumstances:

- correction data are switched off (menu CAL, CAL CORR OFF).
  ⇒ switch on CAL CORR ON or PRESET
- no valid correction data. This may occur after a cold start of the instrument following a firmware update.
  ⇒ record correction data
- Sweep time too short for current instrument settings (span, resolution bandwidth, video band width).
  ⇒ increase sweep time

OVLD / IFOVL

OVLD is indicated when the input mixer is overloaded.
⇒ Increase input attenuation

IFOVL is indicated when overload occurs in the IF signal path after the input mixer.
⇒ Increase reference level

MSG / LOUNL / EXREF

MSG is indicated if a failure has occurred which impair correct measurement. The exact error message can be queried in the menu *SETUP SERVICE INFO.* The display disappears after the cause for the error has been eliminated.

LOUNL is indicated when an error occurs in the frequency processing of the instrument.

EXREF is indicated when the analyzer is configured for use of an external reference signal, but no reference signal is detected at the corresponding input.

OVEN

OVEN is indicated when the crystal oscillator (option FSU-B4) has not yet reached its operating temperature. This indication vanishes after a few minutes after switch on.

Trace info:

Every active measurement curve (trace ≠ BLANK) is allocated a trace info of two or three lines at the left of the diagram. The trace info has the same colour as the measurement curve.

<n> <detector> <*>
<mode>
<trace math>

Example:

```
1 PK *
CLRWR
1-2
```

n = trace number (**1 ... 3**)

detector = selected detector

- **AP:** AUTOPEAK detector
- **PK:** MAX PEAK detector
- **MI:** MIN PEAK detector
- **SA:** SAMPLE detector
- **AV:** AVERAGE detector
- **RM:** RMS detector
- **QP:** QUASIPEAK detector

* = indicates that the selected detector does not correspond to that of the automatic coupling.

mode = indication of sweep mode

- **CLRWR:** CLEAR/WRITE
- **MAXH:** MAX HOLD
- **MINH:** MIN HOLD
- **AVG:** AVERAGE
- **VIEW:** VIEW

Trace math = trace math active

- **1 - 2** trace 1 - trace 2
- **1 - 3:** trace 1 - trace 3

Instrument settings (Enhancement Labels)

Indication of user instrument settings which influence the measuring result and which are not immediately obvious when viewing the measured values.

***** The current instrument setting does not correspond to the one which applied when one of the displayed curves had been stored. This occurs under the following circumstances:

- The instrument setting is modified while a measurement is being performed.
- The instrument setting is modified in SINGLE SWEEP mode subsequent to the end of the sweep and no new sweep is started.
- The instrument setting is modified after setting the trace to VIEW.

The display is retained until the cause is eliminated by the user. I.e., either a new sweep is started (SINGLE SWEEP mode), or the trace of interest is switched to BLANK.

A / B Identification for screen A / B. When screen A / B is activated for the entry of test parameters, this label is highlighted.

SGL The sweep is set to SINGLE SWEEP.

GAT The frequency sweep is controlled via the *EXT TRIG/GATE* input of the instrument.

TRG The instrument is not triggered in *FREE RUN* mode.

LVL A level offset ≠ 0 dB has been set.

FRQ A frequency offset ≠ 0 Hz has been set.

PRN A printer output is active.

75 Ω The input impedance of the instrument is set to 75 Ω.

EXT The instrument is configured for operation with external reference

Entry fields:

Entry window

The data entry window is superimposed in the left upper corner of the diagram area, if required. It covers the display of the title and the time. The field is used to enter numeric or alphanumeric device parameters.

Tables

The tables are superimposed in the diagram area, if required. Sie dienen der Anzeige und Konfiguration von Geräteparametern.

Message windows:

Message field

Message fields provide notes on measurements, e.g. results of the limit check (PASS/FAIL).
These notes are no error messages, which are indicated as system messages.

They can be masked out by pressing the *ESC* key.

System messages

System messages indicate warnings and error messages.

Message without action field:
These system messages contain only arbitrary information. They hint at events which are of interest for the user but do not affect the measurement or functioning of the instrument.

They are deleted either automatically after a predefined time has passed (3 seconds) or upon any keystroke or mouse click.

Message with action field:
These system messages require a decision to be taken by the user. They are not deleted until any action has been selected. Deletion of the message initiates the action selected and appropriate measures to be taken. The action field consists of one (OK), two (OK/CANCEL) or three (arbitrary) buttons.
The user may select one of the buttons using the cursor keys and initiate the associated action by means of the unit keys. The ESC key is used to acknowledge the message without releasing any action.

Traces:

1 to 3

Up to 3 traces in each measurement diagram can be displayed simultaneously.

Limit lines

Limit lines are used to mark level curves or spectral distributions which must not be exceeded or dropped below.

The FSU provides two display modes:

- Full Screen: 1 window, the measurement is performed in the active diagram.
- Split Screen: 2 windows, the measurements are performed in both diagrams.

Full Screen

In the full-screen mode, the settings and measurements are performed in the active visible window. All indications on the screen refer to this window. The designation (SCREEN A or SCREEN B) is inserted as enhancement label A or B on the right diagram margin.
Switching between the windows is by means of *SCREEN A/B* hotkey. The current measurement is terminated when its window is blanked out.
Switching from split-screen to full-screen mode is performed in menu *DISP.*

Split Screen

In Split Screen mode, the screen is divided into two halves.

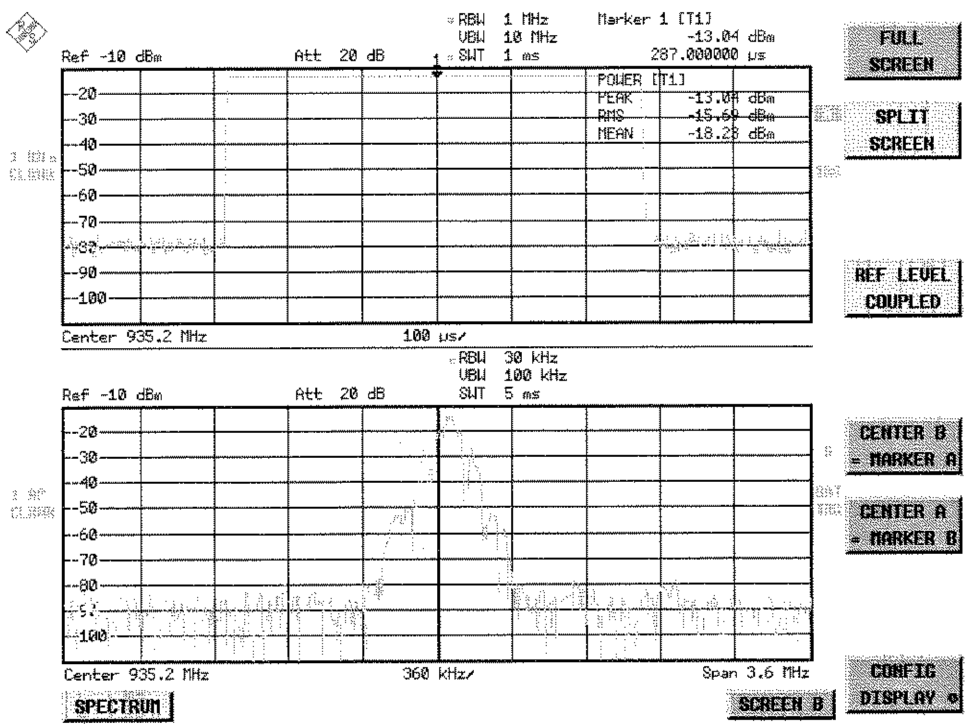


Fig.3-4 Subdivision of the screen in Split Screen mode

The upper half is assigned Screen A, the lower one Screen B. The settings for measurement can be selected independently for both screens. E.g., a spectrum may be displayed in Screen A and a time amplitude in the time range is displayed in Screen B.

The indications which are valid only for one window appear in the margin of the associated diagram. Indications which are valid for the two windows are displayed between the diagrams.

The window for entry of the measuring parameters or the marker operation is selected using the *SCREEN A/B* hotkey. The measurements are simultaneously performed in the two windows irrespective of the currently active one.
Switching from full-screen to split-screen mode is performed in menu *DISP.*

Softkey Area

The softkeys are assigned to the nine keys on the right side of the display
The setup of the softkey area is independent of the operating mode. It consists of the following graphic elements:

Softkey menu:

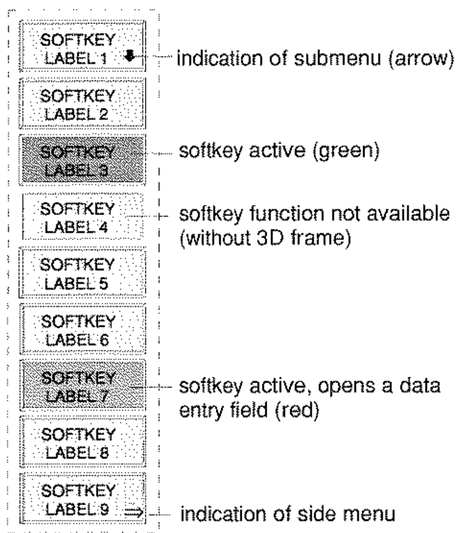


Fig.3-5 Setup of the softkey area

The softkeys have different functions depending on the instrument state. Therefore, their labeling can be varied. The labeling of all softkeys which call a submenu includes a ⇓ arrow.
The function and current state of the softkeys is indicated in the label by different texts and colors. The color assignment is factory-set as follows:

Table 3-1 Factory-set color assignment of soft keys

Softkey color	Meaning
gray	Softkey switched off
green	Softkey switched on
red	Softkey switched on and data entry active

These colors can be changed by the user as desired in the *DISP - CONFIG DISPLAY* menu.

A softkey is switched on or off by pressing the respective hardkey (see following section "Setting the Parameters").

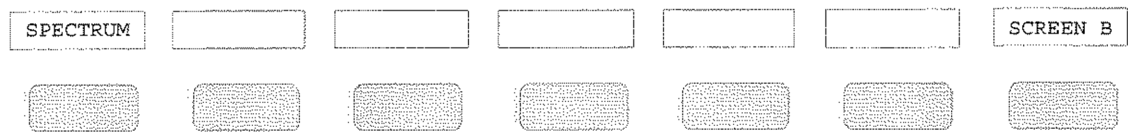
Softkeys are masked out, too, if the functionality which they represent is not available. A distinction has to be made between two cases:

- If an instrument function depends on an option, and if this option is not fitted, the associated softkey is masked out,.
- If the instrument function is not available temporarily due to specific settings, the softkey is displayed without the 3D frame.

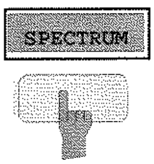
The label ⇒ on the right lower corner of the softkey area indicates that a side menu is available. The side menu is called by pressing the *NEXT* key.

Hotkey Area

Hotkeys are allocated to the eight keys on the bottom margin of the screen. They change between modes and the active diagrams.
The menu only shows the hotkeys which are actually used:



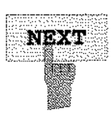
A keystroke activates the associated hotkey. An activated hotkey changes its frame:



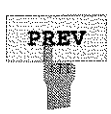
Calling and Changing the Menus

The operation of the spectrum analyzer is menu-controlled via keys and softkeys. Various softkey menus are displayed depending on the instrument status. The individual menus constitute the so-called menu tree. The top menu (the root of the menu tree) is always called by means of a keystroke. Arrows at the lower edge of the softkey area indicate whether a supplementary menu can be entered or not.
Softkeys with an arrow allow for branching into further menus (so-called submenus): The field "⇒" at the lower right side of the softkey area indicates that this menu has a side menu.

The menu change keys on the front panel below the softkey area allow for switching between the main menu and the side menus and submenus.



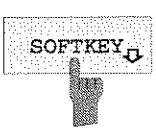
The *NEXT* key calls the side menu.



The *PREVIOUS* key returns to the next higher menu.

Several menus provide for automatic change, i.e., return to the next higher menu is caused automatically after pressing a softkey.

Selection of a submenu is always effected via a softkey.



The labeling of all softkeys which call a submenu includes a ⇓ arrow.

Setting Parameters

Parameters are set either by simple selection (selection parameters) or by (alpha)numeric entries in data entry windows or tables.

The numeric keypad on the front panel, an external keyboard (optional), a roll-key and the cursor keys are provided for the entry of instrument parameters in an entry window or in a table.

The external keyboard is optional. If it is not fitted, the help line editor is called automatically for entry of alphanumeric parameters. The help line editor provides for selection of individual letters and a number of special characters which are copied into the actual entry window.

Numeric Keypad

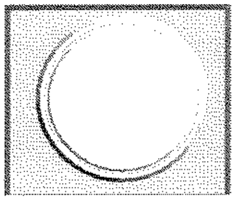
The numeric keypad is provided for entry of numeric parameters. It contains the following keys:

- Number keys 0 to 9
- Decimal point
  Inserts a decimal point "." at the cursor position.
- Sign key
  Changes the sign of the mantissa or exponent of a numeric parameter.
  A "-" is inserted at the cursor position in case of an alphanumeric parameter.
- Unit keys (*GHz/-dBm*, *MHz/dBm*, *kHz/dB* and *Hz/dB*)
  - Provide the numeric value entered with the selected unit and terminate the entry.
    The unit keys are all assigned the value "1" for dimensionless quantities or for level entries (e.g., in dB). The unit keys thus assume the function of an *ENTER* key. The same applies for an alphanumeric entry.
  - Open and close the selection windows of tables.
- *BACK* key
  - Deletes the character left to the cursor with numeric entry.
  - Allows for toggling between the current and the previous values subsequent or prior to entry (UNDO function).
- *ESC/CANCEL* key
  - Aborts the entry before it has been terminated. The previous value is restored.
  - Closes the entry field after termination of input.
  - Closes system messages.
- *ENTER* key
  - Terminates the input of dimensionless quantities. The new value is set.

Note: *The ENTER keys assumes the function of the Hz key for frequency input, and the function of the µs(kHz) key for time input.*

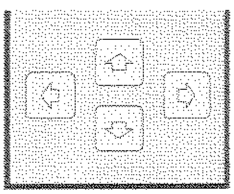
Roll-key and Cursor Keys

The roll-key and the cursor keys are arranged besides the numeric keypad.



The roll-key has various functions:

- With numeric entry, the instrument parameter is incremented (turning clockwise) or decremented (turning counterclockwise) at a defined step size.
- In tables, the roll-key can be used to shift the cursor horizontally or vertically when no entry window is open. The direction (horizontal/ vertical) is switched over using the cursor keys.
- The roll-key is used with the help-line editor to select the individual letters.
- It can be used to shift markers, display lines, limit lines etc.
- Pressing the roll-key terminates the input of parameters.



In tables, the cursor keys are used to shift the cursor between the lines and columns of the table.

The keys  and  are used to shift the cursor inside the entry window to reach a particular position in the string.

The keys  and 

- increase or decrease the value of a parameter for numeric input .
- switch between editing line and help line editor for alphanumeric input.

Selection and Setting of Parameters via Keys or Softkeys

The selection of parameters and their settings is effected by means of a key, a softkey or in a table depending on the hierarchical level of the menu they are assigned to. Selection and setting of parameters in tables is described in section "Selection and Setting of Parameters in Tables" .

Selection via key

Most keys of the network analyzer are used to enter menus where the selection and the settings are made. Few settings can be made directly by means of a keystroke, only.

Example: Call up of preset settings

➢ Press *PRESET* key

The spectrum analyzer is brought into a predefined initial state.

Selection via softkey

In most cases the selection is made by pressing the respective softkey. There are various alternatives of making the selection:

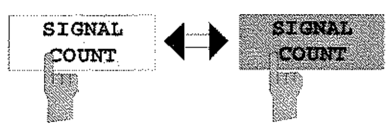
1. The softkey is active or inactive.

Example: Switching on/off the frequency counter

➢ Press *MKR* key.

➢ Press *SIGNAL COUNT* softkey.

Each time the softkey is pressed, the marker info list is switched on or off. If the softkey is active (= marker info list on), it is illuminated.



2. The softkey acts like a toggle switch, each pressing changes the active selection.

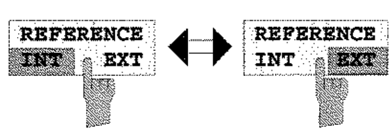
Example: Selection of the reference (internal or external)

➢ Press *SETUP* key.

➢ Press *GENERAL SETUP* softkey, the *GENERAL SETUP* submenu is opened.

➢ Press *REFERENCE INT/EXT* softkey.

With each pressing, the checkmark on the softkey changes from INT (internal reference) to EXT (external reference) and vice versa. When in the active setting the softkey menu item is illuminated.



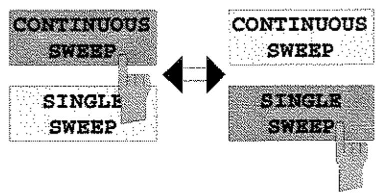
3. Various softkeys act like selection switches. Only one softkey may be active at a time.

Example: sweep setting

➢ Press *SWEEP* key.

➢ Press *CONTINOUS SWEEP* softkey.

The continuous sweep is thus set. The *CONTINOUS SWEEP* softkey is colored (factory-set: green). The second alternative, a series of n sweeps according to the trigger definition, can be selected via the *SINGLE SWEEP* softkey in the same menu. Only one of the two softkeys can be active at a time, the softkeys thus act like selection switches.



4. The softkey is used to select the parameter, the setting is made in an alphanumeric data entry window.

Example: SWEEP COUNT parameter

➢ Press *SWEEP* key

➢ Press *SWEEP COUNT* softkey.

The window for entering the number of sweeps for the SINGLE SWEEP mode is opened. The softkey is colored (factory-set: red). (Data entry is described in the next section).

4. The softkey is used to select the parameter, the setting is made in an (alpha)numeric data entry window. The softkey function is switched on. To switch off the function, the softkey has to be pressed again.

Example: parameter MARKER

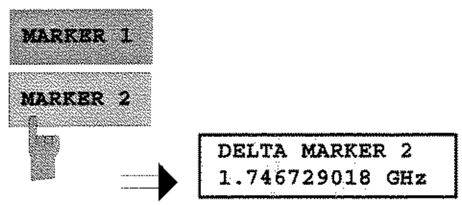
➢ Press *MRK* key.

➢ Press *MARKER 1* softkey.

The window for entering the marker frequency is opened. The softkey is colored (factory set: red). Marker1 is switched on and the peak search is started.

➢ Press *MARKER 2* softkey.

The entry window for the marker frequency of marker 2 is opened. The softkey is colored (red), marker 2 is switched on, and the *MARKER 1* softkey turns green.



➢ Press *MARKER 1* softkey again.

Marker 1 is switched off.

5. The softkey selects the parameter, the setting is made in a selection table.

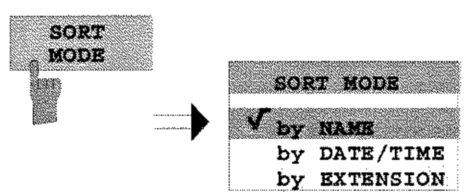
Example: Selection of the sorting criteria of a file list

➢ Press *FILE* key.

➢ Press *FILE MANAGER* softkey.

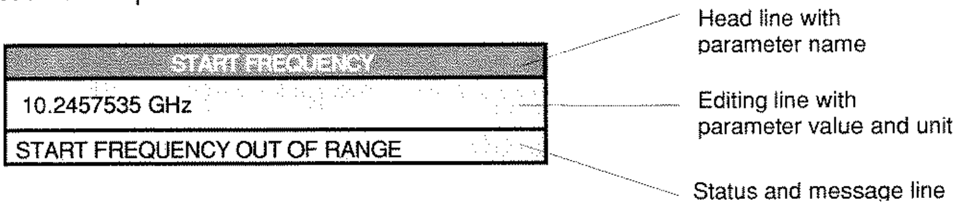
➢ Press *SORT MODE* softkey.

A selection table is displayed. The softkey is colored (factory-set: red). (operation see below).



Editing of Numeric Parameters

The entry of numeric values is always made in a data entry window, which is displayed automatically after selection of the parameter.



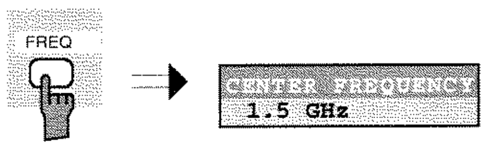
The headline indicates the name of the instrument parameter, which has been selected. The entry is made in the editing line. Subsequent to calling the entry window, the current parameter value including the unit is displayed left-justified in the editing line. Status and error messages which refer to the current entry are displayed in the third and (optionally) fourth line.

Note: *Entry windows may be represented transparent (cf. DISPLAY - CONFIG DISPLAY menu)*

Entry of a numeric value

➢ Call data entry window (cf. selection of parameters)
The editing line indicates the current value

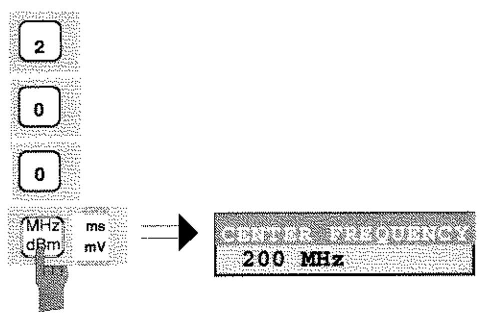
Example: center frequency (frequency-sweep mode)



Entry via number keys

➢ Enter required value via number keys.

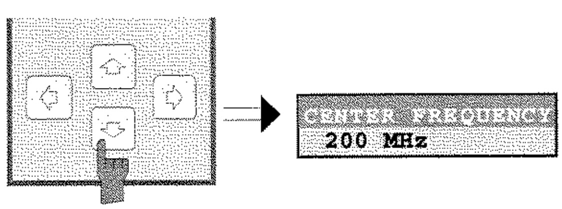
Example:



Entry via cursor keys

➢ Cursor or until obtaining the required value.

Example:



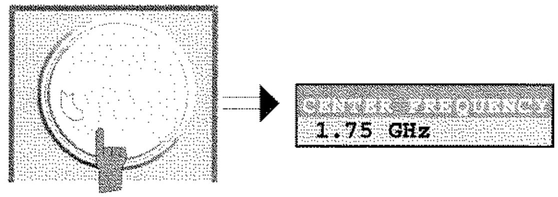
Entry via roll-key

➢ Rotate the roll-key until reaching the required value.

The variation step size increases with increasing rotational speed.

Turning the roll-key clockwise increases the value, turning it counterclockwise decreases the value.

Example:



Note: *When the value is modified by means of the roll-key or the cursor keys the new value is immediately set.*

Terminating the entry

➢ Press one of the unit keys

The unit is entered in the entry window and the new setting is accepted by the instrument.

For dimensionless quantities:

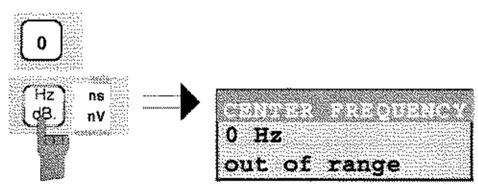
➢ Press the ENTER key or the roll-key

The new setting is accepted by the instrument.

A few data entry windows close automatically whereas others like the entry window for the start frequency remain open even after termination of the entry. They can be closed by pressing the *ESC* key.

If an error occurs, a corresponding error message is displayed in the status line of the entry window, e.g., "Out of range", "Value adjusted", etc. In this case, the new value is not accepted for the instrument setting.

Example:



Correcting the entry

Deleting an entry

➢ Position the cursor beside the digit which is to be deleted using the cursor keys or .

➢ Press the *BACK* key. The entry left to the cursor is deleted.

➢ Enter new numbers. The number is inserted to the left of the cursor, the other numbers are shifted right.

Restoring the original value

➢ Press the *BACK* key

For numerous parameters, the data administration of the instrument stores the previously valid parameter value in addition to the current value. The BACK key can be used to toggle between these two values. This applies for terminated entries as long as the data entry window is displayed.

Aborting the entry

➢ Press *ESC* key

The original parameter value is restored. The new entry is deleted.

➢ Press *ESC* key again

The entry window is closed, the original value remains active.

or

➢ Press any key or any softkey (even the softkey which has opened the entry window).

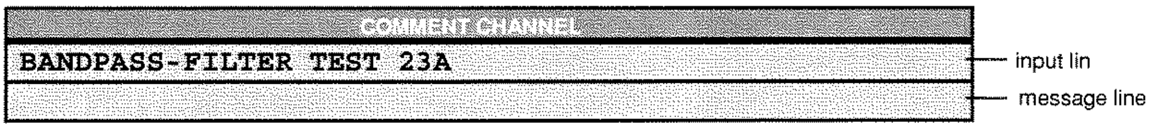
The entry is aborted and the entry window is closed. The original value remains active.

Entry of Alphanumeric Parameter

A help-line editor or an external keyboard (optional) are provided for the entry of alphanumeric instrument parameters.
The roll-key and the exponent key have no function with alphanumeric entry. All unit keys assume the function of an ENTER key.

The entry is always made in a data entry window which is displayed automatically upon selection of the parameter. The editing line comprises 60 characters. Up to 256 characters may be entered. If a text exceeds 60 characters the contents is shifted automatically 20 characters left or right when the left or right margin of the editing line is touched by the cursor.

Editing with External Keyboard



Entry of text

➢ Select parameter.
The data entry is active automatically upon calling the data entry window. The cursor is positioned at the beginning of the previous entry.

➢ Press the required character on the keyboard.
The character is inserted prior to the cursor.

➢ Enter further characters

Correcting the entry

➢ Delete the entry using the *DELETE* key or *BACKSPACE* key.

Terminating the entry

➢ Press the *ENTER* key of the external keyboard
The data entry window is closed and the new value is accepted for the instrument.

Aborting the entry

➢ Press the **ESC** key on the front panel

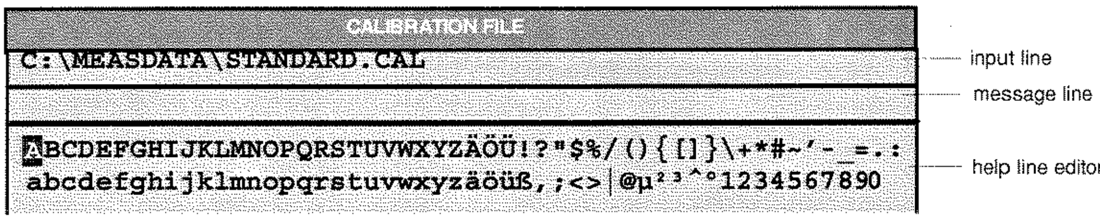
or

➢ any softkey.

The data entry window is closed, the original value is retained.

Editing with Help Line Editor

If the external keyboard is not fitted, the help line editor is called automatically with entry of alphanumeric parameters. The help line editor is an extension of the alphanumeric entry window. It contains the complete alphabet with uppercase and lowercase letters as well as special characters in two lines of 52 characters, each. Individual letters and a series of special characters can be selected in the help line editor and copied into the entry line.



The cursor keys or toggle between entry in the editing line and selection in the help line editor.

Entry of text

- ➢ Select parameter.
  The data entry is active automatically upon calling the data entry window. The cursor is positioned on the left in the editing line.
- ➢ Position the cursor in the help line editor using the cursor key.
  The cursor marks the first letter of the editor.
- ➢ Locate the cursor on the character which is to be entered into the editing line using the cursor keys or or the roll-key.
- ➢ Press the *ENTER* key or the roll-key
  The character is entered in the editing line.

Correcting the entry

- ➢ Locate the cursor in the editing line using the cursor key .
- ➢ Position the cursor after the character which is to be deleted using the cursor keys and .
- ➢ Press the *BACK* key.
  The entry left to the cursor is deleted.

Terminating the entry

- ➢ Locate the cursor in the editing line using the cursor key .
- ➢ Press any unit key or the roll-key.
  The data entry window is closed, the new entry is accepted by the instrument.

Aborting the entry

- ➢ Press the *CLR* key.
  The data entry window is closed, the previous entry is retained.

Selection and Setting of Parameters via Tables

The spectrum analyzer uses numerous tables for display and configuration of instrument parameters.

The tables differ considerably in the number of lines, columns and inscriptions. The basic steps of operation for the selection and setting of parameters are, however, the same for all tables. Shown below is the typical entry of parameters into a table.

Note:

Most of the tables are coupled to a softkey menu which provides further functions for editing table entries such as deletion of tables, copying of lines or columns, marking of table elements, restoring default states.

The definition of individual tables and the operation of particular editing functions can be looked up in the description of the corresponding softkey menu.

1. Activating the table

- If the menu has only one table, the latter is activated automatically subsequent to calling this menu in most cases and the marking cursor is positioned to the top field of the left column.
- If the menu contains various tables, the table of interest must be selected using the softkey which is labeled with the title of the table.

2. Selection of the parameter

marking cursor

LIMIT LINES

NAME	COMPATIBLE	LIMIT CHECK	TRACE	MARGIN
GSM22UP	√	off	1	0 dB
√ LP1GHz		on	2	0 dB
√ LP1GHz	√	off	1	0 dB
MIL461A		off	2	-10 dB

Selection of the parameter (or the setting) is made using the marking cursor.

➢ Press the cursor keys to move to the wanted field.

or

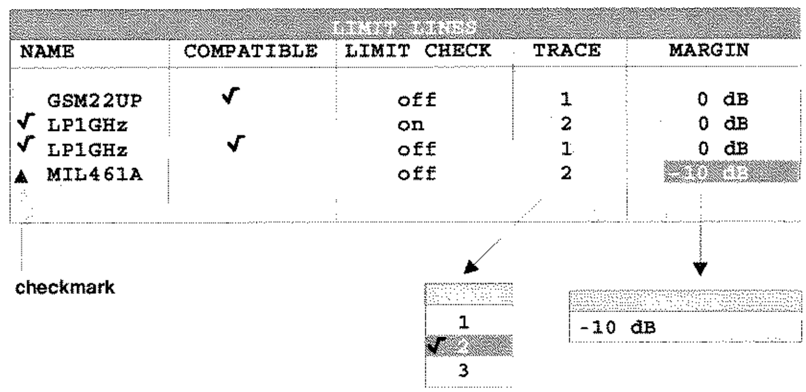
➢ Rotate the roll-key until the wanted field is marked. The cursor keys are used to specify the direction of the roll-key movement (horizontal or vertical)

When shifting the cursor, elements may be skipped which can not be edited. Table elements, which can not be selected are indicated by a different color.

➢ Press the *ENTER* key or the roll-key.
The parameter/the setting has been selected.

The selected parameter can be edited the way described below:

3. Editing the marked parameter



a) Toggling between two states

If an element of a table can be switched on and off only, the unit keys are used to toggle between these two states.

➢ Press one of the unit keys.
The table element is switched on and provided with a checkmark. (√).

➢ Press one of the unit keys once more.
The table element is switched off.

or

➢ Press one of the unit keys.
The table element is switched on, "on" is displayed.

➢ Press one of the unit keys once more.
The table element is switched off, "off" is displayed

b) Opening a data entry window

If a table entry consists of an (alpha-) numeric value, selection of the latter causes the corresponding entry window to be opened.

Note: *For numeric or alphanumeric instrument parameters, the editing operation may be started by entering any number or letter on the front panel or on the external keyboard. In this case, the data entry window is opened automatically.*

c) Opening a selection table

If a table entry may have various states (e.g., colors from a color pallet, fixed filter bandwidths, etc.), a table indicating all possible states is displayed with selection. The current state is and marked by a checkmark and by the cursor.

➢ Set the cursor to the desired setting.

➢ Press one of the unit keys.
The setting is switched on and marked (√). The selection table closes and the value is transferred to the original table. The cursor is positioned automatically on the next table element.

Abortion of entry

➢ Press the *ESC* key.

The current entry/selection is aborted and the original setting is restored.

Scrolling

Some tables contain more entries than can be displayed on one screen page. In this case, a **scrollbar** is displayed at the right margin of the table, whose slider shows the current position in the text.

➢ Actuate the *PAGE UP* or *PAGE DOWN* softkeys.

The table is paged forward or back by one page.

➢ Press cursor key or .

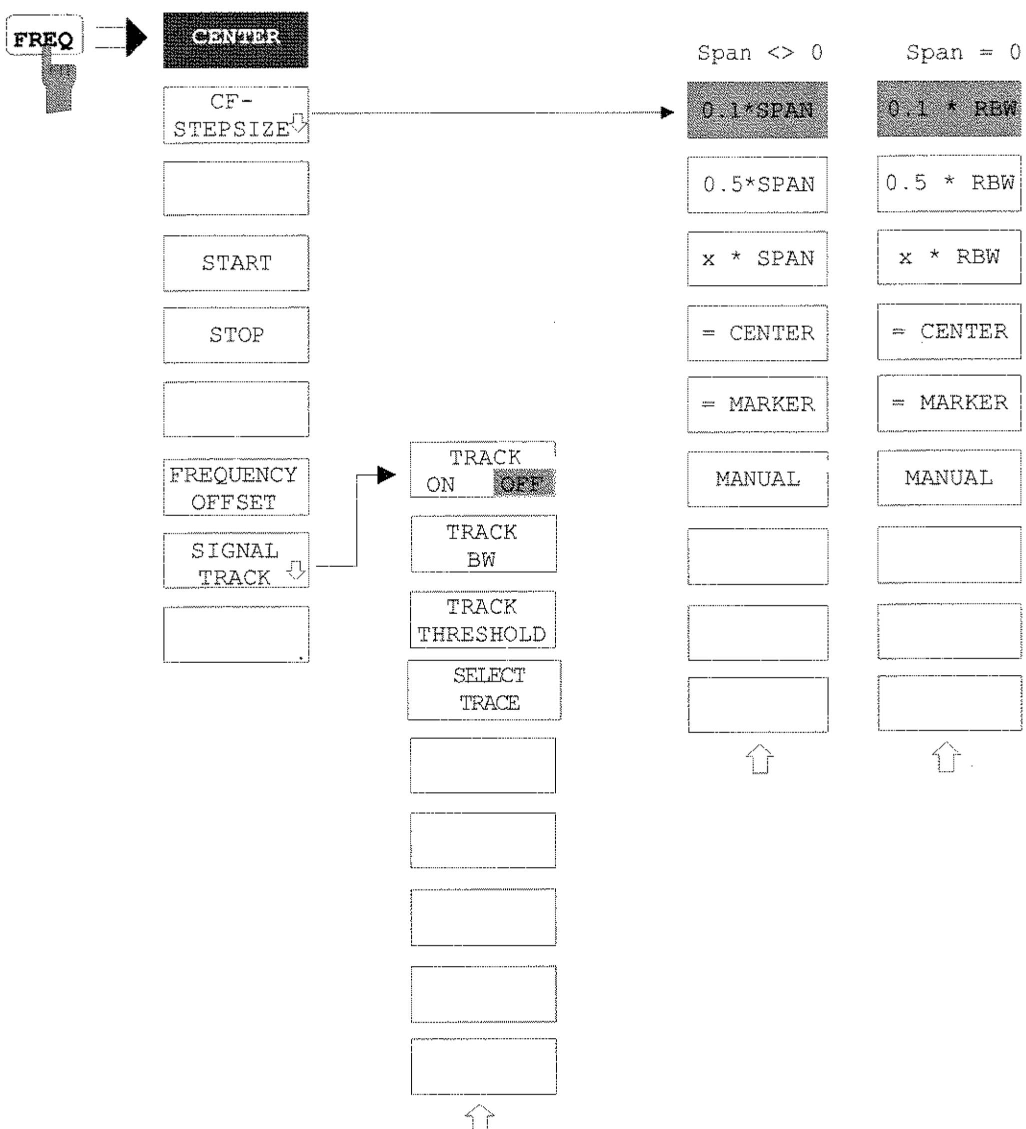
The table is scrolled up or down by one line.

Menu Overview

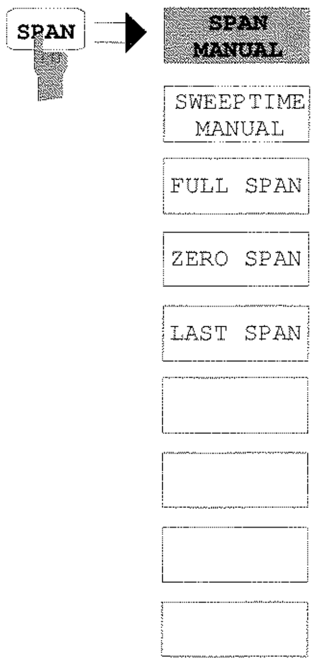
The following section gives a graphical overview of the FSU menus. Side menus are marked by an arrow directed to the left/right, submenus by an arrow showing upwards.
The menus appear in the order corresponding to the arrangement of keys on the front panel. The available hotkeys and the LOCAL menu appearing during the remote control of the instrument are also displayed.

The functions of menus are described in detail in Chapter 4. The IEC/IEEE-bus command associated with each softkey is indicated. In addition, the softkey list at the of Chapter 6 gives the assignment of IEC/IEEE-bus commands to softkeys.

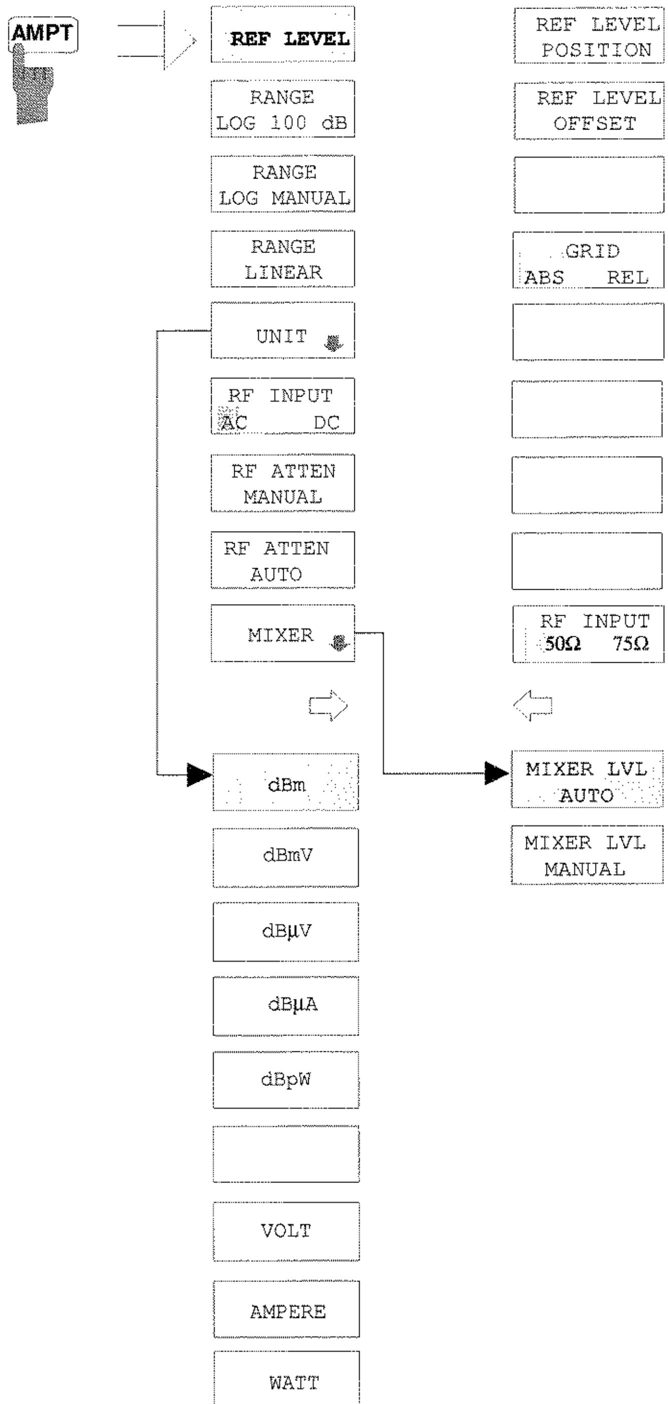
FREQUENCY Key



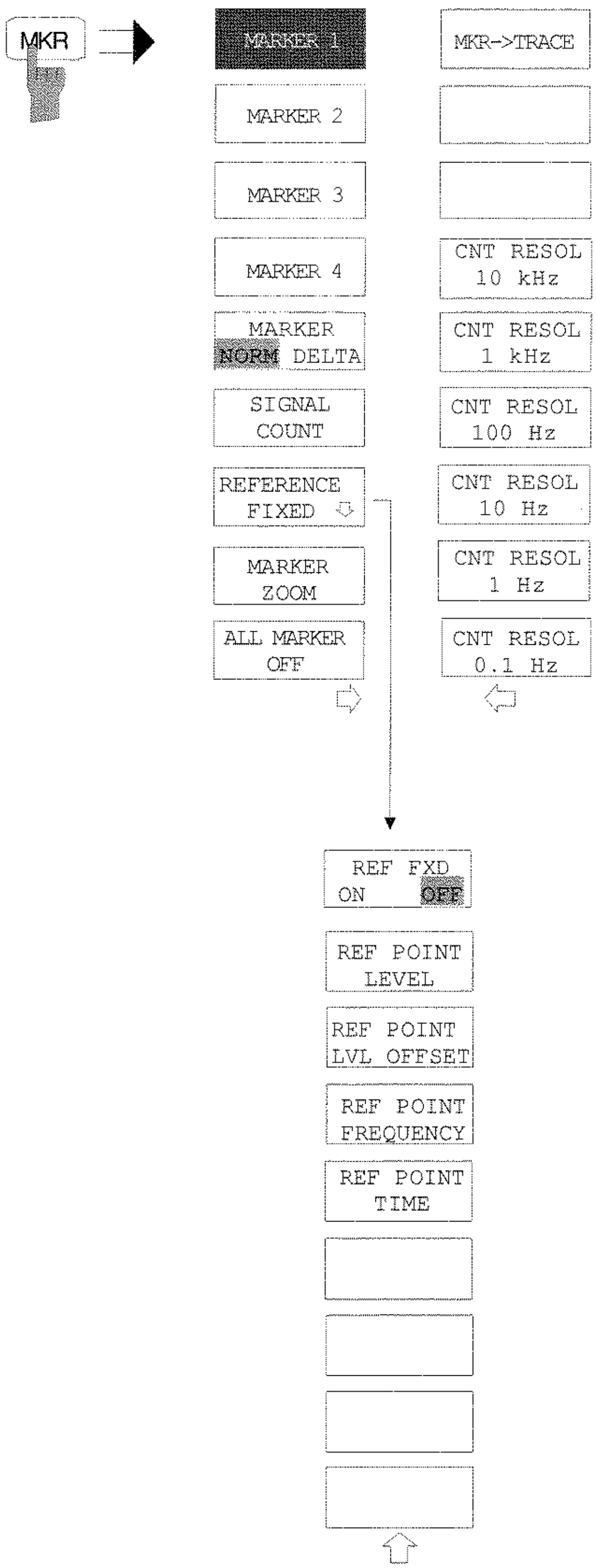
SPAN Key


SPAN
SPAN MANUAL
SWEEPTIME MANUAL
FULL SPAN
ZERO SPAN
LAST SPAN

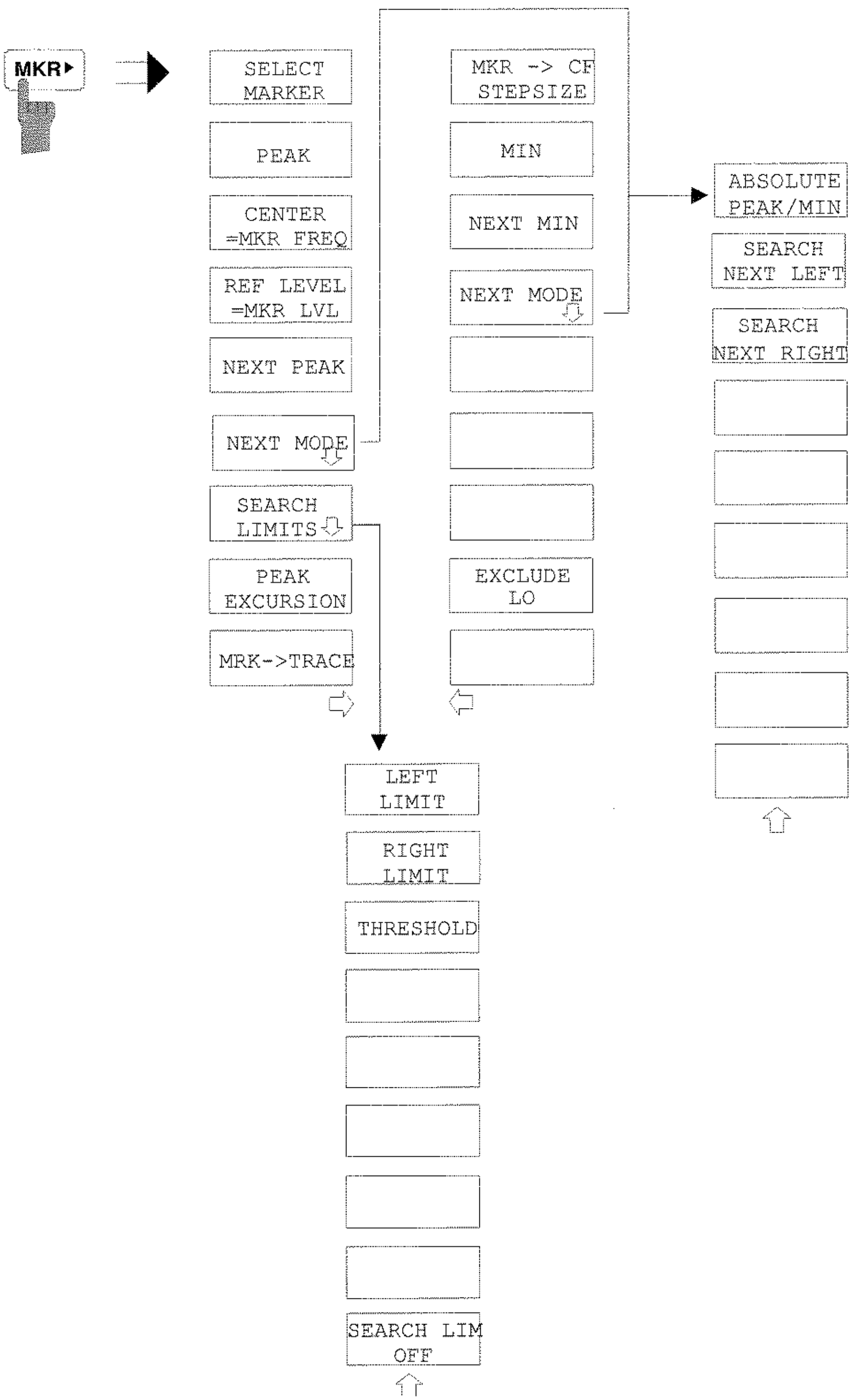
AMPT Key


AMPT
REF LEVEL
RANGE LOG 100 dB
RANGE LOG MANUAL
RANGE LINEAR
UNIT
RF INPUT AC DC
RF ATTEN MANUAL
RF ATTEN AUTO
MIXER
REF LEVEL POSITION
REF LEVEL OFFSET
GRID ABS REL
RF INPUT 50Ω 75Ω
dBm
dBmV
dBμV
dBμA
dBpW
VOLT
AMPERE
WATT
MIXER LVL AUTO
MIXER LVL MANUAL

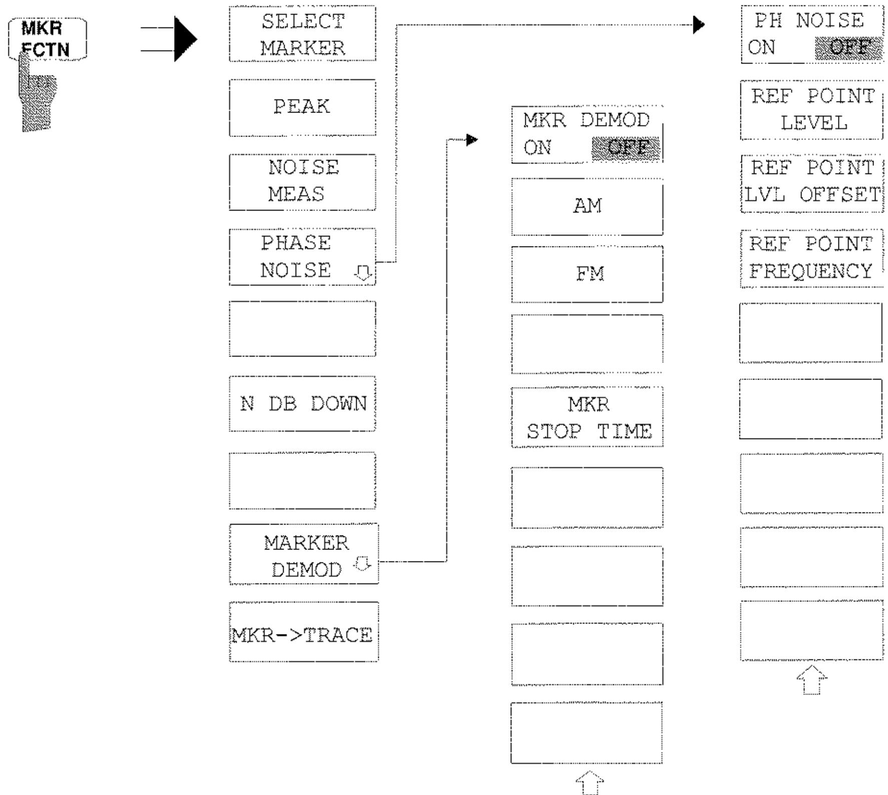
MKR Key


MKR
MARKER 1
MARKER 2
MARKER 3
MARKER 4
MARKER NORM DELTA
SIGNAL COUNT
REFERENCE FIXED
MARKER ZOOM
ALL MARKER OFF
MKR->TRACE
CNT RESOL 10 kHz
CNT RESOL 1 kHz
CNT RESOL 100 Hz
CNT RESOL 10 Hz
CNT RESOL 1 Hz
CNT RESOL 0.1 Hz
REF FXD ON OFF
REF POINT LEVEL
REF POINT LVL OFFSET
REF POINT FREQUENCY
REF POINT TIME

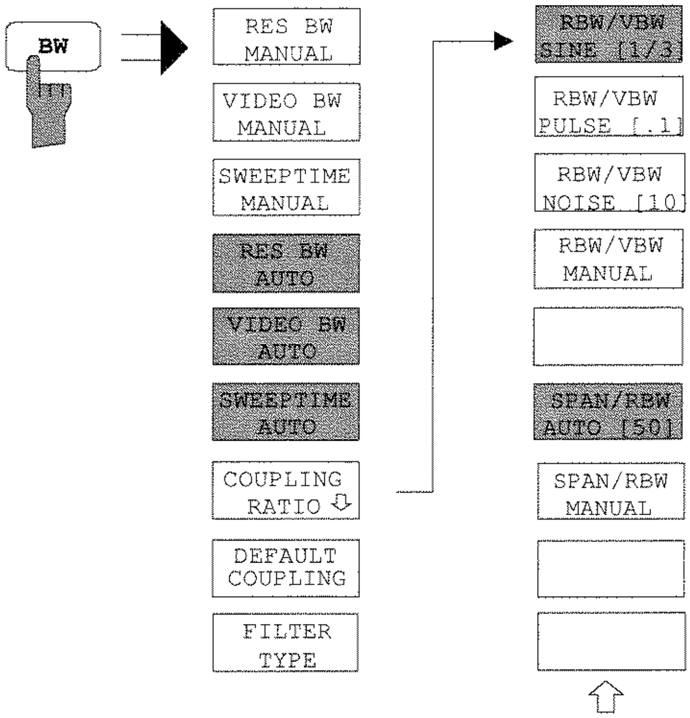
MKR-> Key


MKR▸
SELECT MARKER
PEAK
CENTER =MKR FREQ
REF LEVEL =MKR LVL
NEXT PEAK
NEXT MODE
SEARCH LIMITS
PEAK EXCURSION
MRK->TRACE
MKR -> CF STEPSIZE
MIN
NEXT MIN
NEXT MODE
EXCLUDE LO
ABSOLUTE PEAK/MIN
SEARCH NEXT LEFT
SEARCH NEXT RIGHT
LEFT LIMIT
RIGHT LIMIT
THRESHOLD
SEARCH LIM OFF

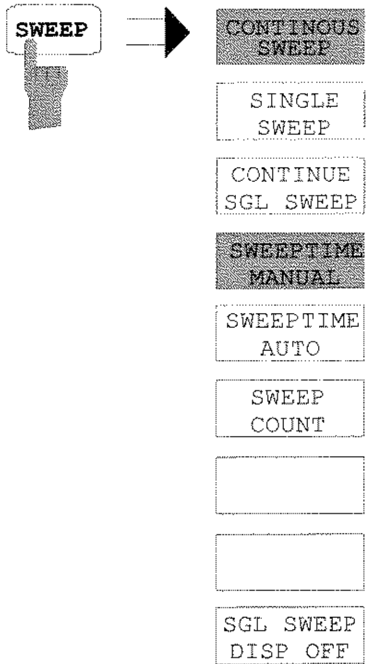
MKR FCTN Key


MKR
FCTN
SELECT MARKER
PEAK
NOISE MEAS
PHASE NOISE
N DB DOWN
MARKER DEMOD
MKR->TRACE
MKR DEMOD ON OFF
AM
FM
MKR STOP TIME
PH NOISE ON OFF
REF POINT LEVEL
REF POINT LVL OFFSET
REF POINT FREQUENCY

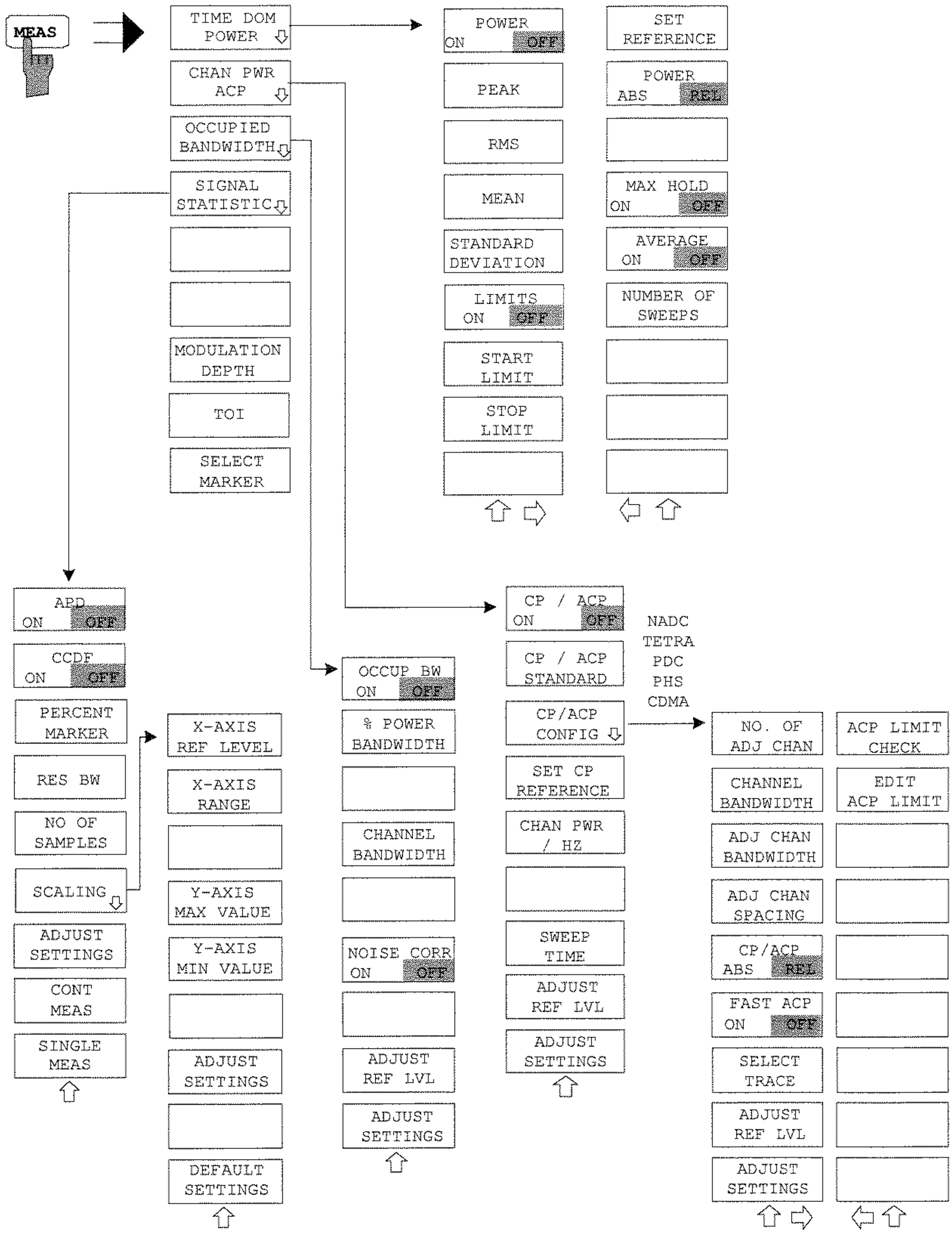
BW Key


BW
RES BW MANUAL
VIDEO BW MANUAL
SWEEPTIME MANUAL
RES BW AUTO
VIDEO BW AUTO
SWEEPTIME AUTO
COUPLING RATIO ⇩
DEFAULT COUPLING
FILTER TYPE
RBW/VBW SINE [1/3]
RBW/VBW PULSE [.1]
RBW/VBW NOISE [10]
RBW/VBW MANUAL
SPAN/RBW AUTO [50]
SPAN/RBW MANUAL

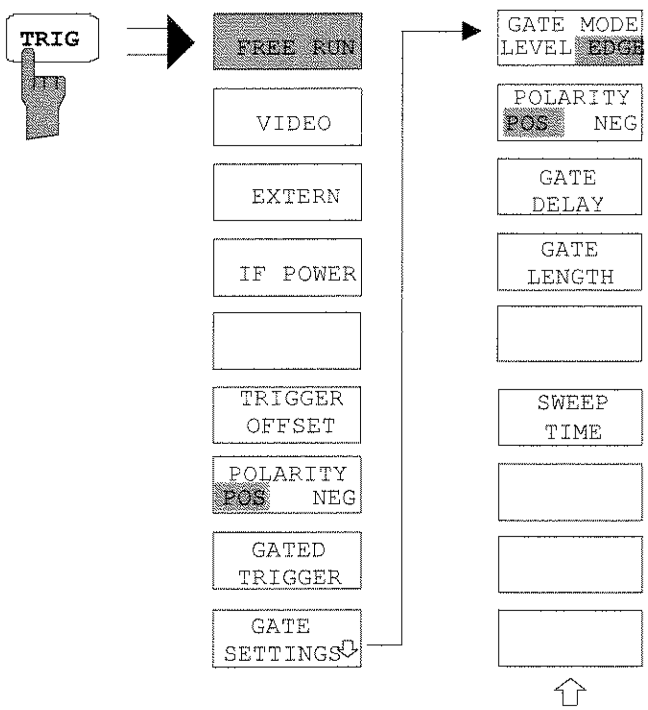
SWEEP Key


SWEEP
CONTINOUS SWEEP
SINGLE SWEEP
CONTINUE SGL SWEEP
SWEEPTIME MANUAL
SWEEPTIME AUTO
SWEEP COUNT
SGL SWEEP DISP OFF

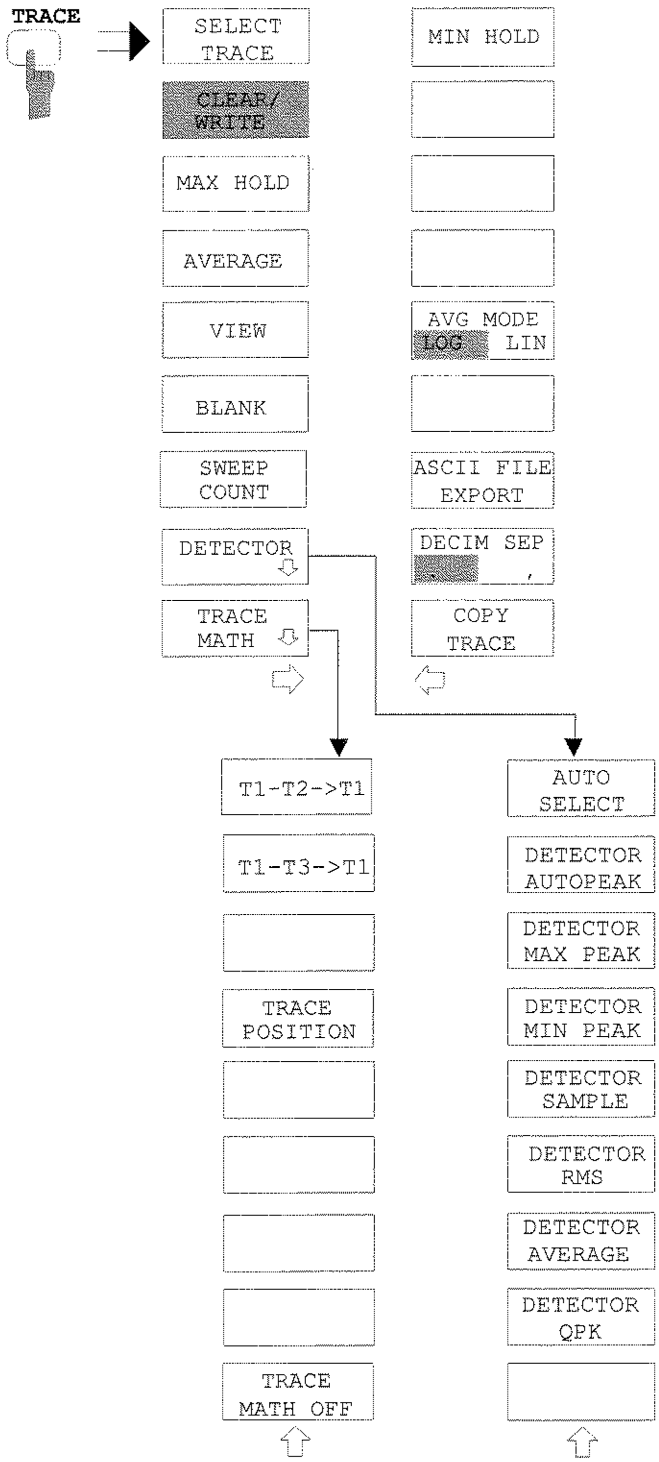
MEAS Key


MEAS
TIME DOM POWER
CHAN PWR ACP
OCCUPIED BANDWIDTH
SIGNAL STATISTIC
MODULATION DEPTH
TOI
SELECT MARKER
POWER ON OFF
PEAK
RMS
MEAN
STANDARD DEVIATION
LIMITS ON OFF
START LIMIT
STOP LIMIT
SET REFERENCE
POWER ABS REL
MAX HOLD ON OFF
AVERAGE ON OFF
NUMBER OF SWEEPS
APD ON OFF
CCDF ON OFF
PERCENT MARKER
RES BW
NO OF SAMPLES
SCALING
ADJUST SETTINGS
CONT MEAS
SINGLE MEAS
X-AXIS REF LEVEL
X-AXIS RANGE
Y-AXIS MAX VALUE
Y-AXIS MIN VALUE
ADJUST SETTINGS
DEFAULT SETTINGS
OCCUP BW ON OFF
% POWER BANDWIDTH
CHANNEL BANDWIDTH
NOISE CORR ON OFF
ADJUST REF LVL
ADJUST SETTINGS
CP / ACP ON OFF
CP / ACP STANDARD
CP/ACP CONFIG
SET CP REFERENCE
CHAN PWR / HZ
SWEEP TIME
ADJUST REF LVL
ADJUST SETTINGS
NADC
TETRA
PDC
PHS
CDMA
NO. OF ADJ CHAN
CHANNEL BANDWIDTH
ADJ CHAN BANDWIDTH
ADJ CHAN SPACING
CP/ACP ABS REL
FAST ACP ON OFF
SELECT TRACE
ADJUST REF LVL
ADJUST SETTINGS
ACP LIMIT CHECK
EDIT ACP LIMIT

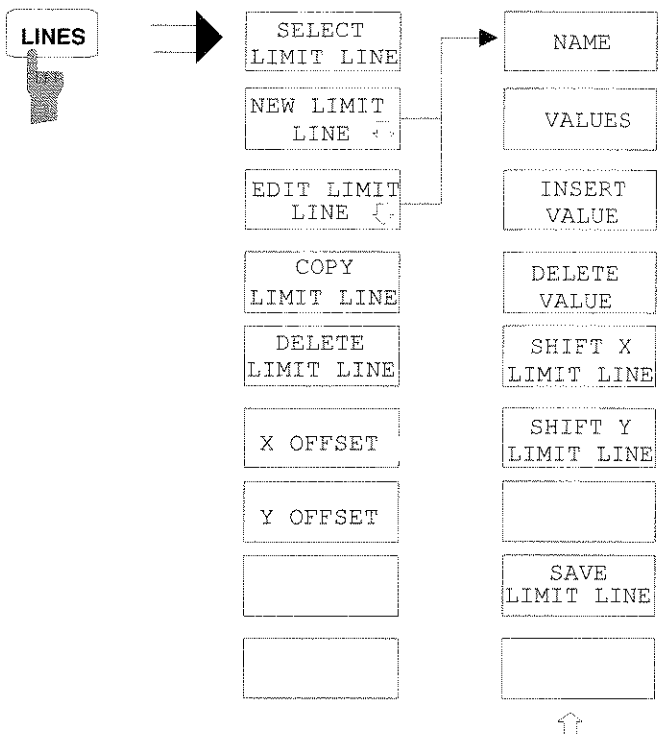
TRIG Key


TRIG
FREE RUN
VIDEO
EXTERN
IF POWER
TRIGGER OFFSET
POLARITY POS NEG
GATED TRIGGER
GATE SETTINGS
GATE MODE LEVEL EDGE
POLARITY POS NEG
GATE DELAY
GATE LENGTH
SWEEP TIME

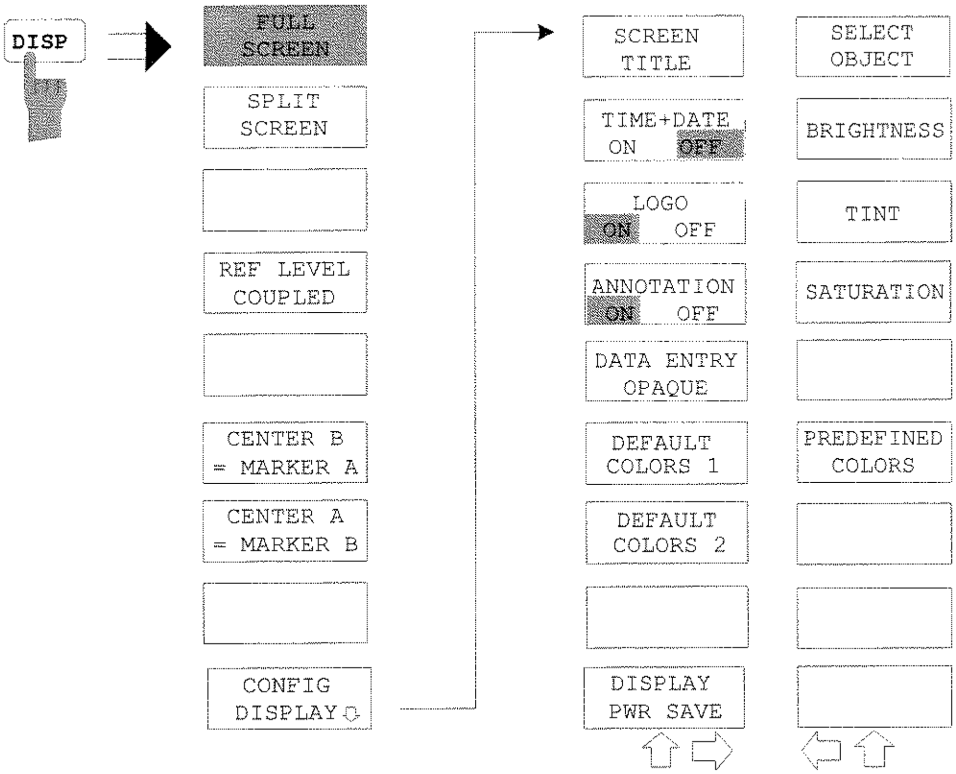
TRACE Key


TRACE
SELECT TRACE
CLEAR/ WRITE
MAX HOLD
AVERAGE
VIEW
BLANK
SWEEP COUNT
DETECTOR
TRACE MATH
MIN HOLD
AVG MODE LOG LIN
ASCII FILE EXPORT
DECIM SEP . ,
COPY TRACE
T1-T2->T1
T1-T3->T1
TRACE POSITION
TRACE MATH OFF
AUTO SELECT
DETECTOR AUTOPEAK
DETECTOR MAX PEAK
DETECTOR MIN PEAK
DETECTOR SAMPLE
DETECTOR RMS
DETECTOR AVERAGE
DETECTOR QPK

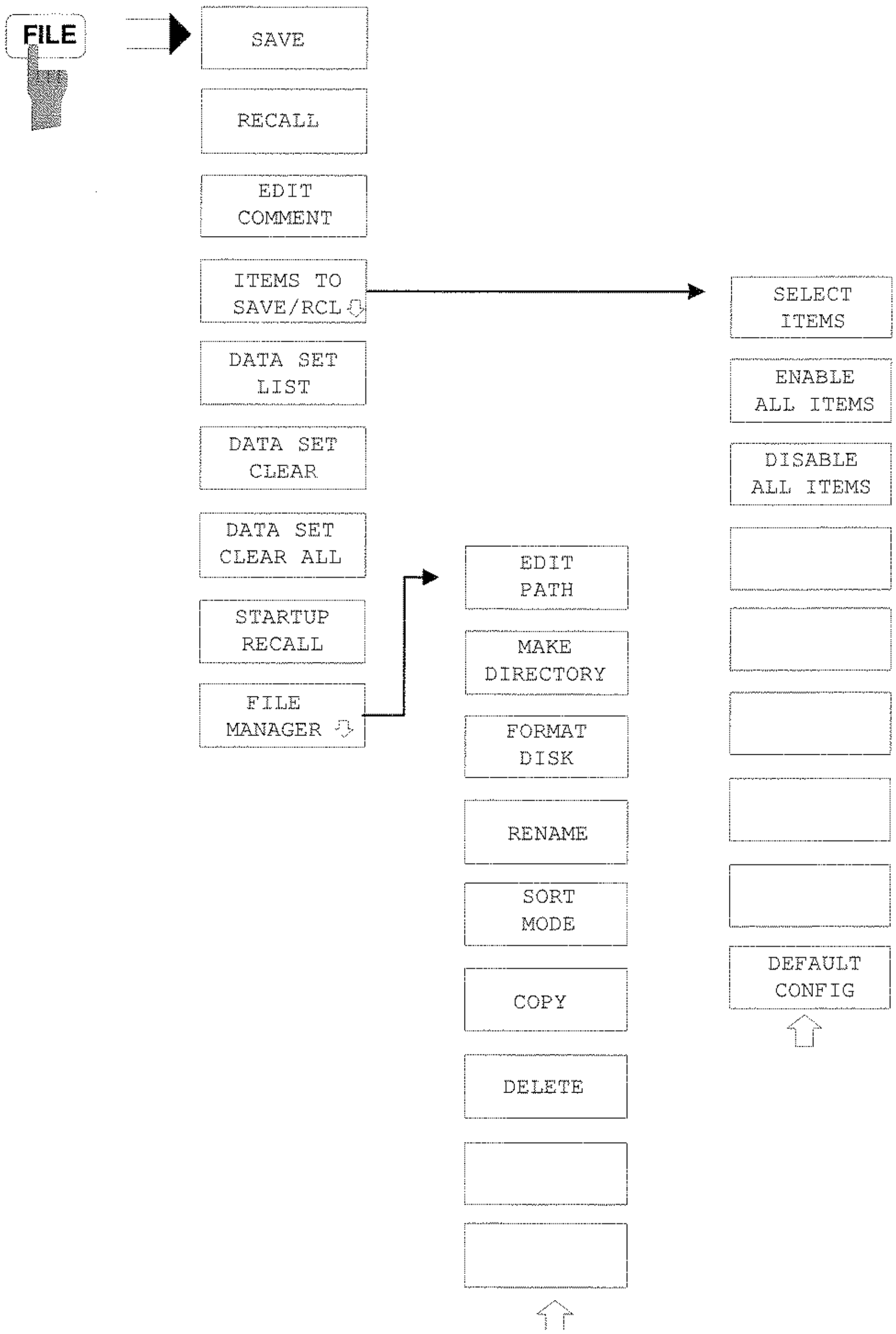
LINES Key


LINES
SELECT LIMIT LINE
NEW LIMIT LINE
EDIT LIMIT LINE
COPY LIMIT LINE
DELETE LIMIT LINE
X OFFSET
Y OFFSET
NAME
VALUES
INSERT VALUE
DELETE VALUE
SHIFT X LIMIT LINE
SHIFT Y LIMIT LINE
SAVE LIMIT LINE

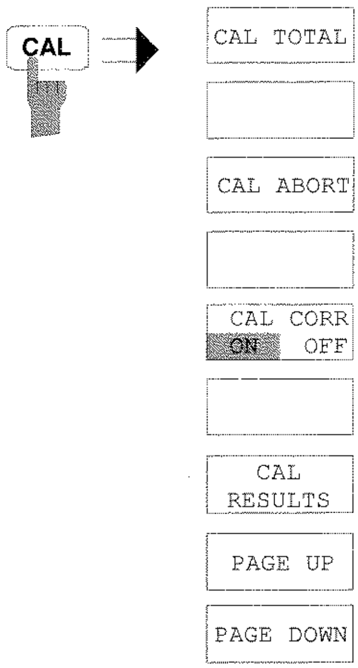
DISP Key


DISP
FULL SCREEN
SPLIT SCREEN
REF LEVEL COUPLED
CENTER B = MARKER A
CENTER A = MARKER B
CONFIG DISPLAY
SCREEN TITLE
TIME+DATE ON OFF
LOGO ON OFF
ANNOTATION ON OFF
DATA ENTRY OPAQUE
DEFAULT COLORS 1
DEFAULT COLORS 2
DISPLAY PWR SAVE
SELECT OBJECT
BRIGHTNESS
TINT
SATURATION
PREDEFINED COLORS

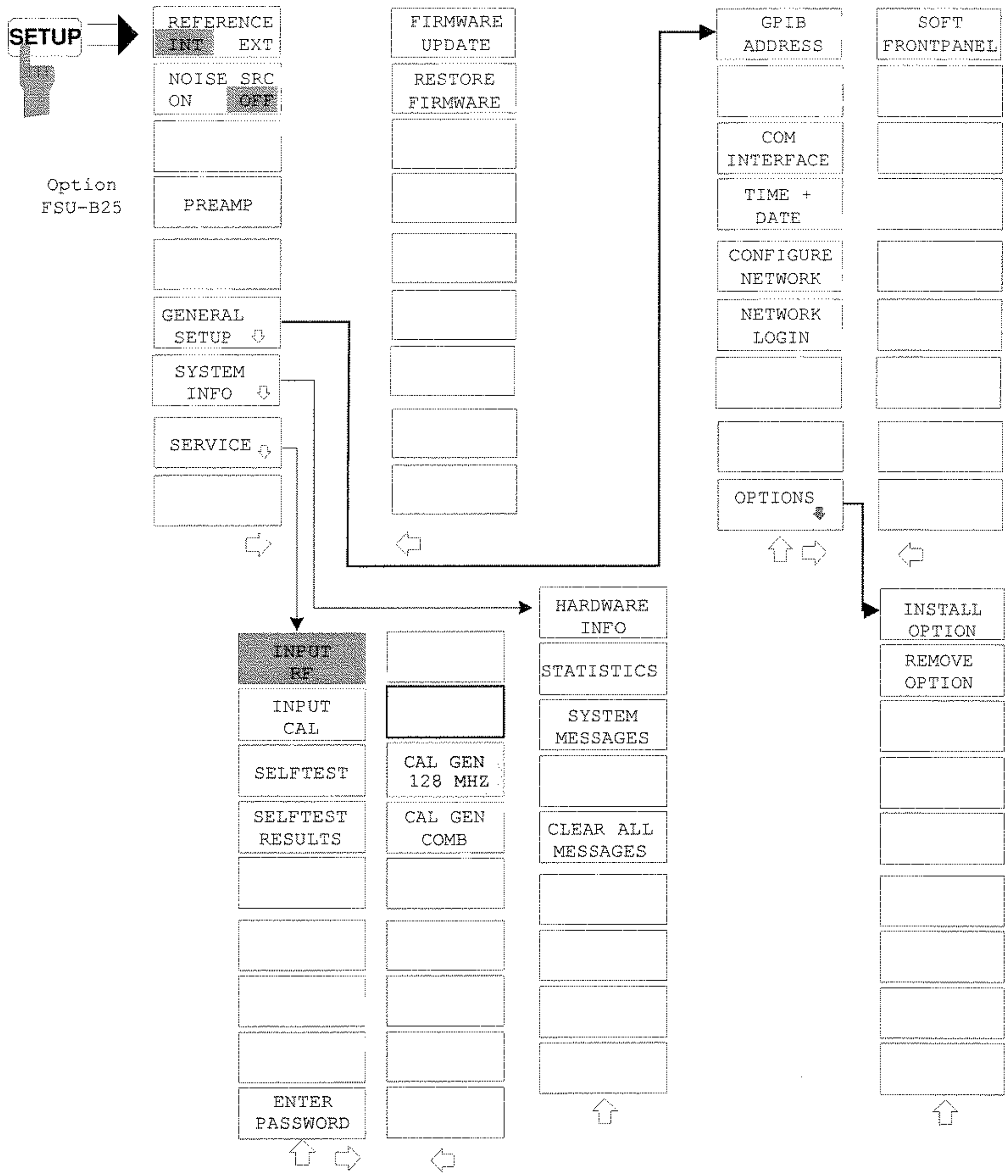
FILE Key


FILE
SAVE
RECALL
EDIT COMMENT
ITEMS TO SAVE/RCL
DATA SET LIST
DATA SET CLEAR
DATA SET CLEAR ALL
STARTUP RECALL
FILE MANAGER
SELECT ITEMS
ENABLE ALL ITEMS
DISABLE ALL ITEMS
DEFAULT CONFIG
EDIT PATH
MAKE DIRECTORY
FORMAT DISK
RENAME
SORT MODE
COPY
DELETE

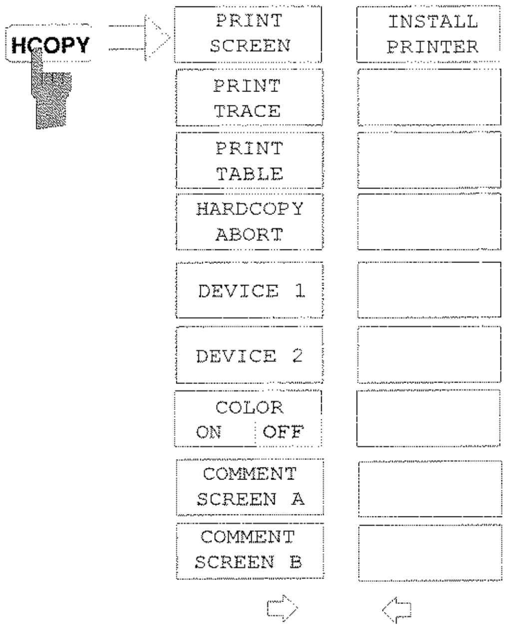
CAL Key


CAL
CAL TOTAL
CAL ABORT
CAL CORR
ON OFF
CAL RESULTS
PAGE UP
PAGE DOWN

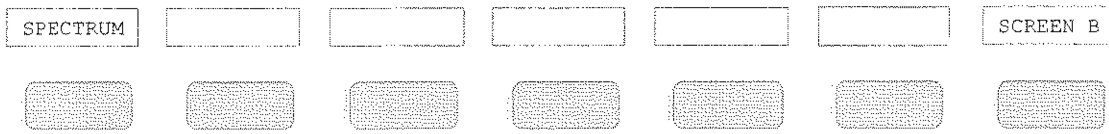
SETUP Key


SETUP
REFERENCE INT EXT
NOISE SRC ON OFF
Option FSU-B25
PREAMP
GENERAL SETUP
SYSTEM INFO
SERVICE
FIRMWARE UPDATE
RESTORE FIRMWARE
GPIB ADDRESS
COM INTERFACE
TIME + DATE
CONFIGURE NETWORK
NETWORK LOGIN
OPTIONS
SOFT FRONTPANEL
INSTALL OPTION
REMOVE OPTION
HARDWARE INFO
STATISTICS
SYSTEM MESSAGES
CLEAR ALL MESSAGES
INPUT RF
INPUT CAL
SELFTEST
SELFTEST RESULTS
ENTER PASSWORD
CAL GEN 128 MHZ
CAL GEN COMB

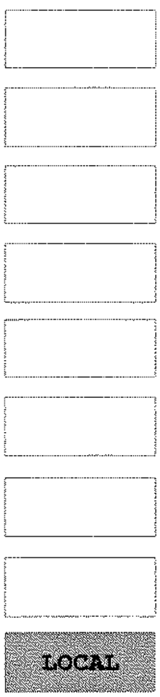
HCOPY Key


HCOPY
PRINT SCREEN
PRINT TRACE
PRINT TABLE
HARDCOPY ABORT
DEVICE 1
DEVICE 2
COLOR ON OFF
COMMENT SCREEN A
COMMENT SCREEN B
INSTALL PRINTER

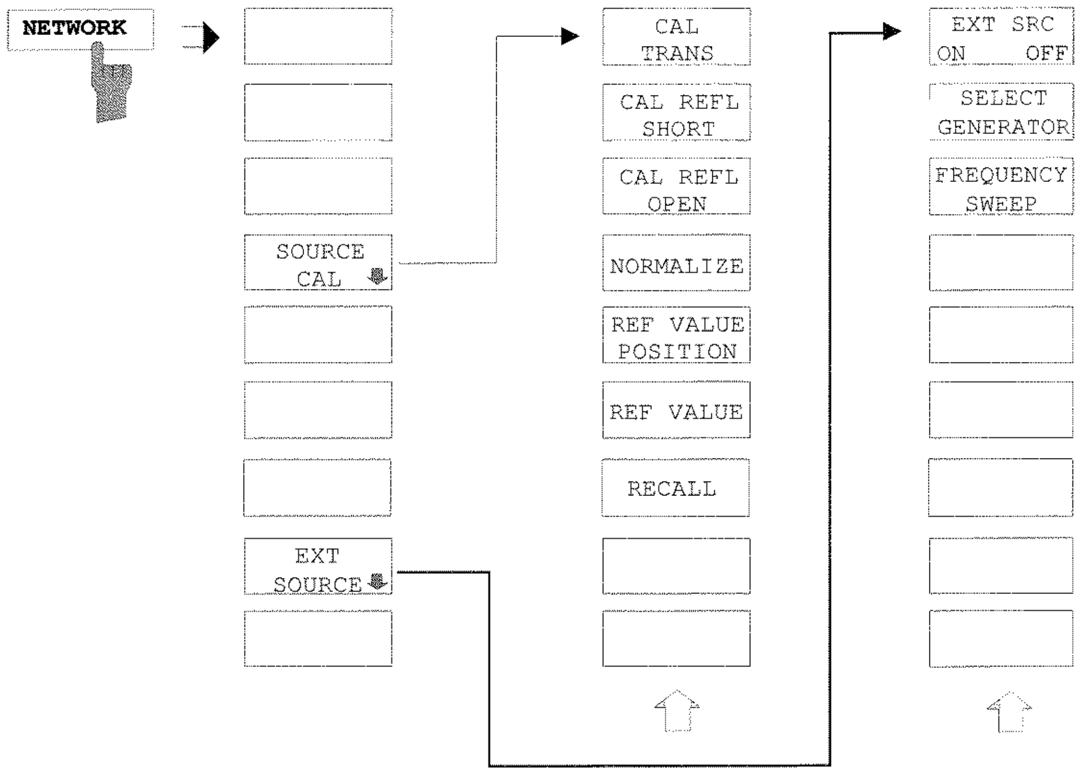
Hotkey Menu



LOCAL Menu



Menu Overview Option Ext. Generator Control



Contents - Chapter 4 "Instrument Functions"

4 Instrument Functions

All functions of the spectrum analyzer and their application are explained in detail in this chapter. The sequence of the described menu groups depends on the procedure selected for the configuration and start of a measurement:

1. Resetting the instrument - *PRESET* key
2. Setting the mode – hotkey bar and *LOCAL* key
3. Setting the measurement parameters - keys *FREQ*, *SPAN*, *AMPT*, *BW*, *SWEEP*, *TRIG*, *TRACE*, *CAL*
4. Selecting and configuring the measurement function - keys *MKR*, *MKR->*, *MKR FCTN*, *MEAS*, *LINES*

The instrument functions for general settings, printout and data management are described at the end of this chapter – keys *DISP*, *SETUP*, *FILE* and *HCOPY*.

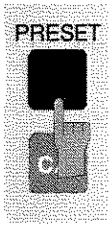
The different softkeys of a menu are described from top to bottom and from the left to the right side menu. The submenus are marked by an indentation or displayed in a separate section. The whole path (key - softkey - ...) is indicated in the line above the menu display.

An overview of the menus is given in chapter 3 which also contains the description of the operating concept.

The IEC/IEEE-bus commands (if any) are indicated for each softkey. For a fast overview a list of softkeys with the associated IEC/IEEE-bus commands is given at the end of Chapter 6.

An index at the end of the handbook serves as further help for the user.

FSU Initial Configuration – *PRESET* Key



Using the *PRESET* key, the FSU can be set to a predefined initial state.

Notes: *The settings are selected in a way that the RF input is always protected against overload, provided that the applied signal levels are in the allowed range for the instrument.*

The initial instrument state set by the PRESET key can be adapted to arbitrary applications using the STARTUP RECALL function. With this function the STARTUP RECALL dataset is loaded upon pressing the PRESET key. For further information refer to section "Saving and Recalling Data Sets".

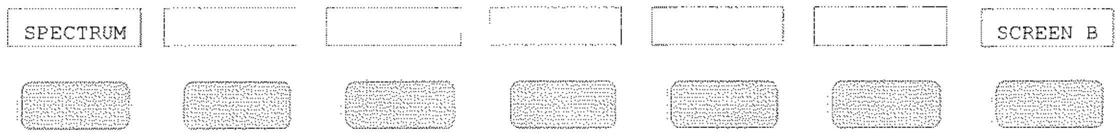
Pressing the *PRESET* key causes the FSU to enter its initial state according to the following table:

Table 4-1 Initial State of FSU

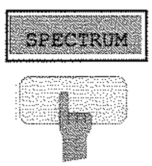
Parameter	Settings	
Mode	Spectrum	
Center frequency	1,8 GHz / 4 GHz	(FSU-3/-8)
Center frequency step size	0.1 * center frequency	
Span	3,6 GHz / 8 GHz	(FSU-3/-8)
RF attenuation	auto (10 dB)	
Reference level	-20 dBm	
Level range	100 dB log	
Level unit	dBm	
Sweep time	auto	
Resolution bandwidth	auto (3 MHz)	
Video bandwidth	auto (10 MHz)	
FFT filters	off	
Span / RBW	50	
RBW / VBW	0.33	
Sweep	cont	
Trigger	free run	
Trace 1	clr write	
Trace 2/3	blank	
Detector	auto peak	
Trace math	off	
Frequency offset	0 Hz	
Reference level offset	0 dB	
Reference level position	100 %	
Grid	abs	
Cal correction	on	
Noise source	off	
Input	RF	
Display	Full screen, active screen A	

Mode Selection – *HOTKEY* Bar

For fast mode selection FSU has seven keys (the so-called *HOTKEY*s) which can be allocated depending on the options installed on the instrument.



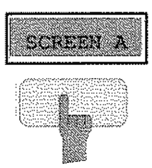
Two keys are reserved for the basic model:



The *SPECTRUM* hotkey sets FSU to spectrum analysis mode.

The spectrum analysis mode is the basic setting of FSU.

IEC/IEEE-bus command: `INST:SEL SAN`



With the *SCREEN A / SCREEN B* hotkey two different settings can be selected on the FSU in the FULL SCREEN mode.

In the SPLIT SCREEN mode the key switches between active diagram A and B.

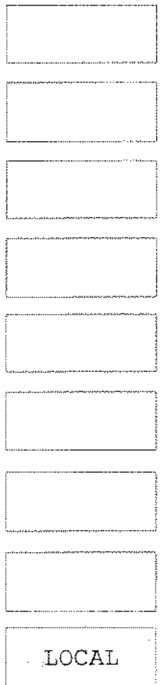
The key designation indicates the diagram which has been activated by means of the key.

The currently active window is marked by **A** or **B** on the right of the diagram.

IEC/IEEE-bus command: `DISP:WIND<1|2>:SEL`

The meaning of the other keys is described in the operating manuals of the various options.

Return to manual control – *LOCAL* Menu



The menu LOCAL is displayed on switching the instrument to remote control mode.

At the same time, the *HOTKEY* bar is blanked out and all keys are disabled except the *PRESET* key. The diagram, traces and display fields are then blanked out (they can be activated using the remote control command `SYSTem:DISPlay:UPDate ON`).

The menu contains only one softkey, the *LOCAL* key. The *LOCAL* key switches the instrument from remote to manual control, with the assumption that the remote controller has not previously set the LOCAL LOCKOUT function.

A change in the control mode consists of:

- **Enabling the Front Panel Keys**
  Returning to manual mode enables all inactive keys and turns on the hotkey menu. The soft key menu which is displayed is the main menu of the current mode.

  Inserting the measurement diagrams
  The blanked diagrams, traces and display fields are inserted.

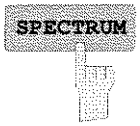
- **Generating the message OPERATION COMPLETE**
  If, at the time of pressing the *LOCAL* softkey, the synchronisation mechanism via *OPC, *OPC? or *WAI is active, the currently running measurement procedure is aborted and synchronisation is achieved by setting the corresponding bits in the registers of the status reporting system.

- **Setting Bit 6 (User Request) of the Event Status Register**
  With a corresponding configuration of the status reporting system, this bit immediately causes the generation of a service request (*SRQ*) which is used to inform the control software that the user wishes to return to front-panel control. This information can be used, e.g., to interrupt the control program so that the user can make necessary manual corrections to instrument settings. This bit is set each time the *LOCAL* softkey is pressed.

Note: *If the LOCAL LOCKOUT function is active in the remote control mode, the front-panel PRESET key is also disabled. The LOCAL LOCKOUT state is left as soon as the process controller de-activates the REN line or the IEC/IEEE-bus cable is disconnected from the instrument.*

Spectrum Analyzer Mode

The analyzer mode is activated by pressing hotkey *SPECTRUM* (see also Section 'Mode Selection')



The *SPECTRUM* hotkey selects the *ANALYZER* mode.

This mode is the default setting of the FSU.

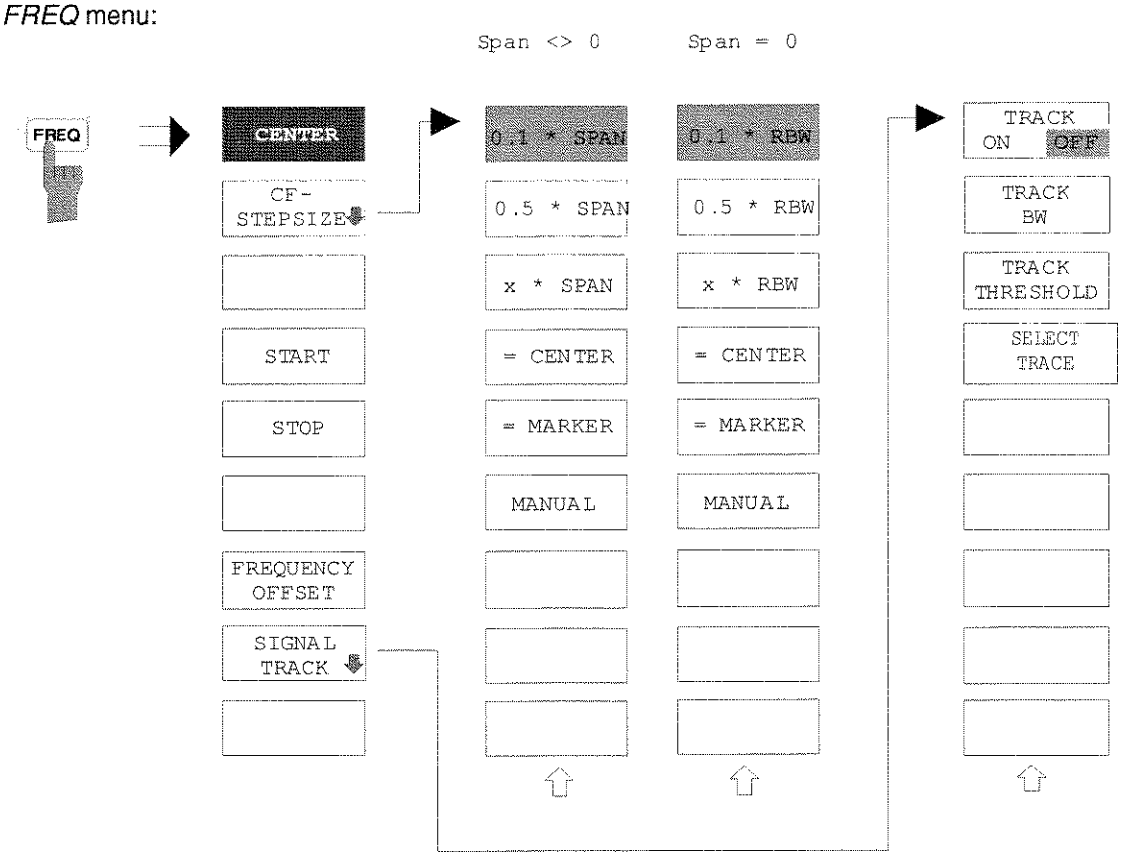
The functions provided correspond to those of a conventional spectrum analyzer. The analyzer measures the frequency spectrum of the test signal over the selected frequency range with the selected resolution and sweep time, or, for a fixed frequency, displays the waveform of the video signal.

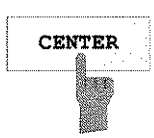
Note: *If two displays (screen A and screen B) are opened after switch-on of signal analysis, the analyzer mode is only set for the display activated for entry (marked at the top right corner of diagram). For the other display, the previous settings remain valid.*
Data acquisition and display of measured values is sequential: first in the upper and then in the lower display.

Frequency and Span Selection – *FREQ* Key

The *FREQ* key is used to specify the frequency axis of the active display window. The frequency axis can be defined either by the start and stop frequency or by the center frequency and the span (*SPAN* key). With two windows (*SPLIT SCREEN)* displayed at the same time, the input data always refer to the window selected in the *SYSTEM-DISPLAY* menu.
After pressing one of the *CENTER*, *START* or *STOP* softkeys, the value of the corresponding parameter can be defined in an input window.

FREQ menu:





The *CENTER* softkey opens the window for manually entering the center frequency.

The allowed range of values for the center frequency is:

for the frequency domain (span >0):

$$minspan / 2 \leq f_{center} \leq f_{max} - minspan / 2$$

and for the time domain (span = 0):

$$0\ \text{Hz} \leq f_{center} \leq f_{max}$$

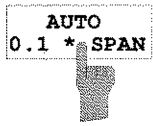
f_{center}	center frequency
minspan	smallest selectable span > 0 Hz (10 Hz)
f_{max}	max. frequency

IEC/IEEE-bus command: `FREQ:CENT 100MHz`

The CF *STEPSIZE* softkey opens a submenu for setting the step size of the center frequency. The step size can be coupled to the span (frequency domain) or the resolution bandwidth (time domain) or it can be manually set to a fixed value. The softkeys are mutually exclusive selection keys.

The softkeys are presented according to the selected domain (frequency or time).

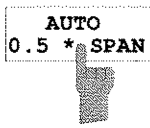
Softkeys in frequency domain:



The *0.1 * SPAN* softkey sets the step size for the center frequency entry to 10% of the span.

IEC/IEEE-bus command:

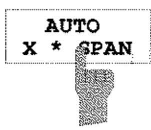
```
FREQ:CENT:STEP:LINK SPAN
FREQ:CENT:STEP:LINK:FACT 10PCT
```



The *0.5 * SPAN* softkey sets the step size for the center frequency entry to 50% of the span.

IEC/IEEE-bus command:

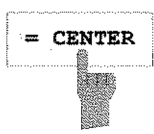
```
FREQ:CENT:STEP:LINK SPAN
FREQ:CENT:STEP:LINK:FACT 50PCT
```



The *X * SPAN* softkey allows the factor defining the center frequency step size to be entered as % of the span.

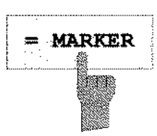
IEC/IEEE-bus command:

```
FREQ:CENT:STEP:LINK SPAN
FREQ:CENT:STEP:LINK:FACT 20PCT
```



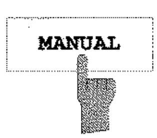
The *= CENTER* softkey sets the step size coupling to *MANUAL* and the step size to the value of the center frequency. This function is especially useful during measurements of the signal harmonic content because by entering the center frequency each stroke of the *STEP* key selects the center frequency of another harmonic.

IEC/IEEE-bus command: --



The *= MARKER* softkey sets the step size coupling to *MANUAL* and the step size to the value of the marker. This function is especially useful during measurements of the signal harmonic content at the marker position because by entering the center frequency each stroke of the *STEP* key selects the center frequency of another harmonic.

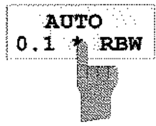
IEC/IEEE-bus command: --



The *MANUAL* softkey activates the window for entering a fixed step size.

IEC/IEEE-bus command: `FREQ:CENT:STEP 120MHz`

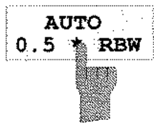
Softkeys in time domain:



The *0.1 * RBW* softkey sets the step size for the center frequency entry to 10% of the resolution bandwidth.

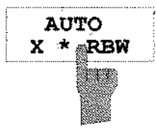
*AUTO 0.1 * RBW* corresponds to the default setting.

IEC/IEEE-bus command:
```
FREQ:CENT:STEP:LINK RBW
FREQ:CENT:STEP:LINK:FACT 10PCT
```



The *0.5 * RBW* softkey sets the step size for the center frequency entry to 50% of the resolution bandwidth.

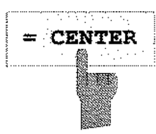
IEC/IEEE-bus command:
```
FREQ:CENT:STEP:LINK RBW
FREQ:CENT:STEP:LINK:FACT 50PCT
```



The *X * RBW* softkey allows the factor defining the center frequency step size to be entered as % of the resolution bandwidth.

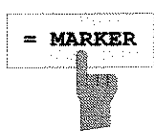
Values between 1 and 100% in steps of 1% are allowed. The default setting is 10%.

IEC/IEEE-bus command:
```
FREQ:CENT:STEP:LINK RBW
FREQ:CENT:STEP:LINK:FACT 20PCT
```



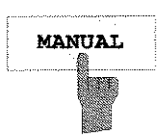
The *= CENTER* softkey sets the step size coupling to *MANUAL* and the step size to the value of the center frequency. This function is especially useful during measurements of the signal harmonic content because by entering the center frequency each stroke of the *STEP* key selects the center frequency of another harmonic.

IEC/IEEE-bus command: --



The *= MARKER* softkey sets the step size coupling to *MANUAL* and the step size to the value of the marker. This function is especially useful during measurements of the signal harmonic content at the marker position because by entering the center frequency each stroke of the *STEP* key selects the center frequency of another harmonic.

IEC/IEEE-bus command: --



The *MANUAL* softkey activates the window for entering a fixed step size.

IEC/IEEE-bus command:
```
FREQ:CENT:STEP 120MHz
```

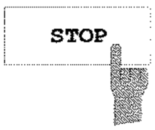
The *START* softkey activates the window for manually entering the start frequency.

The allowed range of values for the start frequency is:

$0\ \text{Hz} \le f_{start} \le f_{max} - \text{minspan}$

f_{start}	start frequency
minspan	smallest selectable span (10 Hz)
f_{max}	max. frequency

IEC/IEEE-bus command: `FREQ:STAR 20MHz`



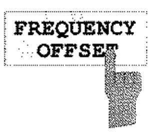
The *STOP* softkey activates the window for entering the .

The allowed range of values for the stop frequency is:

$\text{minspan} \le f_{stop} \le f_{max}$

f_{stop}	stop frequency
minspan	smallest selectable span (10 Hz)
f_{max}	max. frequency

IEC/IEEE-bus command: `FREQ:STOP 2000MHz`



The *FREQUENCY OFFSET* softkey activates the window for entering an arithmetical frequency offset which is added to the frequency axis labelling. The allowed range of values for the offset is -100 GHz to 100 GHz. The default setting is 0 Hz.

IEC/IEEE-bus command: `FREQ:OFFS 10 MHz`

The *SIGNAL TRACK* softkey switches on the tracking of a signal near the center frequency. The signal is tracked as long it is in the search bandwidth around the center frequency defined with *TRACK BW* and above the level threshold defined with *TRACK THRESHOLD*.
For that purpose, the maximum signal is searched (*PEAK SEARCH)* on the screen and the center frequency set to this signal (*MARKER ->CENTER)* after each frequency sweep within the search bandwidth.

If the signal falls below the level threshold or jumps out of the search bandwidth around the center frequency, the center frequency is not varied until a signal is in the search bandwidth above the level threshold. This can be achieved by manually modifying the center frequency, for example.

On switching on, the softkey is highlighted and the search bandwidth and the threshold value are marked on the diagram by two vertical lines and one horizontal line. All these lines are allocated the designation TRK.

At the same time a submenu is opened in which the search bandwidth, the threshold value and the trace can be modified for the maximum search.

The softkey is only available in the frequency domain (span >0).

IEC/IEEE-bus command: `CALC:MARK:FUNC:STR OFF`

The *TRACK ON/OFF* softkey switches on and off signal tracking.

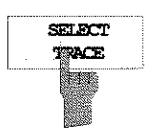
IEC/IEEE-bus command: `CALC:MARK:FUNC:STR OFF`

The *TRACK BW* softkey defines the search bandwidth for signal tracking. The frequency range is symmetrical with respect to the center frequency.

IEC/IEEE-bus command:
`CALC:MARK:FUNC:STR:BAND 10KHZ`

The *TRACK THRESHOLD* softkey defines the threshold value for signal detection. The value is always entered as an absolute level value.

IEC/IEEE-bus command:
`CALC:MARK:FUNC:STR:THR -70DBM`



The *SELECT TRACE* softkey selects the trace on which signal tracking is to be performed.

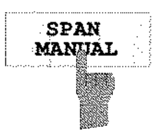
IEC/IEEE-bus command:
`CALC:MARK:FUNC:STR:TRAC 1`

Setting the Frequency Span – *SPAN Key*

SPAN menu

- SPAN MANUAL
- SWEEPTIME MANUAL
- FULL SPAN
- ZERO SPAN
- LAST SPAN

The *SPAN* key opens a menu which offers various options for setting the span.
The entry of the span (*SPAN MANUAL* softkey) is automatically active for span > 0 Hz.
For span = 0 Hz the entry for sweep time (*SWEEPTIME MANUAL*) is automatically active.
With two windows (*SPLIT SCREEN)* displayed at the same time, the input data always refer to the window selected with hotkey *SCREEN A/B.*



The *SPAN MANUAL* softkey activates the window for manually entering the frequency span. The center frequency is kept constant.

The allowed range of span values is:

for the time domain (span = 0): 0 Hz

and for the frequency domain (span >0): minspan $\leq f_{span} \leq f_{max}$

f_{span}	frequency span
minspan	smallest selectable span (10 Hz)
f_{max}	max. frequency

IEC/IEEE-bus command `FREQ:SPAN 2GHz`

SWEEPTIME MANUAL

The *SWEEPTIME MANUAL* softkey activates the window for entering the sweep time manually with Span = 0 Hz. The softkey is not available for Span > 0 Hz.

IEC/IEEE-bus command: `SWE:TIME 10s`

FULL SPAN

The *FULL SPAN* softkey sets the span to the full frequency range of FSU.

IEC/IEEE-bus command `FREQ:SPAN:FULL`

ZERO SPAN

The *ZERO SPAN* softkey sets the span to 0 Hz. The x axis becomes the time axis with the grid lines corresponding to 1/10 of the current sweep time (SWT).

IEC/IEEE-bus command `FREQ:SPAN 0Hz`

LAST SPAN

After changing the span setting the *LAST SPAN* softkey activates the previous setting. With this function a fast change between overview measurement (*FULL SPAN*) and detailed measurement (manually set center frequency and span) is possible.

Note: *Only values > 0 Hz are restored, i.e. a transition between time and frequency domain is not possible.*

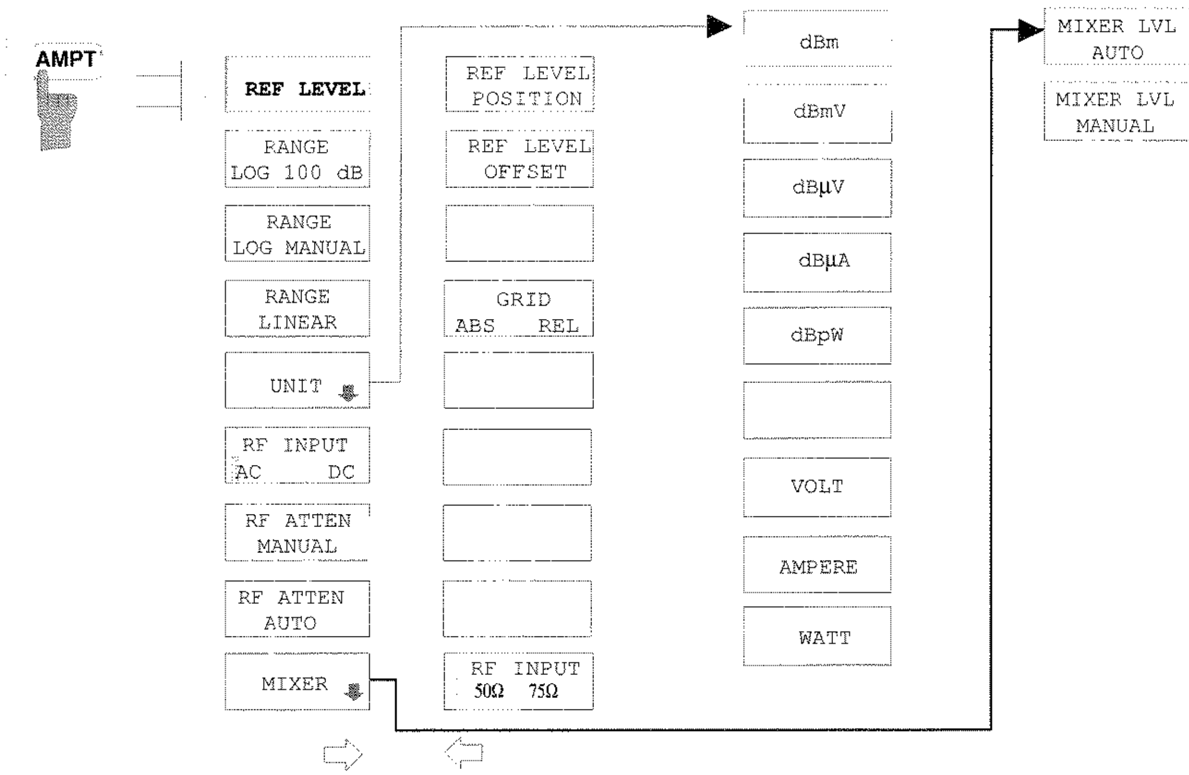
IEC/IEEE-bus command ---

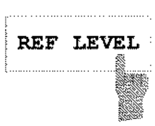
Level Display Setting and RF Input Configuration – *AMPT Key*

The *AMPT* key is used to set the reference level, the maximum level and the display range of the active window as well as the input impedance and the input attenuation of the RF input.

The *AMPT* key opens a menu for setting the reference level and the input attenuation of the active window. The data entry for the reference level (*REF LEVEL* softkey) is opened automatically.

Further settings regarding level display and attenuation can be made in this menu.





The *REF LEVEL* softkey allows the reference level to be input in the currently active unit (dBm, dBμV, etc).

IEC/IEEE-bus command: `DISP:WIND:TRAC:Y:RLEV -60dBm`

The *RANGE LOG 100 dB* softkey sets the level display range to 100 dB.

IEC/IEEE-bus command: `DISP:WIND:TRAC:Y:SPAC LOG`
`DISP:WIND:TRAC:Y 100DB`

RANGE LOG MANUAL

The *RANGE LOG MANUAL* softkey activates the manual entry of the level display range. Display ranges from 10 to 200 dB are allowed in 10 dB steps. Inputs which are not allowed are rounded to the next valid value.

The default setting is 100 dB.

IEC/IEEE-bus command: `DISP:WIND:TRAC:Y:SPAC LOG`
`DISP:WIND:TRAC:Y 120DB`

RANGE LINEAR

The *RANGE LINEAR* softkey switches the display range of the analyzer to linear scaling. The horizontal lines are labelled in %. The grid has a decadic scaling.

IEC/IEEE-bus command: `DISP:WIND:TRAC:Y:SPAC LIN`

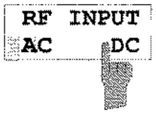
UNIT → dBm | dBmV | dBμV | dBμA | dBpW | VOLT | AMPERE | WATT

The *UNIT* softkey opens a sub menu allowing to select the unit for the level axis.

The default setting is dBm.

In general, the spectrum analyzer measures the signal voltage at the RF input. The level display is calibrated in rms values of an unmodulated sinewave signal. In the default state, the level is displayed at a power of 1 mW (= dBm). Via the known input resistance of 50 Ω or 75Ω , conversion to other units is possible. The units dBm, dBmV, dBμV, dBμA, dBpW, V, A and W are directly convertible.

IEC/IEEE-bus command: `CALC:UNIT:POW DBM`



The *RF INPUT AC/DC* softkey toggles the RF input of the analyzer between AC and DC coupling.

IEC/IEEE-bus command: `INP:COUP AC`

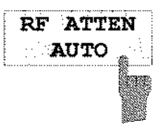
The *RF ATTEN MANUAL* softkey allows the attenuation to be entered irrespective of the reference level.

The attenuation can be set in 10 dB steps between 0 and 70 dB (in 5 dB steps between 0 and 75 dB if option FSU-B25, *Electronic Attenuator*, is fitted).
The attenuation can be set in 5 dB steps between 0 and 75 dB. Other entries will be rounded to the next lower integer value.

If the defined reference level cannot be set for the given RF attenuation, the reference level will be adjusted accordingly and the warning "Limit reached" will be output.

Note: *The 0-dB value can be entered only via the numeric keypad in order to protect the input mixer against occasional overload.*

IEC/IEEE-bus command: `INP:ATT 40 DB`

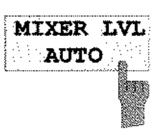


The *RF ATTEN AUTO* softkey sets the RF attenuation automatically as a function of the selected reference level.
This ensures that the optimum RF attenuation desired by the user is always used.

RF ATTEN AUTO is the default setting.

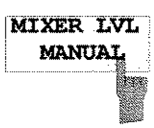
IEC/IEEE-bus command: `INP:ATT:AUTO ON`

Der Softkey *MIXER LEVEL* öffnet das Untermenü zur Eingabe des maximalen Mischerpegels, der bei Referenzpegel erreicht wird.



The *MIXER LVL AUTO* softkey activates the automatic calculation of the mixer level dependent on the selected reference level and the selected RF attenuation.

IEC/IEEE-bus command: `INP:MIX:AUTO ON`

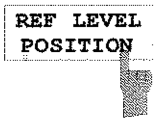


The *MIXER LVL MANUAL* softkey allows the maximum mixer level attainable at the reference level to be entered.

The available range is 0 to -100 dBm in 10 dB steps.

IEC/IEEE-bus command: `INP:MIX -25DBM`

AMPT – NEXT menu:



The *REF LEVEL POSITION* softkey allows the reference level position to be entered.

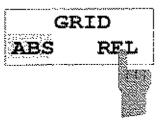
The setting range is from -200 to +200%, 0% corresponding to the lower and 100% to the upper limit of the diagram.

IEC/IEEE-bus command: `DISP:WIND:TRAC:RPOS 100PCT`

The *REF LEVEL OFFSET* softkey allows the arithmetic level offset to be entered. This offset is added to the measured level irrespective of the selected unit. The scaling of the Y axis is changed accordingly.

The setting range is ±200 dB in 0.1 dB steps.

IEC/IEEE-bus command: `DISP:WIND:TRAC:RLEV:OFFS -10dB`



The *GRID ABS/REL* softkey switches between absolute and relative scaling of the level axis.

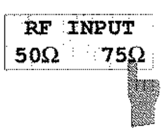
GRID ABS is the default setting.

ABS The labelling of the level lines refers to the absolute value of the reference level.

REL The upper line of the grid is always at 0 dB.
The scaling is in dB whereas the reference level is always in the set unit (dBm, dBμV,..).

For setting *RANGE LINEAR* (linear scaling, labelling of axes in %) the softkey is not displayed since the unit % itself implies a relative scale.

IEC/IEEE-bus command: `DISP:WIND:TRAC:Y:MODE ABS`



The *RF INPUT 50 Ω / 75 Ω* softkey switches the input impedance of the instrument between 50 Ω (= default setting) and 75 Ω.

The setting 75 Ω should be used if the input impedance (50 Ω) is transformed to 75 Ω using the corresponding adapter unit of type RAZ (= 25 Ω in series to the input impedance of the analyzer). The correction value used for the adaption is 1.76 dB = 10 log (75Ω / 50Ω).

All levels specified in this operating manual refer to the default setting of the instrument (50 Ω).

IEC/IEEE-bus command: `INP:IMP 50OHM`

Electronic Attenuator

Besides the mechanical attenuator at the RF input, the FSU also offers an electronic attenuation setting (option *ELECTRONIC ATTENUATOR FSU-B25*). The attenuation range is 0 to 30 dB, with the default attenuation being preset by the mechanical attenuator.

The *EL ATTEN MANUAL* softkey switches the electronic attenuator on and allows the attenuation of the electronic attenuator to be set.

The attenuation can be varied in 5 dB steps from 0 to 30 dB. Other entries are rounded to the next lower integer value.

If the defined reference level cannot be set for the given RF attenuation, the reference level will be adjusted accordingly and the warning "Limit reached" will be output.

IEC/IEEE-bus command: `INP:EATT:AUTO OFF`
`INP:EATT 10 DB`

This function is only available with option *ELECTRONIC ATTENUATOR FSU-B25.*

The *EL ATTEN AUTO* softkey switches the electronic attenuator on and automatically sets its attenuation to 0 dB.
The allowed setting range of the reference level ranges from the current reference level on switching on the electronic attenuator to over 30 dB. If a reference level is set outside the allowed 30-dB range, setting is performed by means of the mechanical attenuator. From this new reference level to over 30 dB the setting is again performed with the electronic attenuator.

IEC/IEEE-bus command: `INP:EATT:AUTO ON`

This function is only available with option *ELECTRONIC ATTENUATOR FSU-B25.*

The *EL ATTEN OFF* softkey switches the electronic attenuator off.

IEC/IEEE-bus command: `INP:EATT:STAT OFF`

This function is only available with option *ELECTRONIC ATTENUATOR FSU-B25.*

Setting the Bandwidths and Sweep Time – *BW* Key

The *BW* key calls a menu for setting the resolution bandwidth (*RBW*), video bandwidth (*VBW*) and sweep time (*SWT*) for the frequency sweep. The parameters may be coupled dependent on the span (stop minus start frequency) or freely set by the user. When working with a split screen display, the settings always refer to the active window.

The FSU offers resolution bandwidths from 10 Hz to 20 MHz in 1, 2, 3, 5, 10 steps and additionally 50 MHz as maximum bandwidth:

Resolution bandwidths up to 100 kHz are realized using digital bandpasses with Gaussian characteristics. As far as the attenuation characteristic is concerned they behave like analog filters but have a much higher measurement speed than comparable analog filters. This is due to the fact that the transient response can be compensated as a result of an accurately defined filter behaviour.

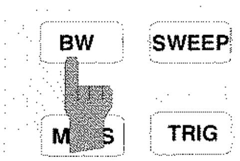
Bandwidths above 100 kHz are realized using decoupled 5-circuit LC filters.

As an alternative to the analog filters, FFT filters are available for the bandwidths between 1 Hz and 30 kHz. When working with bandwidths up to 30 kHz, the FFT algorithm offers considerably higher measurement speeds with all the other settings remaining the same. The reason is that with analog filters the sweep time required for a particular span is proportional to ($Span/RBW^2$). When using the FFT algorithm, however, the sweep time is proportional to (Span/RBW).

The video bandwidths are available in 1, 2, 3, 5, 10 steps between 1 Hz and 10 MHz. They can be set in accordance with the resolution bandwidth.
The video filters serve for smoothing the displayed trace. Video bandwidths that are small compared to the resolution bandwidth average out noise peaks and pulsed signals, so that only the signal average is displayed. If pulsed signals are to be measured, it is recommended to use a video bandwidth that is large compared to the resolution bandwidth ($VBW \geq 10 \times RBW$) for the amplitudes of pulses to be measured correctly.

Note:
*For analog and digital filters, the FSU has overload reserves of different magnitude above the reference level. Due to the LO breakthrough the overload display OVLD responds with digital filters with RBW < 100 kHz, as soon as the start frequency is selected <6 * resolution bandwidth, for RBW = 100 kHz, as soon as the start frequency is below 3 MHz.*

BW menu:



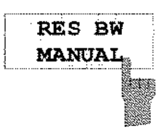
RES BW MANUAL	RBW / VBW SINE [1/3]
VIDEO BW MANUAL	RBW / VBW PULSE [0.1]
SWEEPTIME MANUAL	RBW / VBW NOISE [10]
RES BW AUTO	RBW / VBW MANUAL
VIDEO BW AUTO	
SWEEPTIME AUTO	SPAN /RBW AUTO [50]
COUPLING RATIO	SPAN /RBW MANUAL
DEFAULT COUPLING	
FILTER TYPE	

The *BW* key calls a menu for setting the resolution bandwidth, video bandwidth, sweep time and their couplings.

The various .. *BW AUTO* softkeys are used to couple the functions. The coupling ratios are selected by the *COUPLING RATIO* softkey.

The .. *BW MANUAL* softkeys enable the entry of the parameter concerned. This parameter is not coupled to the other parameters.

Note: *With the ... BW AUTO softkeys the resolution bandwidth, the video bandwidth and the sweep time can be entered separately for the frequency domain (span > 0 Hz) and the time domain (span = 0 Hz).*
But with ...BW MANUAL softkeys the selected values apply to both the frequency and time domain.



The *RES BW MANUAL* softkey activates the manual data entry for the resolution bandwidth.

The resolution bandwidth can be selected in 1/2/3/5/10 steps in the range between 10 Hz and 20 MHz. Additionally a maximum bandwidth of 50 MHz is available. The nominal resolution bandwidth is the 3 dB bandwidth. When FFT filters are used, the lower limit of the bandwidth is 1 Hz. FFT filters may be used with bandwidths up to 30 kHz.

For numeric inputs, the values are always rounded to the nearest possible bandwidth. For rollkey or UP/DOWN key inputs, the bandwidth is adjusted in steps either upwards or downwards.

For filter type CHANNEL or RRC the bandwidth is selected from the list of available channel filters given at the end of this chapter. For data entry, the cursor keys ↑ and ↓ scroll through this list.

The manual input mode of the resolution bandwidth is indicated by a green terisk (*) on the display.

IEC/IEEE-bus command: `BAND:AUTO OFF;`
`BAND 1MHz`

VIDEO BW MANUAL

The *VIDEO BW MANUAL* softkey activates the manual data entry for the video bandwidth.

The video bandwidth can be selected in 1/2/3/5/10 steps in the range between 1 Hz and 10 MHz.
For numeric inputs, the values are always rounded to the nearest possible allowed bandwidth. For rollkey or UP/DOWN key inputs, the bandwidth is adjusted in steps either downwards or upwards.
The manual input mode of the video bandwidth is indicated by a green terisk (*) on the display.

IEC/IEEE-bus command: `BAND:VID:AUTO OFF;`
`BAND:VID 10 kHz`

SWEEP TIME MANUAL

The *SWEEPTIME MANUAL* softkey activates the manual data entry for the sweep time. At the same time, the coupling of the sweep time is cancelled. Other couplings (*VIDEO BW, RES BW*) remain effective.

In the frequency domain (span > 0 Hz) and for resolution bandwidths above 1 kHz, the allowed sweep times for spans > 3.2 kHz range from 2.5 ms through to 16000 s. With spans below 3.2 kHz, the maximum allowed sweep time is reduced to 5 s * span/Hz.
If FFT filters are used, the sweep time is fixed by the span and the bandwidth and therefore cannot be set.
In time domain (span = 0 Hz), the range of sweep times is 1 µs to 16000 s is selectable in steps of max. 5% of the sweep time. For numeric inputs, rounding is made to the nearest possible sweep time. For rollkey or UP/DOWN key inputs, the sweep time is adjusted in steps either downwards or upwards.

The manual input mode of the sweep time is indicated by a green terisk (*) on the display. If the selected sweep time is too short for the selected bandwidth and span, level measurement errors will occur. This happens because the available settling time for the resolution or video filters is too short. In this case, the FSU outputs *UNCAL* on the display and marks the indicated sweep time with a red asterisk (*).

IEC/IEEE-bus command: `SWE:TIME:AUTO OFF;`
`SWE:TIME 10s`

RES BW AUTO

The *RES BW AUTO* softkey couples the resolution bandwidth to the selected span. Changing the span causes automatic adjustment of the resolution bandwidth.

Automatic coupling of resolution bandwidth to span is always recommended when a favourable setting of the resolution bandwidth in relation to the selected span is desired for the measurement under request.

The coupling ratio is set in the *COUPLING RATIO* submenu.

The *RES BW AUTO* softkey is only available in the frequency domain (span > 0 Hz). The softkey is blanked in the time domain.

IEC/IEEE-bus command: `BAND:AUTO ON`

VIDEO BW AUTO

The *VIDEO BW AUTO* softkey couples the video bandwidth to the resolution bandwidth. If the resolution bandwidth is changed, the video bandwidth is automatically adjusted.

The coupling of the video bandwidth is always recommended when the minimum sweep time is required for a selected resolution bandwidth. Narrower video bandwidths require longer sweep times due to the longer settling time. Wider bandwidths reduce the signal/noise ratio.

The coupling ratio is set in the *COUPLING RATIO* submenu.

The coupling of the video bandwidth to the resolution filter is also permitted for the time domain display (span = 0).

IEC/IEEE-bus command: `BAND:VID:AUTO ON`

SWEEPTIME AUTO

The *SWEEPTIME AUTO* softkey couples the sweep time to the span, video bandwidth (VBW) and resolution bandwidth (RBW). The sweep time is automatically adjusted on any change in span, resolution bandwidth or video bandwidth.

The softkey is only available in the frequency domain (span >0 Hz). It is blanked in the time domain.
The FSU always selects the shortest sweep time possible without falsifying the signal. The maximum level error compared to using a longer sweep time is < 0.1 dB. If additional bandwidth and level errors are to be avoided, the sweep time is to be set to three times the time offered in coupled mode.

IEC/IEEE-bus command: `SWE:TIME:AUTO ON`

COUPLING RATIO →

RBW / VBW SINE [1/3]

RBW / VBW PULSE [.1]

RBW / VBW NOISE [10]

RBW / VBW MANUAL

SPAN / RBW AUTO [50]

SPAN / RBW MANUAL

The *COUPLING RATIO* softkey opens a sub menu for selection of the coupling ratios.

When the default setting is active, ie the *COUPLING RATIO* softkey is deactivated (not highlighted), the ratio span/resolution bandwidth (SPAN/RBW) is 50 (this corresponds to SPAN / RBW AUTO [50]) and the ratio resolution bandwidth/video bandwidth (RBW/VBW) is 0.33 (this corresponds to RBW / VBW SINE [1/3]).

If the ratio RBW/VBW or SPAN/RBW is different from the default setting, the *COUPLING RATIO* softkey is highlighted.

The softkeys RBW/VBW... are selection keys. Only one softkey can be enabled at any one time. The softkeys are only effective for the *VBW AUTO* selection in the main menu.

The softkeys SPAN/RBW... are also selection keys. They are only effective for the *RBW AUTO* selection in the main menu.

RBW / VBW SINE [1/3]

The *RBW/VBW SINE [1/3]* softkey sets the following coupling ratio:
video bandwidth = 3 x resolution bandwidth.

This is the default setting for the coupling ratio resolution bandwidth/video bandwidth.

This is the coupling ratio recommended if sinusoidal signals are to be measured.

IEC/IEEE-bus command `BAND:VID:RAT 3`

This setting is only effective for the *VBW AUTO* selection in the main menu.

RBW / VBW PULSE [.1]

The *RBW/VBW PULSE [.1]* softkey sets the following coupling ratio:
video bandwidth = 10 x resolution bandwidth or
video bandwidth = 10 MHz (= max. VBW).

This coupling ratio is recommended whenever the amplitudes of pulsed signals are to be measured correctly. The IF filter is exclusively responsible for pulse shaping. No additional evaluation is performed by the video filter.

IEC/IEEE-bus command `BAND:VID:RAT 10`

This setting is only effective for the *VBW AUTO* selection in the main menu.

RBW / VBW NOISE [10]

The *RBW/VBW NOISE [10]* softkey sets the following coupling ratio:
video bandwidth = resolution bandwidth/10

At this coupling ratio, noise and pulsed signals are suppressed in the video domain. For noise signals, the average value is displayed.

IEC/IEEE-bus command `BAND:VID:RAT 0.1`

This setting is only effective for the *VBW AUTO* selection in the main menu.

RBW / VBW MANUAL

The *RBW/VBW MANUAL* softkey activates the manual input of the coupling ratio.

The resolution bandwidth/video bandwidth ratio can be set in the range 0.001 to 1000.

IEC/IEEE-bus command `BAND:VID:RAT 10`

This setting is only effective for the *VBW AUTO* selection in the main menu.

SPAN /RBW AUTO [50]

The *SPAN/RBW AUTO [50]* softkey sets the following coupling ratio:
resolution bandwidth = span/50

This coupling ratio is the default setting of the analyzer.

IEC/IEEE-bus command `BAND:RAT 0.02`

This setting is only effective for the *RBW AUTO* selection in the main menu.

SPAN /RBW MANUAL

The *SPAN/RBW MANUAL* softkey activates the manual input of the coupling ratio.

The span / resolution bandwidth ratio can be set in the range 1 to 10000.

IEC/IEEE-bus command `BAND:RAT 0.1`

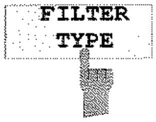
This setting is only effective for the *RBW AUTO* selection in the main menu.

DEFAULT COUPLING

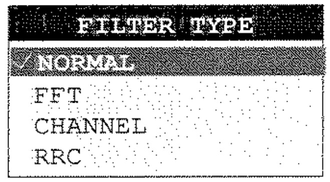
The *DEFAULT COUPLING* softkey sets all coupled functions to the default state (*AUTO*). In addition, the ratio *RBW/VBW* is set to *SINE [1/3]* and the ratio *SPAN/RBW* to 50 in the *COUPLING RATIO* submenu (default setting, *COUPLING RATIO* softkey not highlighted).

IEC/IEEE-bus command

```
BAND:AUTO ON
BAND:VID:AUTO ON
SWE:TIME:AUTO ON
```



The *FILTER TYPE* softkey opens the selection list for different filter types. In the range up to 30 kHz digital band filters with Gaussian characteristic and filtering with FFT algorithm can be selected.



NORMAL For resolution bandwidths up to 100 kHz digital bandpasses are used.

FFT An FFT is performed. For that purpose, the filtered IF signal is digitized and then transformed into the spectral domain via FFT. The transformation range depends on the selected filter bandwidths and can be set between 4 kHz to 50 kHz. If the span is larger than the transformation range, several transformations are performed and the results are appended to each other in the spectral domain. If the span is smaller than the transformation range, the measurement results are interpolated when the number of measurement points provided by the FFT is smaller than the number of display points in x-direction. A flattop window serves as a window in the time domain so that high amplitude precision with good selection is achieved.

Sweep time	Defined by the selected bandwidth and span (reason: FFT filtering is a block transformation). It cannot be changed (softkey deactivated).
Detector	Sample detector and peak detector are available. Peak detector is active when AUTO SELECT is selected.
Video bandwidth	Not defined in case of FFT; therefore cannot be set (softkeys deactivated).

Compared to bandpasses, FFT filters lead to significantly reduced sweep times. For a span of 50 kHz and a bandwidth of 100 Hz, for instance, the sweep time is reduced from 5 s to 40 ms. FFT filters are particularly suitable for stationary signals (sinusoidal signals or signals that are continuously modulated in time). For burst signals (TDMA) or pulsed signals, normal filters are preferable.

Note:

As soon as the FFT filters are active (RBW ≤ 30 kHz) the sweep time display field (SWT) is replaced by the acquisition time (AQT) display field.

FFT is a block transformation so the result depends on the time relation between the dataset to be transformed and the burst or pulsed signal. A gated sweep measurement for TDMA signals is therefore not provided if FFT filters are used.

Additionally, a number of especially steep-edged channel filters are available for power measurement since firmware version 1.10.

A distinction is made between the following filter types:

CHANNEL	=	general, steep-edged channel filters
RRC	=	filters with root-raised cosine characteristic (RRC = Root Raised Cosine)

When selecting these filter types, the automatic coupling of the resolution bandwidth to the span is not available. The filters are selected via the *RES BW* softkey.

A list of all available channel filters with their associated applications can be found at the end of this chapter.

IEC/IEEE-bus command: `BAND:TYPE NORM`

List of available channel filters

The channel filters included in the following table are available for firmware version 1.10 or higher. They can be activated via the *FILTER TYPE* softkey and are then available as resolution filters (softkey *RES BW*).

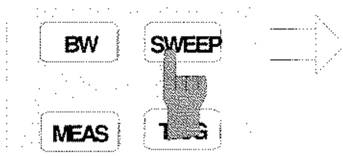
Note:
For filters of type RRC (Root Raised Cosine), the filter bandwidth indicated describes the sampling rate of the filter.
For all other filters (CFILter) the filter bandwidth is the 3 dB bandwidth.

Filter Bandwidth	Filter Type	Application
100 Hz	CFILter	
200 Hz	CFILter	A0
300 Hz	CFILter	
500 Hz	CFILter	
1 kHz	CFILter	
1.5 kHz	CFILter	
2 kHz	CFILter	
2.4 kHz	CFILter	SSB
2.7 kHz	CFILter	
3 kHz	CFILter	
3.4 kHz	CFILter	
4 kHz	CFILter	DAB, Satellite
4.5 kHz	CFILter	
5 kHz	CFILter	
6 kHz	CFILter	
8.5 kHz	CFILter	ETS300 113 (12.5 kHz channels)
9 kHz	CFILter	AM Radio
10 kHz	CFILter	
12.5 kHz	CFILter	CDMAone
14 kHz	CFILter	ETS300 113 (20 kHz channels)
15 kHz	CFILter	
16 kHz	CFILter	ETS300 113 (25 kHz channels)
18 kHz, α=0.35	RRC	TETRA
20 kHz	CFILter	
21 kHz	CFILter	PDC
24.3 kHz, α=0.35	RRC	IS 136
25 kHz	CFILter	
30 kHz	CFILter	CDPD, CDMAone
50 kHz	CFILter	
100 kHz	CFILter	
150 kHz	CFILter	FM Radio
192 kHz	CFILter	PHS
200 kHz	CFILter	
300 kHz	CFILter	
500 kHz	CFILter	J.83 (8-VSB DVB, USA)
1.0 MHz	CFILter	CDMAone
1.2288 MHz	CFILter	CDMAone
1.5 MHz	CFILter	DAB

Sweep Settings – *SWEEP* Key

The SWEEP key serves for configuring the sweep mode.

SWEEP menu



SWEEP

CONTINUOUS SWEEP

SINGLE SWEEP

CONTINUE SGL SWEEP

SWEEPTIME MANUAL

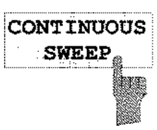
SWEEPTIME AUTO

SWEEP COUNT

SGL SWEEP DISP OFF

The *SWEEP* key calls a menu in which the sweep mode is defined. In split-screen mode, the entries made are valid for the active window only.

The *CONTINUOUS SWEEP, SINGLE SWEEP* and *SGL SWEEP DISP OFF* softkeys are mutually exclusive selection keys.

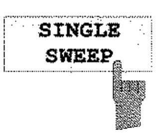


The *CONTINUOUS SWEEP* softkey activates the continuous sweep mode, which means that the sweep takes place continuously according to the trigger mode set.

When working in the split-screen mode and with different settings in the two windows, screen A is swept first, followed by screen B. When the softkey is pressed, the sweep is restarted.

CONTINUOUS SWEEP is the default setting of FSU.

IEC/IEEE-bus command: `INIT:CONT ON`



The *SINGLE SWEEP* softkey starts n sweeps after triggering. The number of sweeps is determined by the *SWEEP COUNT* softkey.

When working in the split-screen mode, the frequency ranges of the two windows are swept one after the other.

If a trace is swept using *TRACE AVERAGE* or *MAXHOLD,* the value set via the SWEEP COUNT softkey determines the number of sweeps. If 0 has been entered, one sweep is performed.

IEC/IEEE-bus command: `INIT:CONT OFF`

CONTINUE SGL SWEEP

The *CONTINUE SGL SWEEP* softkey repeats the number of sweeps set under *SWEEP COUNT,* however without first deleting the trace.

This is particularly of interest when using the functions *TRACE AVERAGE* and *MAXHOLD*, if previously recorded measurement results are to be taken into consideration for averaging / maximum search.

If *SGL SWEEP DISP OFF* is active, the screen is switched off also during repeated sweeps.

IEC/IEEE-bus command: `INIT:CONM`

SWEEPTIME MANUAL

The *SWEEPTIME MANUAL* softkey activates the window for entering the sweep time manually (see also BW menu).

IEC/IEEE-bus command: `SWE:TIME 10s`

SWEEPTIME AUTO

The *SWEEPTIME AUTO* softkey activates the automatic selection of the sweep time as a function of the bandwidth of the resolution and video filters (see also BW menu).

IEC/IEEE-bus command: `SWE:TIME:AUTO ON`

SWEEP COUNT

The *SWEEP COUNT* softkey activates the window for the entry of the number of sweeps to be performed by FSU after a single sweep has been started. If Trace Average, Max Hold or Min Hold is activated, this also determines the number of averaging or maximum search procedures.

Example:
[**TRACE1**: *MAX HOLD*]
[**SWEEP**: *SWEEP COUNT*: {10} **ENTER**]
[*SINGLE SWEEP*]

FSU performs the Max Hold function over 10 sweeps.

The permissible range for the sweep count is 0 to 32767. For sweep count = 0 or 1, one sweep is performed. For trace averaging in the continuous-sweep mode, FSU performs running averaging over 10 sweeps if sweep count = 0; if sweep count = 1, no averaging is performed.

The sweep count is valid for all the traces in a diagram.

Note: *The number of sweeps set in the TRACE menu is the same as that in the SWEEP menu.*
If SINGLE SWEEP is selected, the measurement stops after the selected number of sweeps has been performed.

IEC/IEEE-bus command: `SWE:COUN 64`

SGL SWEEP DISP OFF

The *SGL SWEEP DISP OFF* softkey deactivates the display while a single sweep is being performed. Once the sweep has been completed, the trace is shown.

IEC/IEEE-bus command: `INIT:DISP OFF;:INIT.04`

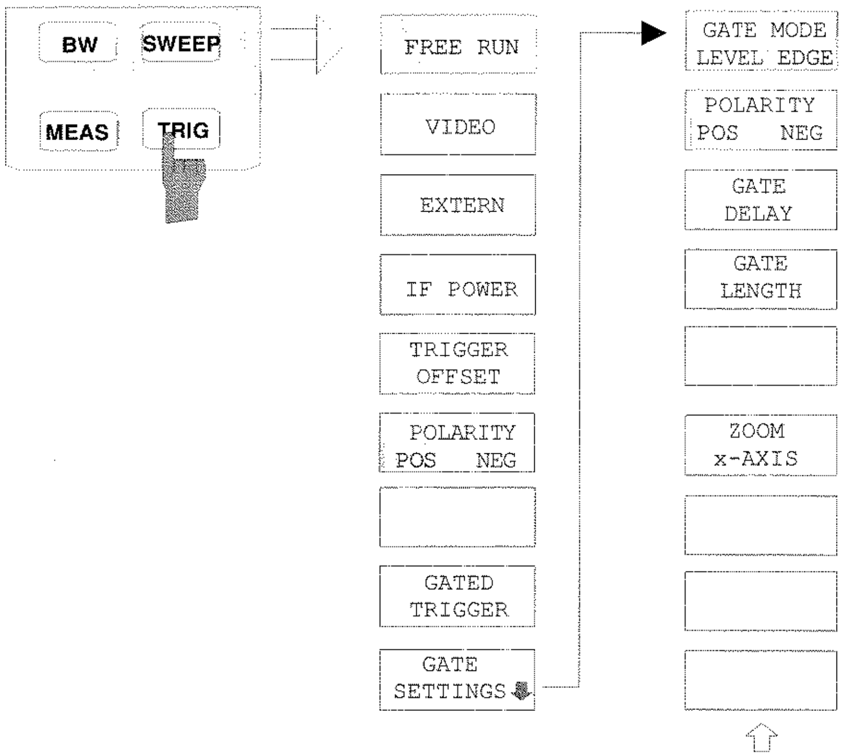
Triggering the Sweep– *TRIG* Key

The *TRIG* key opens a menu for selection of the various trigger sources, trigger polarity and external gate function. The active trigger mode is indicated by highlighting the corresponding softkey.

For video trigger, a trigger threshold can be entered, which is represented in the diagram as a horizontal line.

To indicate that a trigger mode other than *FREE RUN* has been set, the enhancement label **TRG** is displayed on the screen. If two windows are displayed, TRG appears next to the appropriate window.

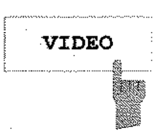
TRIGGER menu



The *FREE RUN* softkey activates the free-run sweep mode, ie start of a sweep is not triggered. Once a measurement is completed, another is started immediately.

FREE RUN is the default setting of FSU.

IEC/IEEE-bus command: `TRIG:SOUR IMM`

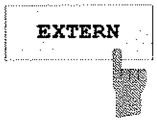


The *VIDEO* softkey activates triggering through the displayed voltage.

For the video triggering mode, a horizontal trigger line is shown in the diagram. It may be used to set the trigger threshold between 0% and 100% of the overall diagram height.

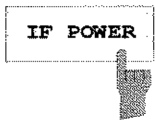
IEC/IEEE-bus command:

```
TRIG:SOUR VID
TRIG:LEV:VID 50 PCT
```



The *EXTERN* softkey activates triggering via a TTL signal at the input connector *EXT TRIGGER/GATE* on the rear panel.

IEC/IEEE-bus command: `TRIG:SOUR EXT`
`SWE:EGAT:SOUR EXT`



The *IF POWER* softkey activates triggering of the measurement via signals which are outside the measurement channel.

FSU uses a level detector at the second intermediate frequency. The detector threshold is approximately -20 dBm at the input mixer. This means that the actual trigger level at the RF input is approx. -20 dBm plus the set RF attenuation.
The bandwidth at the intermediate frequency is 10 MHz. Triggering takes place when the trigger threshold is exceeded within a 5 MHz bandwidth about the selected frequency (= start frequency in the frequency sweep). Thus, the measurement of spurious emissions, eg for pulsed carriers, is possible even when the carrier lies outside the selected frequency span.

IEC/IEEE-bus command: `TRIG:SOUR IFP`
`SWE:EGAT:SOUR IFP`

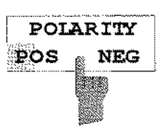
The *TRIGGER OFFSET* softkey activates the window for entering the time offset between the trigger signal and the start of the sweep.

Triggering is delayed by the entered time with respect to the trigger signal (time entered > 0) or is started earlier (time entered < 0). The time may be entered in multiples of 125 ns in the range -100 s to 100 s (default 0 s).

Note: *A negative offset (pretrigger) can be set in the time domain only (SPAN = 0 Hz) provided GATED TRIGGER is not active in that domain.*

As a common input signal is used for both trigger and gate when selecting *EXTERN* and *IF POWER,* changes to the gate delay will affect the trigger delay *(TRIGGER OFFSET)* as well.

IEC/IEEE-bus command: `TRIG:HOLD 10US`



The *POLARITY POS/NEG* softkey selects the polarity of the trigger source.

The sweep starts after a positive or negative edge of the trigger signal. The selected setting is highlighted.

The selection is valid for all trigger modes with the exception of *FREE RUN*; in the gate mode, it also applies to the gate polarity.

The default setting is *POLARITY POS.*

IEC/IEEE-bus command: `TRIG:SLOP POS`

By using a gate in sweep mode and stopping the measurement while the gate signal is inactive, the spectrum for pulsed RF carriers can be displayed without the superposition of frequency components generated during switching. Similarly, the spectrum can also be examined for an inactive carrier. The sweep can be controlled by an external gate or by the internal power trigger.

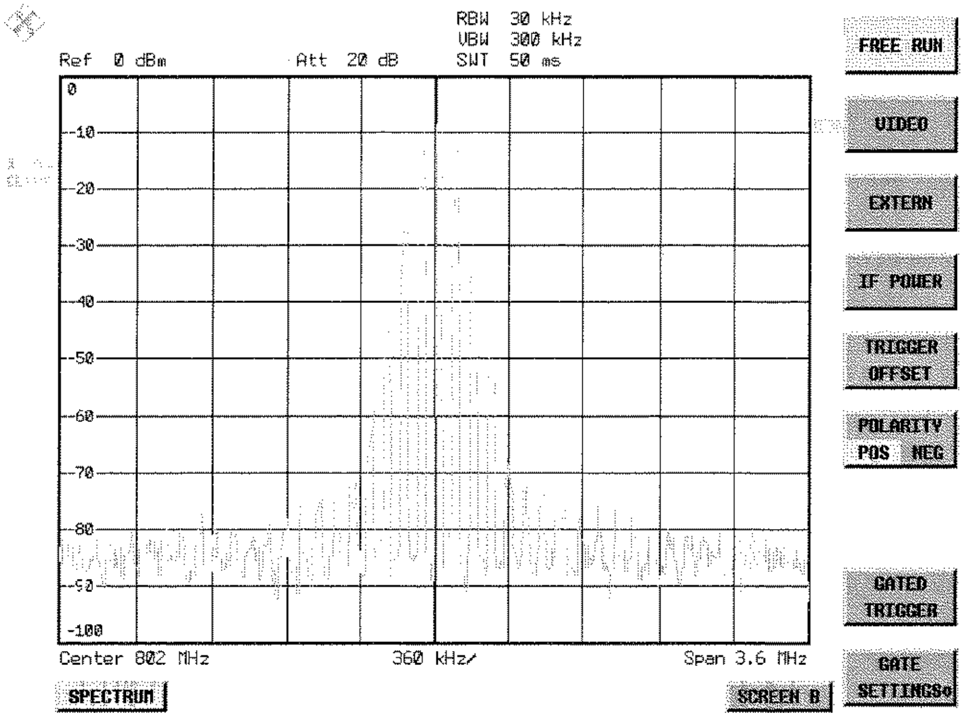


Fig. 4-1 Pulsed signal GATE OFF

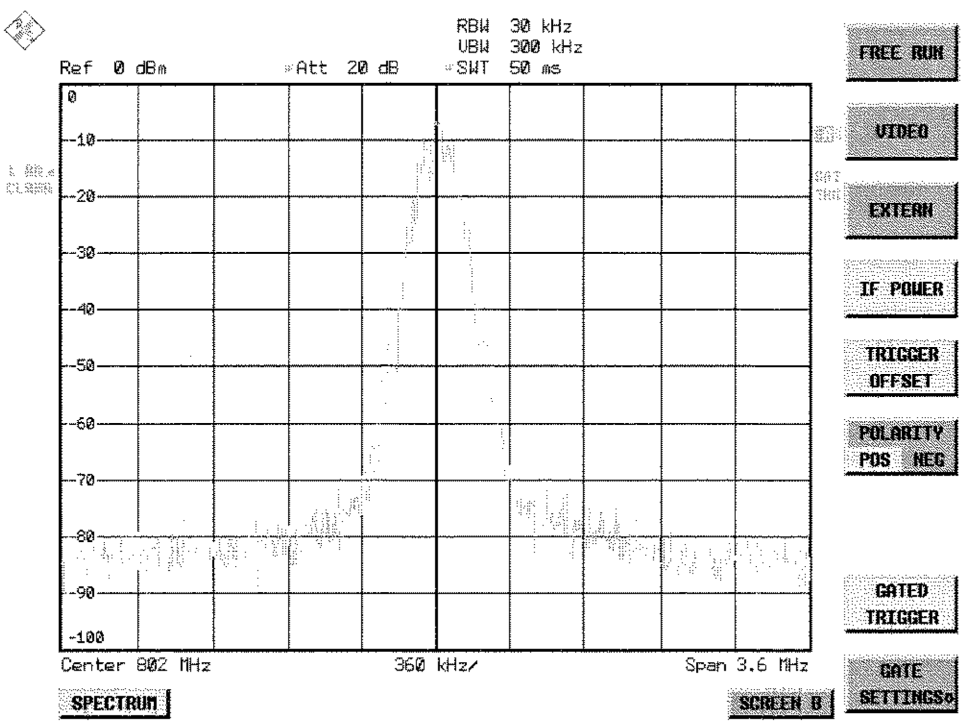
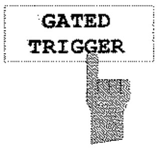


Fig. 4-2 TDMA signal with GATE ON

The gated-sweep mode is activated by the *GATED TRIGGER* softkey. The setting of the mode takes place in the *GATE SETTINGS* submenu.



The *GATED TRIGGER* softkey switches the sweep mode with gate on and off.

When gate is switched on, a gate signal applied to the rear panel connector *EXT TRIGGER/GATE* or the internal IF power detector controls the sweep of the analyzer. This selection is made via the *EXTERN* and *IF POWER* softkeys for trigger and gate.
The length of the gate signal defines when the sweep is to be interrupted. Here a differentiation is made between edge-triggered and level-triggered modes: in case of edge triggering the gate length can be set via the *GATE LENGTH* softkey, while in case of level triggering the gate length depends on the length of the gate signal.

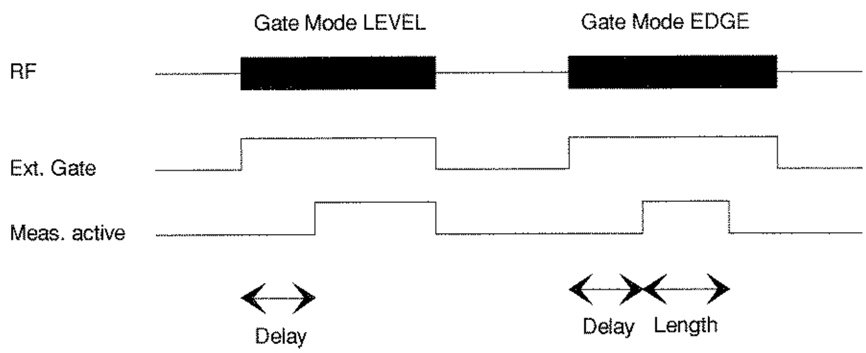


Fig.4-3 Timing diagram for GATE, GATE DELAY and GATE LENGTH

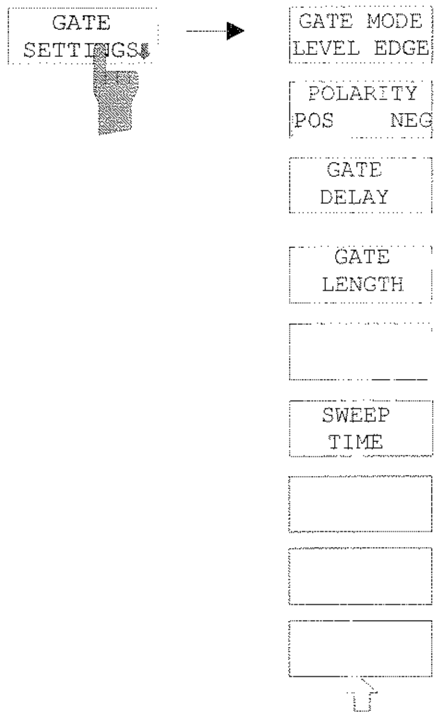
This softkey requires the *EXTERN* or *IF POWER* trigger mode. If a different mode is active, IF POWER is automatically selected.

Gated-sweep operation is also possible in the time domain. This enables - eg in burst signals - level variations of individual slots to be displayed versus time.

To indicate that a gate is used for the sweep, the enhancement label **GAT** is displayed on the screen. This label appears to the right of the window for which the gate is configured.

IEC/IEEE-bus command:

```
SWE:EGAT ON
SWE:EGAT:SOUR IFP
or:
SWE:EGAT:SOUR EXT
```



The *GATE SETTINGS* softkey calls a submenu for making all the settings required for gated-sweep operation.

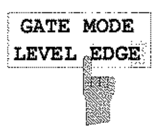
At the same time, a transition is made to the time domain (span = 0) and the time parameters *GATE DELAY* and *GATE LENGTH* are represented as vertical lines. This allows the required gate time parameters to be set easily.

For highly accurate setting of gate delay and gate length, the x axis can be altered using the *ZOOM x-AXIS* softkey in a way that the signal range concerned (eg one full burst) is displayed.

Then the sampling time and duration can be set by *GATE DELAY* and *GATE LENGTH* in a way that the desired portion of the signal is shown.

When quitting the submenu, the program will return to the frequency domain provided it was active before. The original span is restored so the desired measurement can now be performed with the accurately set gate.

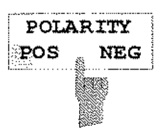
IEC/IEEE-bus command: --



The *GATE MODE LEVEL/EDGE* softkey selects the trigger mode. Gated sweep is possible in the level-triggered as well as in the edge-triggered mode.

If level triggering is selected, the *GATE LENGTH* softkey becomes inactive and cannot be operated.

IEC/IEEE-bus command: `SWE:EGAT:TYPE EDGE`



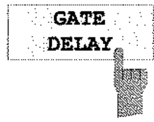
The *POLARITY POS/NEG* softkey controls the polarity of the *EXT TRIGGER/GATE* control line.

In case of level triggering the sweep is stopped by *POLARITY POS* and a logic ´0´ signal; the signal ´1´ will restart the sweep after the *GATE DELAY* time has elapsed.

In case of edge triggering the sweep is continued on a ´0´ to ´1´ transition for the duration of *GATE LENGTH* after a delay (*GATE DELAY)* has elapsed.

Changing the polarity automatically implies a transition of the trigger-edge polarity (*POLARITY* softkey in the higher menu).

IEC/IEEE-bus command: `SWE:EGAT:POL POS`



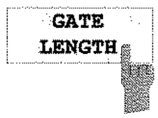
The *GATE DELAY* softkey activates the window for setting the delay time between the gate signal and the continuation of the sweep.

This may be useful for taking into account a delay between the gate signal and the stabilization of an RF carrier for example.

As gate delay, values between 125 ns and 100 s may be set. The position of the delay on the time axis in relation to the sweep is indicated by the line labelled **GD**.

As there is a common input signal for trigger and gate if *EXTERN* or *IF POWER* is selected, changes to the gate delay will affect the trigger delay (*TRIGGER OFFSET*) as well.

IEC/IEEE-bus command: `SWE:EGAT:HOLD 1US`



The *GATE LENGTH* softkey activates the window for setting the sweep duration of FSU in the edge-triggered mode.

Values between 125 ns and 100 s may be set for the gate length. The length of the gate in relation to the sweep is indicated by the line labelled **GL.**

This softkey is only available if *GATE MODE EDGE* (edge triggering) has been selected.

IEC/IEEE-bus command: `SWE:EGAT:LENG 100US`

The *SWEEP TIME* softkey enables the user to change the time axis to obtain a higher resolution for positioning gate delay and gate length.
When this is to be done, the sweep time temporarily changes; the original value is restored when the menu is quit.

IEC/IEEE-bus command: --

Measurement example:

The modulation spectrum of a GSM or PCS1900 signal is to be measured using the gated-sweep function. The signal is generated by a Signal Generator SME03 whose RF output is directly connected to the RF input of FSU.

Settings on SME03:

FREQ:	802 MHz
Level:	0 dBm: Return
Digital Mod:	Select: GMSK: Select
Source:	Select: PRBS: Select: Return
Level Attenuation:	Select: 60 dB: Return

The SME03 supplies a GMSK-modulated TDMA signal (GSM).

Settings on FSU:

Conventions:

	[KEY]	Menu called by this key. All information between the brackets refers to this menu.
	{Number}	Numeric value to be entered for the parameter on hand.
	SOFTKEY	Softkey to be used for making a selection or entering a value.

[PRESET]
[FREQ: *CENTER* {802} **MHz]**
[SPAN {3.6} **MHz]**
[AMPT: *REF LEVEL* {0} **dBm**: *RF ATTEN MANUAL*: {10} **dB]**
[BW: *RES BW MANUAL*: {30} **kHz]**
[TRACE : *TRACE 1* *DETECTOR*: *RMS*]
[SWEEP: *SWEEPTIME MANUAL*: {50} **ms]**
[TRIG: *EXTERN*
GATED TRIGGER;
GATE SETTINGS: *GATE MODE EDGE; POLARITY POS*
SWEEPTIME MANUAL {1} **ms**: *GATE DELAY* {300} **µs**:
GATE LENGTH: {250} **µs]**

The following figure shows the screen display for setting gate parameters. The vertical lines for gate delay (GD) and gate length (GL) can be adjusted to the burst signal by entering numeric values or by means of the rollkey.

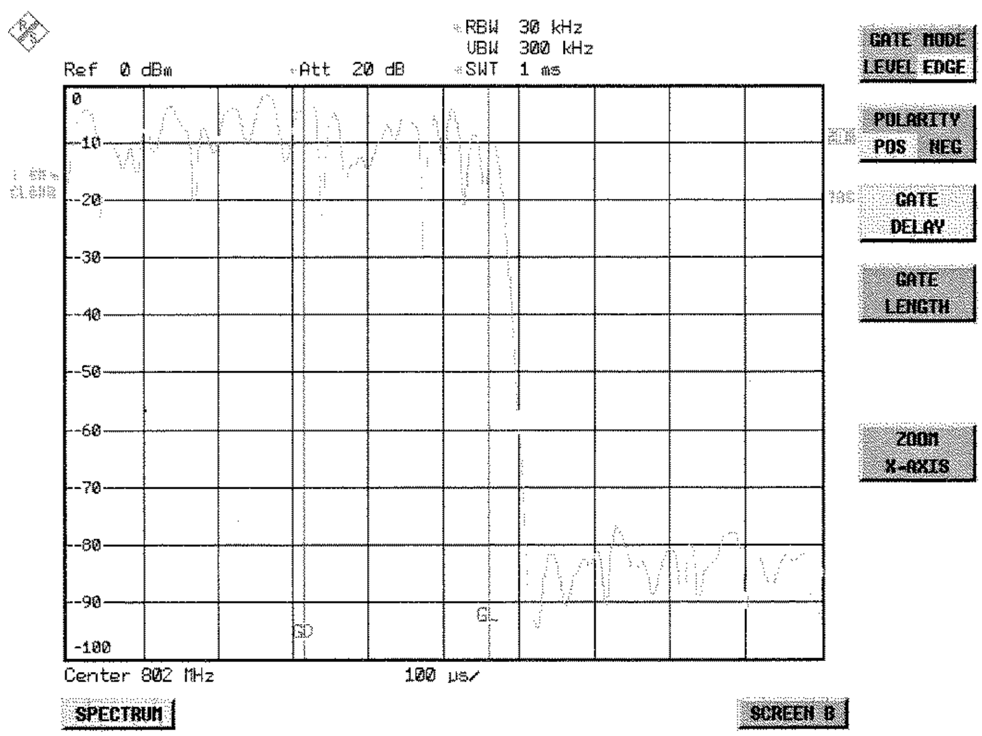


Fig.4-4 Setting GATE DELAY and GATE LENGTH in time domain by means of lines GD and GL

On quitting the *GATE SETTINGS* menu, FSU returns to the previous screen.

Selection and Setting of Traces – *TRACE* Key

The FSU is capable of displaying up to three different traces at a time in a diagram. A trace consists of a maximum of 625 pixels on the horizontal axis (frequency or time). If more measured values than pixels are available, several measured values are combined in one pixel.
The traces are selected using the *SELECT TRACE* softkey in the menu of the *TRACE* key.

The traces can individually be activated for a measurement or frozen after completion of a measurement. Traces that are not activated are blanked.

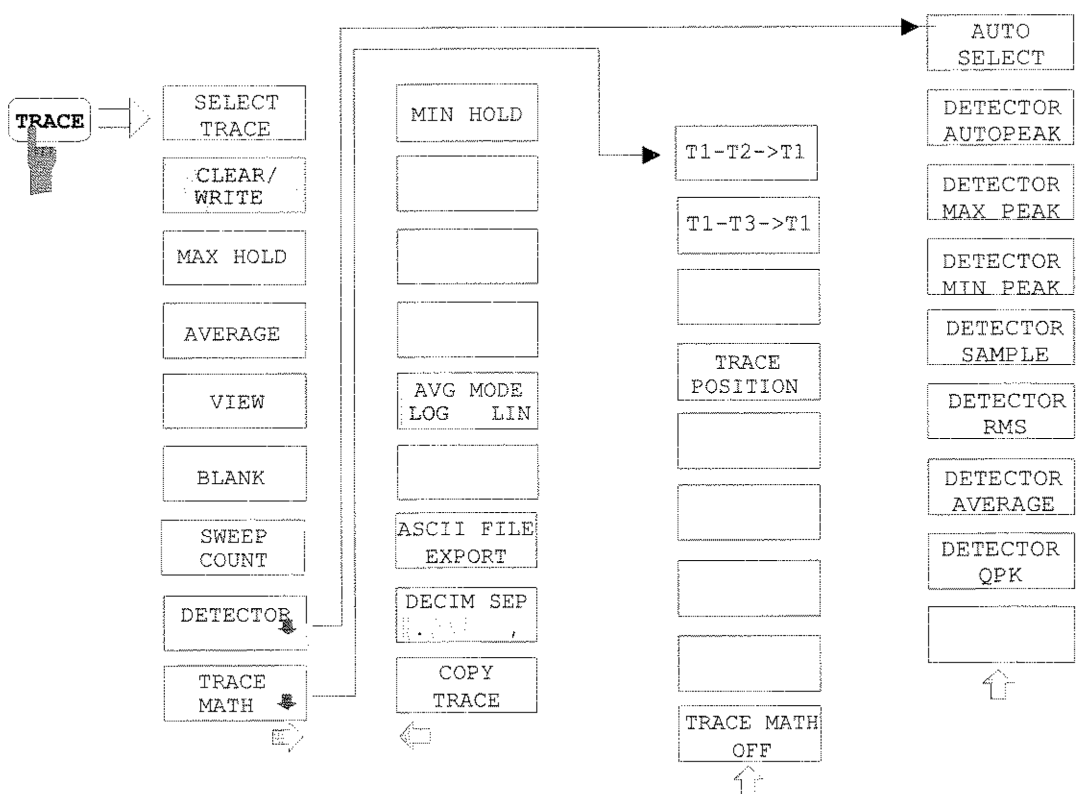
The display mode can be selected for each trace. Traces can be overwritten in each measurement (CLEAR/WRITE mode), averaged over several measurements (AVERAGE mode), or a maximum or minimum value can be determined from several measurements and displayed (MAX HOLD or MIN HOLD).
Individual detectors can be selected for the various traces. The autopeak detector displays maximum and minimum values connected by a vertical line. The max peak detector and min peak detector display the maximum and minimum value of the level within a pixel. The sample detector displays the instantaneous value of the level at a pixel. The rms detector displays the power (rms value) of the measured values within a pixel, the average detector the average value.

Selection of Trace Function

The trace functions are subdivided as follows:

- Display mode of trace (CLEAR/WRITE, VIEW and BLANK)
- Evaluation of the trace as a whole (AVERAGE, MAX HOLD and MIN HOLD)
- Evaluation of individual pixels of a trace (AUTOPEAK, MAX PEAK, MIN PEAK, SAMPLE, RMS, AVERAGE and QUASIPEAK)

TRACE menu



The *TRACE* key opens a menu offering the setting options for the selected trace.

In this menu, the mode of representing the measured data in the frequency or time domain in the 625 pixels of the display is determined. Upon start of the measurement, each trace can be displayed either completely new or based on the previous results.
Traces can be displayed, blanked and copied. Traces can also be corrected with the aid of mathematical functions.
The measurement detector for the individual display modes can be selected directly by the user or set automatically by FSU.

The default setting is trace 1 in the overwrite mode (*CLEAR / WRITE*), the other traces 2 and 3 are switched off (*BLANK*).

The *CLEAR/WRITE, MAX HOLD, MIN HOLD, AVERAGE, VIEW* and *BLANK* softkeys are mutually exclusive selection keys.

The *SELECT TRACE* softkey activates the entry for the active trace (1, 2, 3).

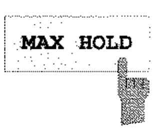
IEC/IEEE-bus command -- (selected via numeric suffix of `:TRACe`)

The *CLEAR/WRITE* softkey activates the overwrite mode for the collected measured values, ie the trace is overwritten by each sweep.

In the *CLEAR/WRITE* display mode all the available detectors can be selected. In the default mode the autopeak detector (setting *AUTO*) is selected.

Each time the *CLEAR/WRITE* softkey is actuated, FSU clears the selected trace memory and starts the measurement anew.

IEC/IEEE-bus command `DISP:WIND:TRAC:MODE WRIT`



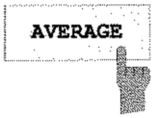
The *MAX HOLD* softkey activates the max peak detector.
FSU saves the sweep result in the trace memory only if the new value is greater than the previous one.

The detector is automatically set to *MAX PEAK*. The maximum value of a signal can thus be determined over several sweeps.

This is especially useful with modulated or impulsive signals. The signal spectrum is filled up upon each sweep until all signal components are detected in a kind of envelope.

Pressing the *MAX HOLD* softkey again clears the trace memory and restarts the max hold mode.

IEC/IEEE-bus command `DISP:WIND:TRAC:MODE MAXH`



The *AVERAGE* softkey activates the trace averaging function. The average is formed over several sweeps. Averaging can be performed with any of the detectors available. If the detector is automatically selected by FSU, the sample detector is used.

Depending on the setting of AVG MODE LOG / LIN, the logarithmic level values or the measured power/voltage values are averaged.

Averaging is restarted every time the *AVERAGE* softkey is pressed. The trace memory is always cleared.

IEC/IEEE-bus command `DISP:WIND:TRAC:MODE AVER`

Description of averaging

Averaging is carried out over the pixels derived from the measurement samples. Several measured values may be combined in a pixel. This means that with linear level display the average is formed over linear amplitude values and with logarithmic level display over levels. For this reason the trace must be measured again when changing between *LIN* and *LOG* display mode. The settings *CONT/SINGLE SWEEP* and running averaging apply to the average display analogously.

There are two methods for calculating the average. For a sweep count = 0 , a running average is calculated according to the following formula:

$$\mathrm{TRACE} = \frac{9 * \mathrm{TRACE} + \text{ meas. value}}{10}$$

Due to the weighting between the new measured value and the trace average, past values have practically no influence on the displayed trace after about ten sweeps. With this setting, signal noise is effectively reduced without need for restarting the averaging process after a change of the signal.

If the sweep count is >1, averaging takes place over the selected number of sweeps. In this case the displayed trace is determined during averaging according to the following formula:

$$\mathrm{Trace}_n = \frac{1}{n}\left[\sum_{i=1}^{n-1}(T_i) + \text{meas. value}_n\right]$$

where n is the number of the current sweep (n = 2 ... SWEEP COUNT). No averaging is carried out for the first sweep but the measured value is stored in the trace memory. With increasing n, the displayed trace is increasingly smoothed since there are more single sweeps for averaging.

After the selected number of sweeps the average trace is saved in the trace memory. Until this number of sweeps is reached, a preliminary average is displayed.

After completion of averaging, ie when the averaging length defined by *SWEEP COUNT* is attained, a running averaging is continued with *CONTINUOUS SWEEP* according to the following formula:

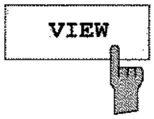
$$\mathrm{Trace} = \frac{(N-1)\cdot \mathrm{Trace}_{old} + \text{meas. value}}{N}$$

where

Trace = new trace
Trace_{old} = old trace
N = SWEEP COUNT

The display "Sweep N of N" does not change any more until a new start is triggered.

In the *SINGLE SWEEP* mode, the number of sweeps is triggered with *SWEEP START*. The sweeps are stopped when the selected number of sweeps is attained. The number of the current sweep and the total number of sweeps are shown on the display: "Sweep 3 of 200".

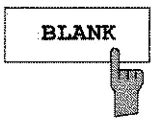


The *VIEW* softkey freezes the current contents of the trace memory and displays it.

If a trace is frozen by *VIEW*, the instrument settings can be changed without the displayed trace being modified (exception: level display range and reference level, see below). The fact that the trace and the current instrument setting do not agree any more is indicated by an enhancement label "*" at the right edge of the grid.

If in the *VIEW* display mode the level display range (*RANGE*) or the reference level (*REF LEVEL*) are changed, FSU automatically adapts the measured data to the changed display range. This allows an amplitude zoom to be made after the measurement in order to show details of the trace.

IEC/IEEE-bus command `DISP:WIND:TRAC:MODE VIEW`



The *BLANK* softkey activates the blanking of the trace on the screen.

IEC/IEEE-bus command `DISP:WIND:TRAC OFF`

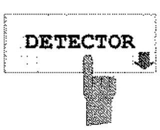
The *SWEEP COUNT* softkey activates the entry of the number of sweeps used for averaging. The allowed range of values is 0 to 30000 and the following should be observed:

- Sweep Count = 0 means running averaging
- Sweep Count = 1 means no averaging being carried out
- Sweep Count > 1 means averaging over the selected number of sweeps; in the continuous sweep mode averaging is performed until the set number of sweeps is attained and is then continued as running averaging.

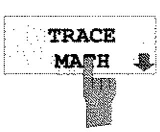
The default setting is running averaging (Sweep Count = 0). The number of sweeps used for averaging is the same for all active traces in the selected diagram.

Note: *The setting of the sweep count in the trace menu is equivalent to the setting in the sweep menu.*

IEC/IEEE-bus command `SWE:COUN 64`



See following Section "Selection of Detector"



See following Section "Mathematical Functions for Traces"

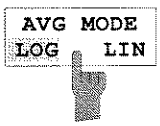
TRACE - NEXT menu

The *MIN HOLD softkey* activates the min peak detector. FSU saves for each sweep the smallest of the previously stored/currently measured values in the trace memory. The detector is automatically set to *MIN PEAK*. In this way, the minimum value of a signal can be determined over several sweeps.

This function is useful eg for making an unmodulated carrier in a composite signal visible. Noise, interference signals or modulated signals are suppressed by the min hold function whereas a CW signal is recognized by its constant level.

Pressing the *MIN HOLD* softkey again clears the trace memory and restarts the min hold function.

IEC/IEEE-bus command `DISP:WIND:TRAC:MODE MINH`



The *AVG MODE LOG/LIN* softkey selects logarithmic or linear averaging for the logarithmic level display mode.

At the same time the difference calculation is switched between linear and logarithmic in submenu *TRACE MATH*.

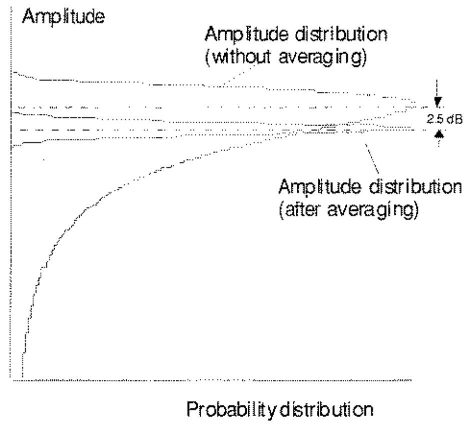
IEC/IEEE-bus command `CALC:MATH:AVER:MODE LIN`

With logarithmic averaging, the dB values of the display voltage are averaged or substracted from each other with trace mathematical functions. With linear averaging the level values in dB are converted into linear voltages or powers prior to averaging. Voltage or power values are averaged or offset against each other and reconverted into level values.

For stationary signals the two methods yield the same result.

Logarithmic averaging bzw. Verrechnung is recommended if sinewave signals are to be clearly visible against noise since with this type of averaging noise suppression is improved while the sinewave signals remain unchanged.

For noise or pseudo-noise signals the positive peak amplitudes are decreased in logarithmic averaging due the characteristic involved and the negative peak values are increased relative to the average value. If the distorted amplitude distribution is averaged, a value is obtained that is smaller than the actual average value. The difference is -2.5 dB.



This low average value is usually corrected in noise power measurements by a 2.5 dB factor. Therefore the FSU offers the selection of linear averaging. The trace data are delogarithmized prior to averaging, then averaged and logarithmized again for display on the screen. The average value is always correctly displayed irrespective of the signal characteristic.

The *ASCII FILE EXPORT* softkey stores the active trace in ASCII format on a floppy disk.

IEC/IEEE command `FORM ASC;`
`MMEM:STOR:TRAC 1,'TRACE.DAT'`

The file consists of the header containing important scaling parameters and a data section containing the trace data.

The data of the file header consist of three columns, each separated by a semicolon:
parameter name; numeric value; basic unit

The data section starts with the keyword " Trace <n> " (<n> = number of stored trace), followed by the measured data in one or several columns (depending on measurement) which are also separated by a semicolon.
This format can be read in from spreadsheet calculation programs, eg MS-Excel. It is necessary to define ';' as a separator.

Note: *Different language versions of evaluation programs may require a different handling of the decimal point. It is therefore possible to select between separators '.' (decimal point) and ',' (comma) using softkey DECIM SEP.*

Example:

	File contents	Description
File header	Type;FSU3;	Instrument model
	Version;1.00;	Firmware version
	Date;01.Jul 1999;	Date of data set storage
	Mode;Spectrum;	Instrument mode
	Center Freq;55000;Hz	Center frequency
	Freq Offset;0;Hz	Frequency offset
	Span;90000;Hz	Frequency range (0 Hz with zero span and statistics measurements)
	x-Axis;LIN;	Scaling of x axis linear (LIN) or logarithmic (LOG)
	Start;10000;Hz Stop;100000;Hz	Start/stop of the display range. Unit: Hz for span > 0, s for span = 0, dBm/dB for statistics measurements
	Ref.Level;-30;dBm	Reference level
	Level Offset;0;dB	Level offset
	Ref Position;75;%	Position of reference level referred to diagram limits (0% = lower edge)
	y-Axis;LOG;	Scaling of y axis linear (LIN) or logarithmic (LOG)
	Level Range;100;dB	Display range in in y direction. Unit: dB with x axis LOG, % with x axis LIN
	RF Att;20;dB	Input attenuation
	RBW;100000;Hz	Resolution bandwidth
	VBW;30000;Hz	Video bandwidth
	SWT;0.005;s	Sweep time
	Trace Mode;AVERAGE;	Display mode of trace: CLR/WRITE,AVERAGE,MAXHOLD,MINHOLD
	Detector;SAMPLE;	Detector set: AUTOPEAK,MAXPEAK,MINPEAK,AVERAGE, RMS,SAMPLE,QUASIPEAK
	Sweep Count;20;	Number of sweeps set
Data section of the file	Trace 1:;;	Selected trace
	x-Unit;Hz;	Unit of x values: Hz with span > 0; s with span = 0; dBm/dB with statistics measurements
	y-Unit;dBm;	Unit of y values: dB*/V/A/W depending on the selected unit with y axis LOG or % with y axis LIN
	Values; 625;	Number of test points
	10000;-10.3;-15.7 10180;-11.5;-16.9 10360;-12.0;-17.4 ...;...;	Measured values: <x value>, <y1>, <y2> <y2> being available only with detector AUTOPEAK and containing in this case the smallest of the two measured values for a test point.

The *DECIM SEP* softkey selects the decimal separator between '.' (decimal point) and ',' (comma) with floating-point numerals for the function ASCII FILE EXPORT.
With the selection of the decimal separator different language versions of evaluation programs (eg MS-Excel) can be supported.

IEC/IEEE-bus command `FORM:DEXP:DSEP POIN`

The *COPY TRACE* softkey copies the screen contents of the current trace into another trace memory. The desired memory is selected by entering the number 1, 2 or 3.

Upon copying, the contents of the selected memory is overwritten and the new contents displayed in view mode.

IEC/IEEE-bus command `TRAC:COPY TRACE1,TRACE2`

Selection of Detector

The detectors of the FSU are implemented as pure digital devices. The detectors available are the peak detectors which determine the maximum and/or the minimum value from a number of samples, the rms detector which measures the power within a pixel, the average, the quasipeak and the sample detector. The sample detector routes through the sampled data without any modification or performs a data reduction by suppressing measured values that cannot be displayed.
The peak detectors compare the current level value with the maximum or minimum level from the previously sampled data. When the number of samples defined by the instrument setting is reached, the samples are combined in displayable pixels. Each of the 625 pixels of the display thus represents 1/625 of the sweep range and contains all single measurements (frequency samples) in this subrange in compressed form. For each trace display mode an optimized detector is selected automatically. Since peak detectors and sample detector are connected in parallel, a single sweep is sufficient for collecting all detector values for 3 traces.

Peak detectors (*MAX PEAK* and *MIN PEAK*)

Peak detectors are implemented by digital comparators. They determine the largest of all positive (max peak) or the smallest of all negative (min peak) peak values of the levels measured at the individual frequencies which are displayed in one of the 625 pixels. This procedure is repeated for each pixel so that for wide frequency spans and despite the limited resolution of the display a large number of measurements can be taken into consideration for the display of the spectrum.

Autopeak detector

The *AUTOPEAK* detector combines the two peak detectors. The max peak detector and the min peak detector simultaneously determine the maximum and the minimum level within a displayed testpoint and display it as a single measured value. The maximum and minimum levels within a frequency point are connected by a vertical line.

Sample detector

The *SAMPLE* detector routes through the sampled data without any further evaluation and either displays them directly or, for reasons of speed in case of short sweep times, first writes them into a memory and processes them subsequently.
There is no data reduction, ie no summing up of measured values of neighbouring frequencies or time samples. If during a frequency sweep more measured values are obtained than can be displayed, measured values will be lost. This means that discrete signals might be lost.
The sample detector therefore can only be recommended for a span-to-resolution bandwidth ratio of up to approx. 250 in order to ensure that no signal will be suppressed (example: span 1 MHz, -> min. bandwidth 5 kHz).

RMS detector

The RMS detector forms the rms value of the measured values within a pixel.
To this effect, FSU uses the linear voltage after envelope detection. The sampled linear values are squared, summed and the sum is divided by the number of samples (= root mean square). For logarithmic display the logarithm is formed from the square sum. For linear display the root mean square value is displayed. Each pixel thus corresponds to the power of the measured values summed up in the pixel.
The rms detector supplies the power of the signal irrespective of the waveform (CW carrier, modulated carrier, white noise or impulsive signal). Correction factors as needed for other detectors for measuring the power of the different signal classes are not required.

Average detector

The average detector forms the average value of the measured values within a pixel.
To this effect, FSU uses the linear voltage after envelope detection. The sampled linear values are summed up and the sum is divided by the number of samples (= linear average value). For logarithmic display the logarithm is formed from the average value. For linear display the average value is displayed. Each pixel thus corresponds to the average of the measured values summed up in the pixel.
The average detector supplies the average value of the signal irrespective of the waveform (CW carrier, modulated carrier, white noise or impulsive signal).

Quasipeak detector

The quasipeak detector similates the behaviour of an analog voltmeter by evaluating the measured values in a pixel.
The quasipeak detector is especially designed for the requirements of EMC measurements and is used for evaluating pulse-shaped spurious.

Note: *During a frequency sweep, FSU increments the 1st local oscillator in steps that are smaller than approximately 1/10 of the bandwidth. This is to ensure that the signal level is correctly measured. For narrow bandwidths and wide frequency spans a very large number of measured values is thus obtained. The number of frequency steps, however, always is a multiple of 625 (= number of pixels that can be displayed). With the sample detector selected, only every n^{th} value is displayed. The value of n depends on the number of measured values, ie on the frequency span, the resolution bandwidth and the measurement rate.*

TRACE-DETECTOR submenu

DETECTOR → AUTO SELECT | DETECTOR AUTOPEAK | DETECTOR MAX PEAK | DETECTOR MIN PEAK | DETECTOR SAMPLE | DETECTOR RMS | DETECTOR AVERAGE | DETECTOR QPK

The *DETECTOR* softkey opens a submenu for selecting the detector for the selected trace. The softkey is highlighted if the detector is not selected with *AUTO SELECT*.

The detector can be selected independently for each trace. The *AUTO SELECT* mode selects the optimum detector for each display mode of the trace (Clear/Write, Max Hold or Min Hold).

The softkeys for the detectors are mutually exclusive selection keys.

AUTO SELECT

The *AUTO SELECT* softkey (= default setting) selects the optimum detector for the set display mode of the trace (Clear/Write, Max Hold and Min Hold) and the selected filter mode (bandpass/FFT).

Trace display	**Detector (bandpass)**	**Detector (FFT)**
Clear/Write	Auto Peak	Max Peak
Average	Sample	Sample
Max Hold	Max Peak	Max Peak
Min Hold	Min Peak	Max Peak

The detector activated for the specific trace is identified in the respective trace display field as follows:

Detector	
Auto Peak	AP
Max Peak	PK
Min Peak	MI
Average	AV
RMS	RM
Sample	SA
Quasipeak	QP

IEC/IEEE-bus command `DET:AUTO ON`

DETECTOR AUTO PEAK

The *DETECTOR AUTOPEAK* softkey activates the autopeak detector.

IEC/IEEE-bus command `DET APE`

DETECTOR MAX PEAK

The *DETECTOR MAX PEAK softkey* activates the max peak detector. It is recommended for measurement of impulsive signals.

IEC/IEEE-bus command `DET POS`

DETECTOR MIN PEAK

The *DETECTOR MIN PEAK* softkey activates the min peak detector. Weak sinewave signals become clearly visible in noise using this detector. In case of a composite signal made up of sinewave and impulsive signals, the impulsive signals are suppressed.

IEC/IEEE-bus command `DET NEG`

DETECTOR SAMPLE

The *DETECTOR SAMPLE* softkey activates the sample detector.

It is used for measuring uncorrelated signals such as noise. The power can be determined with the aid of fixed correction factors for evaluation and the logarithmic function.

IEC/IEEE-bus command `DET SAMP`

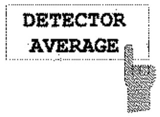
DETECTOR RMS

The *DETECTOR RMS* softkey activates the rms detector.

The rms detector supplies the power of the signal independent of the waveform. For this effect the root mean square of all sampled level values is formed during the sweep of a pixel. The sweep time thus determines the number of averaged values and with increasing sweep time better averaging is obtained. The rms detector is thus an alternative for averaging over several sweeps (see TRACE AVERAGE).

Since the video bandwidth must be at least 10 times the resolution bandwidth (RBW) to ensure that video filtering does not invalidate the rms values of the signal, this ratio is set automatically upon activating the detector.

IEC/IEEE-bus command `DET RMS`



The *DETECTOR AVERAGE* softkey activates the average detector.

In contrast to the rms detector, the average detector supplies the linear average of all sampled level values during the sweep of a pixel.
The same relations as for the rms detector apply (see above).

IEC/IEEE-bus command `DET AVER`

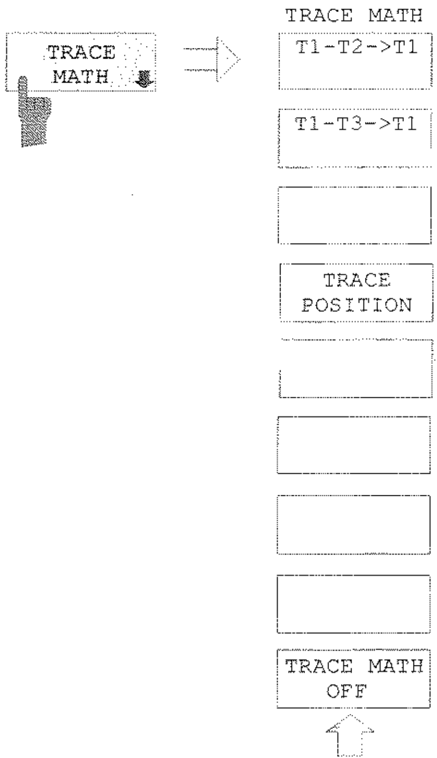
The *DETECTOR QPK* softkey activates the quasipeak detector.

This detector evaluates the sampled level values during the sweep of a pixel like an analog voltmeter.
On switching the quasipeak detector on the video bandwidth is automatically set to 10 MHz so as to exclude the influence of the video filter on the signal evaluation.

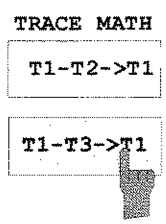
IEC/IEEE-bus command `DET QPE`

Mathematical Functions for Traces

TRACE 1-TRACE MATH submenu:



The *TRACE MATH* softkey opens a submenu in which the difference between the selected trace to trace 1 is calculated. The softkey is highlighted if a math function is activated.



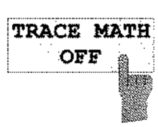
The *T1-T2* and *T1-T3* softkeys subtract the corresponding traces. The result displayed is referred to the zero point defined by *TRACE POSITION*.

To indicate that the trace has been obtained by subtraction, the difference "1 - 2" or "1 - 3" is indicated on the trace info of trace 1 and in the *TRACE* main menu the *TRACE MATH* softkey is highlighted.

IEC/IEEE-bus command `CALC:MATH (TRACE1-TRACE2)`
`CALC:MATH (TRACE1-TRACE3)`

The *TRACE POSITION* softkey activates the entry of the trace position for 0 difference. The position is stated in % of the diagram height.
The range of values extends from -100% to +200%

IEC/IEEE-bus command `DISP:MATH:POS 50PCT`



The *TRACE MATH OFF* softkey switches the math function off.

IEC/IEEE-bus command `CALC:MATH:STAT OFF`

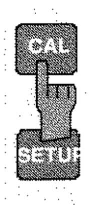
Recording the Correction Data of FSU – *CAL* Key

The FSU obtains its high measurement accuracy through its inbuitl self-alignment method.

The correction data and characteristics required for the alignment are determined by comparison of the results at different settings with the known characteristics of the high-precision calibration signal source of FSU at 128 MHz. The correction data are then available in the instrument as a file and can be displayed by means of the *CAL RESULTS* softkey.
For service purposes the use of correction data can be deactivated by means of the *CAL CORR ON/OFF* softkey. If the correction data recording is aborted, the last complete correction data set is restored.

Note: *The term "Calibration" formerly used for the integrated self alignment was often mistaken for the "true" calibration of the instrument at the test set in production and in service. It is therefore no longer used although it appears in the abbreviated form in the name of keys ("CAL...").*

CAL menu:



CAL TOTAL

CAL ABORT

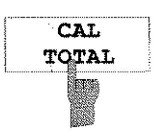
CAL CORR ON OFF

CAL RESULTS

PAGE UP

PAGE DOWN

The *CAL* key opens a menu with the available functions for recording, displaying and activating the data for self alignment.

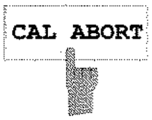


The *CAL TOTAL* softkey starts the recording of correction data of the instrument.

If the correction data recording has failed or if the correction values are deactivated (*CAL CORR = OFF* softkey), the status field indicates

UNCAL.

IEC/IEEE-bus command: `*CAL?`



The *CAL ABORT* softkey interrupts the recording of correction data and restores the last complete correction data set.

IEC/IEEE-bus command: `CAL:ABOR`

The *CAL CORR ON/OFF* softkey switches the calibration data on/off.

ON The status message depends upon the results of the total calibration.

OFF The message *UNCAL* appears in the status line.

IEC/IEEE-bus command: `CAL:STAT ON`

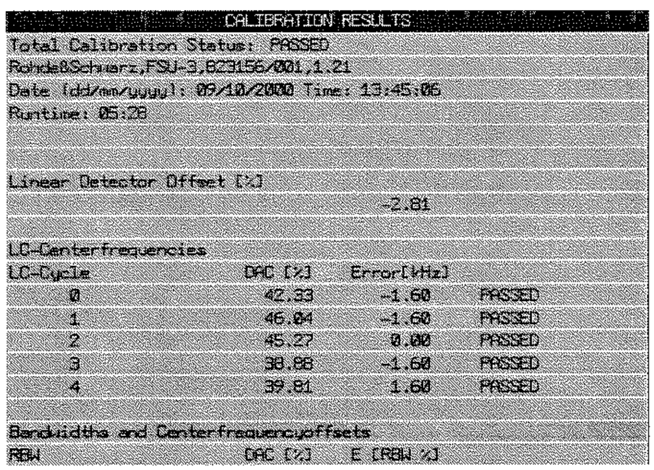
The *CAL RESULTS* softkey calls the *CALIBRATION RESULTS* table, which shows the correction data found during calibration.

The *CALIBRATION RESULTS* table contains the following information:

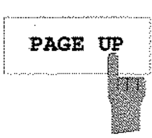
- date and time of last record of correction valuesKorrekturwertaufnahme
- overall results of correction value record
- list of found correction values according to function/module

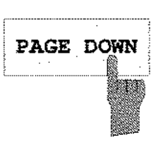
The results have the following meaning:

PASSED	calibration successful without any restrictions
CHECK	deviation of correction value larger than expected, correction could however be performed
FAILED	deviations of correction value too large, no correction was possible. The found correction data are not valid.
ABORTED	calibration aborted



IEC/IEEE-bus command: `CAL:RES?`



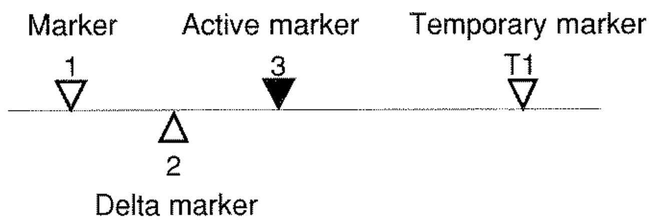


The softkeys *PAGE UP* and *PAGE DOWN* scroll one page forward or backward in the *CALIBRATION RESULTS* table. They have no function when the table is closed.

IEC/IEEE-bus command: --

Markers and Delta Markers – *MKR* Key

The markers are used for marking points on traces, reading out measurement results and for quickly selecting a display section. FSU provides four markers per display window. All markers can be used either as markers or delta markers. The availability of marker functions depends on whether the measurement is performed in the frequency, time or level domain.
The marker that can be moved by the user is defined in the following as the **active marker**.
Examples of marker display:

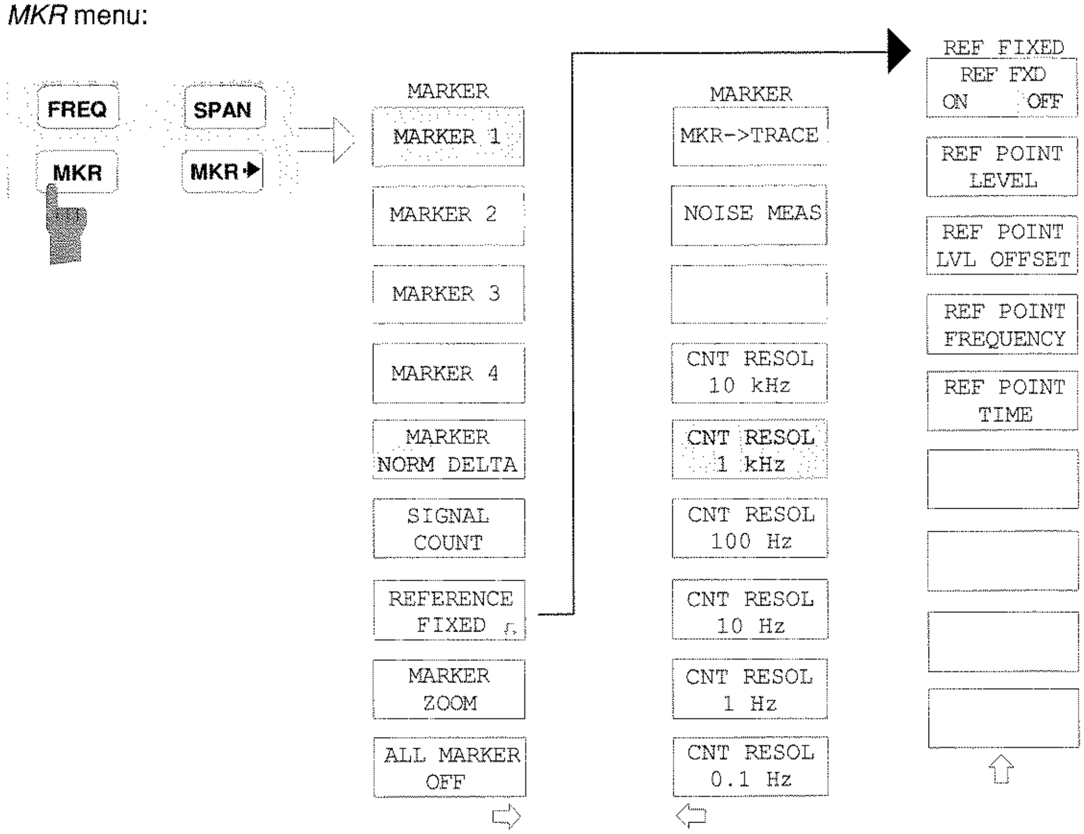


Temporary markers are used in addition to the markers and delta markers to evaluate the measurement results. They disappear when the associated function is deactivated.
The measurement results of the active marker (also called **marker values**) are displayed in the marker field. The marker info field at the upper right of the display shows the marker location (here, frequency), the level and the currently selected trace [T1].

```
MARKER 1 [T1]
 -27.5 dBm
123.4567 MHz
```

The *MKR* key calls a menu that contains all marker and delta marker standard functions. If no marker is active, *MARKER 1* will be enabled and a peak search on the trace carried out. Otherwise, the data entry for the marker activated last is opened.

MKR menu:



MARKER 1

MARKER 4

MARKER NORM DELTA

The *MARKER 1/2/3/4* .softkey selects the corresponding marker and activates it.

MARKER 1 is always the normal marker. After they have been switched on, *MARKERS 2 to 4* are delta markers that refer to *MARKER 1*. These markers can be converted into markers with absolute value display by means of the *MARKER NORM DELTA* softkey. When *MARKER 1* is the active marker, pressing the M*ARKER NORM DELTA* softkey switches on an additional delta marker.

Pressing the *MARKER 1 to 4* softkey again switches off the selected marker.

Example:

[**PRESET**]	FSU is set to the default setting.
[**MKR**]	On calling the menu, *MARKER 1* is switched on ('1' highlighted in the softkey) and positioned on the maximum value of the trace. It is a normal marker and the *MARKER NORMAL* softkey is highlighted.
[*MARKER 2*]	*MARKER 2* is switched on ('2' highlighted in the softkey). It is automatically defined as a delta marker on switching on so the *DELTA* is is highlighted on softkey *MARKER NORM DELTA*. The frequency and level of *MARKER 2* with reference to *MARKER 1* are output in the marker info field.
[MARKER NORM DELTA]	The *MARKER NORM DELTA* softkey is highlighted. *MARKER 2* becomes a normal marker. The frequency and level of *MARKER 2* are output as absolute values in the marker info field.
[MARKER 2]	*MARKER 2* is switched off. *MARKER 1* is the active marker for entry. The frequency and level of *MARKER 1* are output in the marker info field.

IEC/IEEE-bus command:

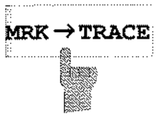
```
CALC:MARK ON;
CALC:MARK:X <value>;
CALC:MARK:Y?

CALC:DELT ON;
CALC:DELT:MODE ABS|REL
CALC:DELT:X <value>;
CALC:DELT:X:REL?
CALC:DELT:Y?
```

When several traces are being displayed, the marker is set to the maximum value (peak) of the active trace which has the lowest number (1 to 3). In case a marker is already located there, it will be set to the frequency of the next lowest level (next peak).

When the split-screen display mode is active, the marker will be placed in the active window. A marker can only be enabled when at least one trace in the corresponding window is visible.

If a trace is turned off, the corresponding markers and marker functions are also deactivated. If the trace is switched on again (*VIEW*, *CLR/WRITE*;..), the markers along with coupled functions will be restored to their original positions provided the markers have not been used on another trace.



The *MKR→TRACE* softkey places the marker on a new trace. The trace is selected via a data entry field. Only those traces can be selected which are visible on the screen in the same window.

Example:
Three traces are presented on the screen. The marker is always on Trace 1 on switching on.

[MKR ->TRACE] *"2"<ENTER>*	The marker jumps to Trace 2 but remains on the previous frequency or time.
[MKR ->TRACE] *"3"<ENTER>*	The marker jumps to Trace 3. '

IEC/IEEE-bus command: `CALC:MARK1:TRAC 1`
`CALC:DELT:TRAC 1`

Frequency Measurement with the Frequency Counter

In order to accurately determine the frequency of a signal, FSU is equipped with a frequency counter which measures the frequency of the RF signal at the intermediate frequency. Using the measured IF, FSU calculates the frequency of the RF input signal by applying the known frequency conversion factors.

The frequency measurement error depends only upon the accuracy of the frequency standard used (external or internal reference). Although FSU always operates synchronously irrespective of the set span, the frequency counter delivers a more exact result than a measurement performed with a marker. This is due to the following:

- The marker measures only the position of the pixel on the trace and infers the frequency of the signal from this value. The trace, however, contains only a limited number of pixels. Depending upon the selected span, each pixel may contain many measurement values, which therefore limits the frequency resolution.
- The resolution with which the frequency can be measured is proportional to the measurement time. For this reason, the bandwidth is normally made as wide as possible and the sweep time as short as possible. This results in a loss of frequency resolution.

For the measurement with the frequency counter, the sweep is stopped at the reference marker, the frequency is counted with the desired resolution and then the sweep is allowed to continue.

SIGNAL COUNT

The *SIGNAL COUNT* softkey switches the frequency counter on/off.

The frequency is counted at the position of the reference marker (*MARKER* 1). The sweep stops at the reference marker until the frequency counter has delivered a result. The time required for a frequency measurement depends on the selected frequency resolution. The resolution is set in the side menu.

If no marker is enabled when the *SIGNAL COUNT* softkey is pressed, *MARKER 1* is switched on and set at the largest signal.

In addition, the *SIGNAL COUNT* function is displayed in the marker info field on the screen with [Tx CNT].

```
MARKER 1 [T1 CNT]
  -27.5 dBm
 23.4567891 MHz
```

Switching the *SIGNAL COUNT* function off is accomplished by pressing the softkey again.

IEC/IEEE-bus command: `CALC:MARK1:COUN ON;`
`CALC:MARK:COUN:FREQ?`

MARKER NEXT menu

The resolution of the frequency counter is set in the *NEXT* menu of the MARKER menu. FSU offers counter resolutions between 0.1 Hz and 10 kHz.

MARKER

CNT RESOL 10 kHz

CNT RESOL 1 kHz

CNT RESOL 100 Hz

CNT RESOL 10 Hz

CNT RESOL 1 Hz

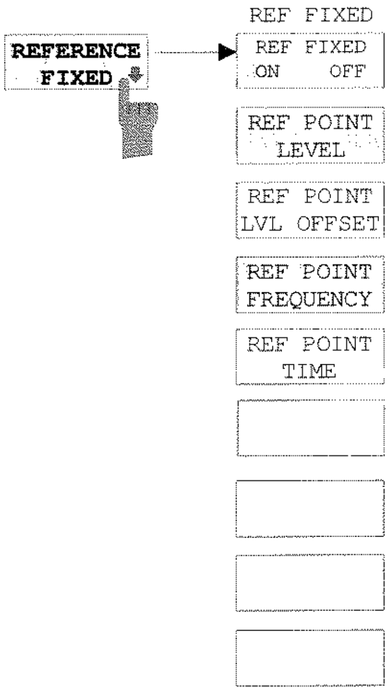
CNT RESOL 0.1 Hz

The *CNT RESOL ...* softkeys select the counter resolution. They are selection switches, i.e. only one of the can be active at any one time.
The marker stop time, ie the frequency measurement time, depends on the selected resolution.

IEC/IEEE-bus command: `CALC:MARK1:COUN:RES <value>`

Measurement example:
The frequency of a CW signal is to be determined by means of the frequency counter with a resolution of 10 Hz.

[PRESET]	FSU is set to the default setting.
[MARKER]	*MARKER 1* is switched on and set to the maximum value of the displayed spectrum.
[*SIGNAL COUNT*]	The frequency counter is switched on. FSU counts the frequency of the signal at the marker position with a resolution of 1 kHz. The counted frequency is indicated in the marker info field.
[*NEXT*]	Changes to the submenu for setting the counter resolution.
[*CNT RESOL 10 Hz*]	The frequency counter resolution is increased to 10 Hz.

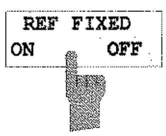


The *REFERENCE FIXED* softkey defines the level and the frequency or time of *MARKER 1* as a reference for one or several delta markers. The measured values for one or several markers displayed in the marker info field are derived from this reference point instead of the current values of the reference marker (*MARKER* 1).

On actuating the softkey, reference fixed is switched on and thus, the level value and the frequency, time or x-level value of *MARKER 1* immediately become the reference point.

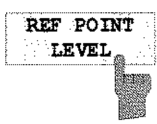
Additionally, the *REFERENCE FIXED* softkey opens the submenu where it is possible to determine manually a reference point with level and frequency, time or x-axis level, to define a level offset or deactivate the reference point.

The *REFERENCE FIXED* function is useful for the measurement of the harmonic suppression at small span (fundamental not represented).



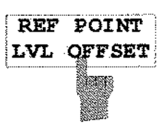
The *REF FXD ON/OFF* softkey switches on or off the relative measurement to a fixed reference value (*REFERENCE POINT*) independent of the trace.

IEC/IEEE-bus command: `CALC:DELT2:FUNC:FIX ON`



The *REF POINT LEVEL* softkey enters a reference level independent of the reference marker level. All relative level values of the delta markers refer to this reference level.

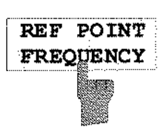
IEC/IEEE-bus command:
`CALC:DELT2:FUNC:FIX:RPO:Y -10dBm`



The *REF POINT LVL OFFSET* softkey specifies a level offset relevant to the reference level. The relative level values of the delta markers refer to the reference point level plus the level offset.

The level offset is set to 0 dB on enabling the *REFERENCE FIXED* or *PHASE NOISE* function.

IEC/IEEE-bus command:
`CALC:DELT2:FUNC:FIX:RPO:Y:OFFS 0dB`



With the *REF POINT FREQUENCY* softkey a reference frequency can be manually activated for the delta markers when the *REFERENCE FIXED* or *PHASE NOISE* function is used.

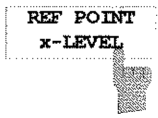
IEC/IEEE-bus command:
`CALC:DELT2:FUNC:FIX:RPO:X 10.7MHz`

The *REF POINT TIME* softkey activates the entry box for the input of a reference time for the *REFERENCE FIXED* function in the time domain (span = 0 Hz).

IEC/IEEE-bus command:

```
CALC:DELT2:FUNC:FIX:RPO:X 5MS
```

For phase noise measurement, input of reference time is not possible.



The *REF POINT x-LEVEL* softkey activates the entry box for the input of a reference level on the x-axis for the *REFERENCE FIXED* function when the power sweep is active.

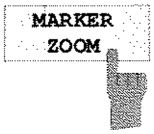
IEC/IEEE-bus command:

```
CALC:DELT2:FUNC:FIX:RPO:X -5DBM
```

Measurement example:

Small-span harmonics measurement to increase sensitivity
CW signal (eg 100 MHz, 0 dBm) with harmonics at the RF input of FSU.

[**PRESET**]	FSU is set to the default setting.
[**CENTER**: 100 **MHz**]	The center frequency of FSU is set to 100 MHz.
[**SPAN**: 1 **MHz**]	The span is set to 1 MHz.
[**AMPL**: 3 **dBm**]	The reference level is set to 3 dBm (3 dB above the expected RF level).
[**MKR**]	*MARKER* 1 is switched on ('1' highlighted in the softkey) and set to the signal peak.
[*MARKER 2*]	*MARKER 2* is switched on and automatically defined as the delta marker (*DELTA* is highlighted on *MARKER NORM DELTA* softkey).
[*REFERENCE FIXED*]	The frequency and level of *MARKER 1* are a reference for the delta marker.
[**CENTER**: 200 **MHz**]	The center frequency is set to 200 MHz (= frequency of the 2nd harmonic). The reference level may have to be reduced to see the 2nd harmonic from the noise. This does not affect the reference level set with *REFERENCE FIXED.*
[**MKR->**: *PEAK*]	The delta marker jumps to the 2nd harmonic of the signal. The level spacing of the harmonic to the fundamental is displayed in the marker info field.



The *MARKER ZOOM* softkey expands the area around MARKER 1. With the zoom function, more details of the spectrum can be seen. The desired display range can be defined in an entry window.
The following sweep is stopped at the position of the reference marker. The frequency of the signal is counted and the measured frequency becomes the new center frequency. The zoomed display range is then configured and the new settings are used by FSU for further measurements.

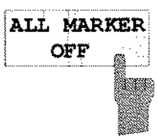
As long as switching to the new frequency display range has not yet taken place, pressing the softkey will abort the procedure.

If *MARKER 1* is not active when the softkey is pressed, it is automatically activated and set to the highest peak in the window.

If an instrument setting is changed after selection of *MARKER ZOOM*, the function is aborted.

The *MARKER ZOOM* softkey is only available in the frequency domain (span > 0).

IEC/IEEE-bus command: `CALC:MARK1:FUNC:ZOOM 1kHz`



The *ALL MARKER OFF* softkey switches off all markers (reference and delta markers). It also switches off all functions and displays associated with the markers/delta markers.

IEC/IEEE-bus command: `CALC:MARK:AOFF`

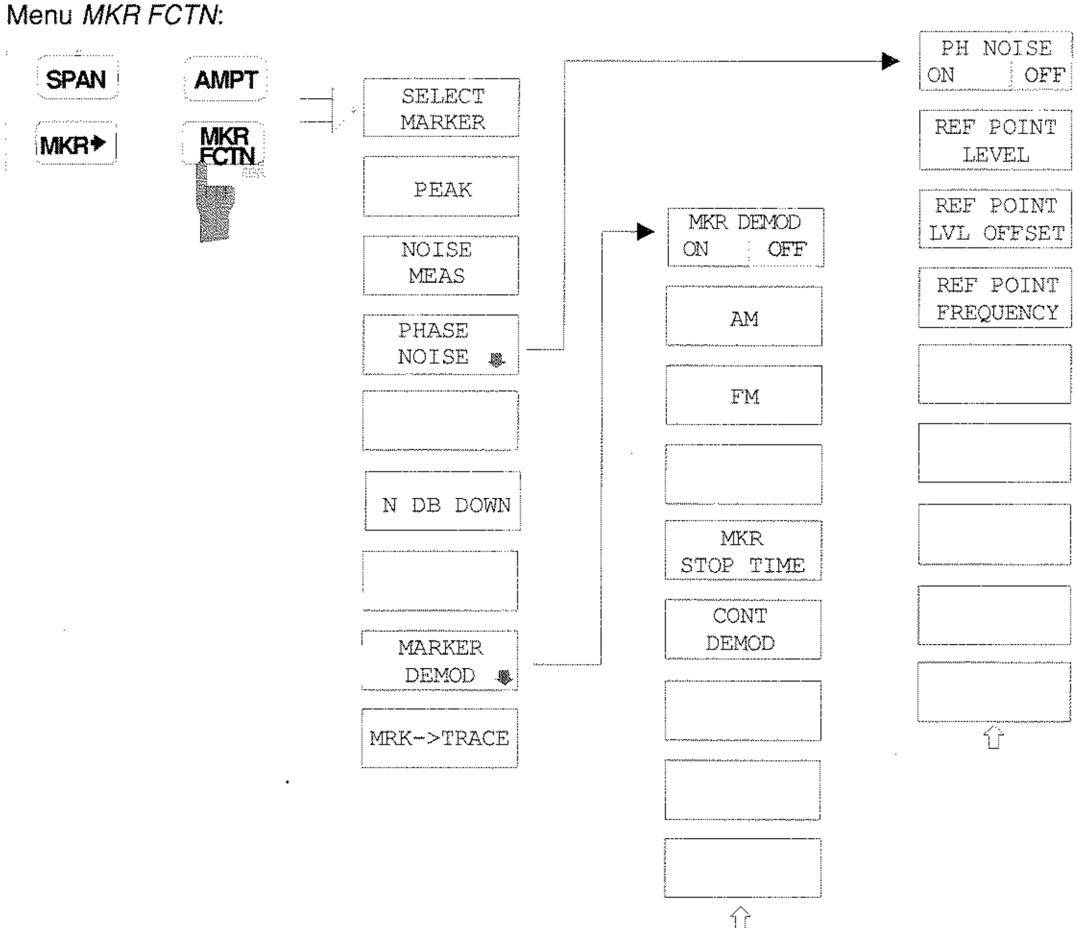
Marker Functions – *MKR FCTN* Key

The MKR FCTN menu offers further measurements with the markers:

- Measurement of noise density (*NOISE MEAS* softkey)
- Measurement of phase noise (*PHASE NOISE* softkey)
- Measurement of filter or signal bandwidth (*N DB DOWN* softkey)
- Activating of AF demodulation (*MARKER DEMOD* softkey)

On calling the menu, the entry for the last active marker is activated (*SELECT MARKER* softkey); if no marker is activated, marker 1 is activated and a maximum search (*PEAK* softkey) is performed. The marker can be set to the desired trace by means of *MKR -> TRACE* softkey.

Menu *MKR FCTN*:



Activating the Markers

Menu *MKR FCTN*:

SELECT MARKER

The *SELECT MARKER* softkey activates the numerical selection of the marker in the data entry field. Delta marker 1 is selected by input of ' 0 '.
If the marker is switched off, then it is switched on and can be moved later on.

IEC/IEEE-bus command: `CALC:MARK1 ON;`
`CALC:MARK1:X <value>;`
`CALC:MARK1:Y?`

PEAK

The *PEAK* softkey sets the active marker/delta marker to the peak of the trace.

IEC/IEEE-bus command: `CALC:MARK1:MAX`
`CALC:DELT1:MAX`

Measurement of noise density

NOISE MEAS

The *NOISE MEAS* softkey switches the noise measurement for the active marker on or off. The corresponding marker becomes the *NORMAL* marker.

During noise measurement, the noise power density is measured at the position of the marker. In the time domain mode, all points of the trace are used to determine the noise power density. When measurements are performed in the frequency domain, two points to the right and left of the marker are used for the measurement to obtain a stable result.
The noise power density is indicated in the marker field. With a logarithmic amplitude units (dBm, dBmV, dBmμV, dBμA) the noise power density is output in dBm/Hz ie as level in 1 Hz bandwidth with reference to 1 mW. With linear amplitude units (V, A, W) the noise voltage density is evaluated in μV/√Hz, the noise current density in μA/√Hz or the noise power density in μW/Hz.

The following settings have to be made to ensure that the power density measurement yields correct values:

Detector: Sample or RMS

Video bandwidth:

- ≤ 0.1 x resolution bandwidth with sample detector (corresponds to RBW / VBW NOISE)
- ≥ 3 x resolution bandwidth with RMS detector (corresponds to RBW / VBW SINE)

In the default setting, FSU uses the sample detector for the noise function.

With the sample detector, the trace can additionally be set to AVERAGE to stabilize the measured values. With RMS detector used, trace averaging must not be used since in this case it produces too low noise levels which cannot be corrected. Instead, the sweep time can be increased to obtain stable measurement results.

The FSU uses the following correction factors to evaluate the noise density from the marker level:

- Since the noise power is indicated with reference to 1 Hz bandwidth, the bandwidth correction value is deducted from the marker level. It is 10 x lg (1Hz/BW_{Noise}), where BW_{Noise} is the noise or power bandwidth of the set resolution filter (RBW).

Sample detector:

- As a result of video filter averaging and trace averaging, 1.05 dB is added to the marker level. This is the difference between the average value and the rms value of white noise.
- With a logarithmic level axis, 1.45 dB is added additionally. Logarithmic averaging is thus fully taken into account which yields a value that is 1.45 dB lower than that of linear averaging.

RMS detector:

- With the exception of bandwidth correction, no further corrections are required for the RMS detector since it already indicates the power with every point of the trace.

To allow a more stable noise display the adjacent (symmetric to the measurement frequency) points of the trace are averaged.

In time domain mode, the measured values are averaged versus time (after a sweep).

IEC/IEEE-bus command: `CALC:MARK:FUNC:NOIS ON;`
`CALC:MARK:FUNC:NOIS:RES?`

Example: Measurement of inherent FSU noise

[**PRESET**] FSU is set to default setting.

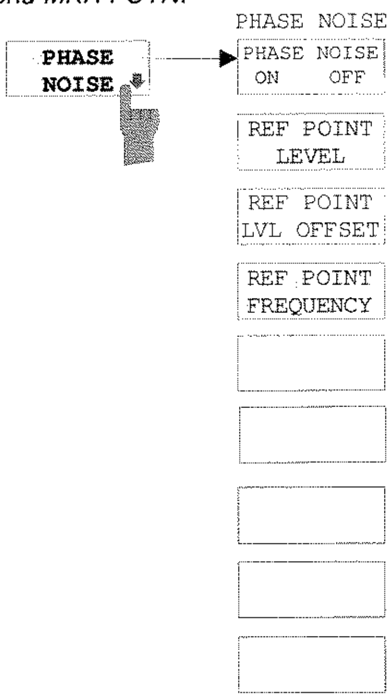
[**MARKER**] Marker 1 is switched on and set to the maximum value of the displayed spectrum. Set marker to desired frequency using the rotary knob.

[***NOISE***] The FSU switches the sample detector on and sets the video bandwidth to 300 kHz (0.1 x RBW). The power density level of inherent noise is displayed in dBm/Hz in the marker info field.

Note: *The FSU noise figure can be calculated from the measured power density level. It is calculated by deducting the set RF attenuation (RF Att) from the displayed noise level. 174 is to be added to the result to obtain the FSU noise figure.*

Phase Noise Measurement

Menu MKR FCTN:



The *PHASE NOISE* softkey switches the *PHASE NOISE* function on/off. Additionally, the softkey opens the submenu for manually setting the reference point. The phase noise measurement can be switched off in the submenu.

MARKER 1 (= reference marker) is used as a reference for the phase noise measurement. The frequency and level of the reference marker are used as fixed reference values, ie the *REFERENCE FIXED* function is activated. After switching on the phase noise measurement the reference level or the center frequency can thus be set in a way that the carrier is outside the displayed frequency range, or, for example, a notch filter is switched on to suppress the carrier.
A noise power density measurement is carried out with the delta marker or delta markers. This measurement corresponds to the NOISE function in the *MARKER* menu (MKR). The result of the phase noise measurement is the difference in level between the reference point and the noise power density.

The following possibilities can be selected on switching on *PHASE NOISE*:

1. No marker enabled:

[**MKR FCTN**]	*MARKER 1* is enabled and set to peak.
[*PHASE NOISE*]	*MARKER 1* becomes the reference marker, *MARKER 2* the delta marker; frequency = frequency of the reference marker. The delta marker is the active marker, ie it can be moved with the rollkey or adjusted by entering numerals. The *PHASE NOISE* function is switched on and the measured value is output.

2. Markers are enabled:

[**MKR FCTN**]	The previous marker configuration remains unchanged.
[*PHASE NOISE*]	*MARKER* 1 becomes the reference marker. If other markers are enabled, they become delta markers and measure the phase noise at their respective positions.

If further markers are enabled during the phase noise measurement, they automatically become delta markers and measure the phase noise at their respective positions.

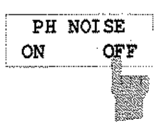
When the phase noise measurement is switched off, the marker configuration remains unchanged and the delta markers measure the relative level to the reference marker (*MARKER 1*).

The *PHASE NOISE* function measures the noise power at the delta markers referred to 1 Hz bandwidth. The sample detector is automatically used and the video bandwidth set to 0.1 times the resolution bandwidth (RBW). The two settings are taken into account in the correction values used for the noise power measurement.
To obtain stable results, two pixels on the right and the left of the respective delta marker position are taken for the measurement. The procedure for determining the noise power is identical to the method used for the noise power measurement (see NOISE softkey). The measured noise level referred to 1 Hz bandwidth is subtracted from the carrier level at the reference marker (*MARKER 1*). The measured values are displayed in the delta marker field in dBc/Hz (= spacing in dB of the noise power from the carrier level in 1 Hz bandwidth).

If several delta markers are enabled, only the value read by the active marker is shown in the marker field. If several delta markers are active, their measurement results are shown in the marker info field.

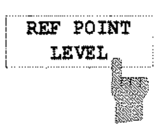
The reference value for the phase noise measurement can be defined with *REF POINT LEVEL*, *REF POINT FREQUENCY* and *REF POINT LVL OFFSET* to differ from that of the reference marker.

IEC/IEEE-bus command: --



The *PH NOISE ON/OFF* softkey switches on/off the phase noise measurement. Switching on is performed by means of the *PHASE NOISE* softkey and is only necessary when the phase noise measurement has been switched off in the submenu.

IEC/IEEE-bus command: `CALC:DELT1:FUNC:PNO ON`
`CALC:DELT1:FUNC:PNO:RES?`



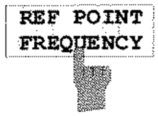
The *REF POINT LEVEL* softkey activates an entry box for the input of a reference level other than the reference marker level. The function is identical to that of the softkey with the same name in the marker menu (MKR).

IEC/IEEE-bus command:
`CALC:DELT1:FUNC:FIX:RPO:Y -10dB`

The *REF POINT LVL OFFSET* softkey activates an entry box for the input of an additional level offset for the phase noise calculation.

This level offset is set to 0 dB on when the *REFERENCE FIXED* or *PHASE NOISE* function is enabled.

IEC/IEEE-bus command:
`CALC:DELT:FUNC:FIX:RPO:Y:OFFS 10dB`



The *REF POINT FREQUENCY* softkey activates an entry box for the manual input of a reference frequency for the *REFERENCE FIXED* or *PHASE NOISE* function.

IEC/IEEE-bus command:
`CALC:DELT1:FUNC:FIX:RPO:X 10.7MHz`

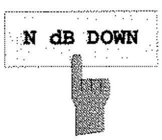
Measurement example:

The phase noise of a CW signal at 100 MHz with 0 dBm level is to be measured at 800 kHz from the carrier

[**PRESET**]	FSU is set to the default setting.
[**CENTER**: 100 **MHz**]	The center frequency is set to 100 MHz.
[**SPAN**: 2 **MHz**]	The span is set to 2 MHz.
[**AMPT**: 0 **dBm**]	The reference level is set to 0 dBm.
[**MKR FCTN**]	*MARKER 1* is switched on and positioned at the maximum of the displayed trace.
[*PHASE NOISE*: 800 **kHz**]	The phase noise measurement is switched on. The delta marker is positioned on the main marker and the measured phase noise value is displayed in the marker info field. The sample detector is used and the video bandwidth is set to 0.1 x RBW. When the phase noise measurement function is enabled, the entry of the delta marker frequency is activated. It can be entered directly.

Measurement of the Filter or Signal Bandwidth

Menu *MKR FCTN*:



The *N dB DOWN* softkey activates the temporary markers T1 and T2 which are n dB below the active reference marker. Marker T1 is placed to the left and marker T2 at the right of the reference marker. The value n can be input in a window.

The default setting is 3 dB.

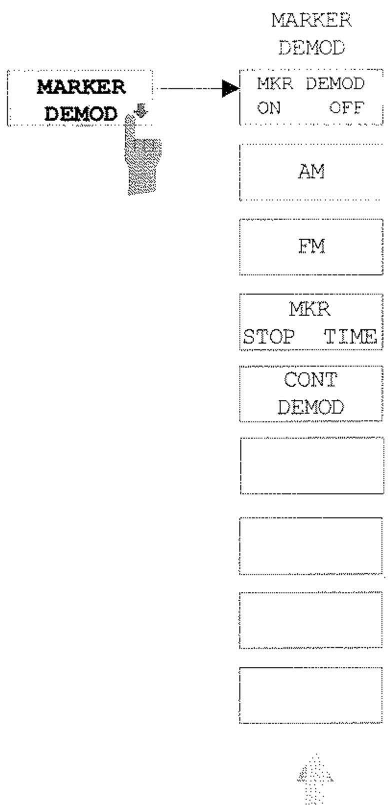
The frequency spacing of the two temporary markers is indicated in the marker info field.
If, for example, it is not possible to form the frequency spacing for the n dB value because of the noise display, dashes are indicated instead of a measured value.

IEC/IEEE-bus command:
```
CALC:MARK1:FUNC:NDBD:STAT ON
CALC:MARK1:FUNC:NDBD 3dB
CALC:MARK1:FUNC:NDBD:RES?
CALC:MARK1:FUNC:NDBD:FREQ?
```

AF Demodulation

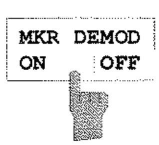
The FSU provides demodulators for AM and FM signals. With these demodulators, a displayed signal can be identified acoustically through the use of the internal loudspeaker or with headphones. The frequency at which the demodulation is enabled is coupled to the markers. The sweep stops at the frequency determined by the active marker for the selected time and the RF signal is demodulated. During a measurement in the time domain (span = 0 Hz) the demodulation is continuously on.
The threshold line (*MKR->SEARCH LIMITS:THRESHOLD*) performs a squelch function in the demodulator. If the threshold is set, the FSU LF demodulation is switched on only when the signal to be demodulated exceeds the set threshold.

Menu *MKR FCTN*:



The *MARKER DEMOD* softkey switches on the audio demodulator and calls a submenu in which the demodulation mode and the duration of the demodulation can be selected.

IEC/IEEE-bus command: `CALC:MARK1:FUNC:DEM ON`



The *MKR DEMOD ON/OFF* softkey switches the demodulation on/off.

In the frequency range (span >0), the frequency scan is stopped at the frequency of the active marker with demodulation switched on – provided that the level is above the threshold line - and the signal is demodulated during the given stop time.
In the time domain (span = 0) demodulation is continuous, ie not only active at the marker position.

IEC/IEEE-bus command: `CALC:MARK1:FUNC:DEM ON`

MKR STOP TIME

The *MKR STOP TIME* softkey defines the stop time for demodulation at the marker or markers.

FSU stops the sweep at the marker or markers for the duration of the defined stop time and then switches the demodulation on (see also *MKR DEMOD ON/OFF*).

IEC/IEEE-bus command: `CALC:MARK1:FUNC:DEM:HOLD 3s`

AM

FM

The softkeys *AM and FM* are selector switches one of which only may be active at a time. They set the desired demodulation mode FM or AM. Default setting is AM.

IEC/IEEE-bus command: `CALC:MARK1:FUNC:DEM:SEL AM`
`CALC:MARK1:FUNC:DEM:SEL FM`

MKR STOP TIME

The *MKR STOP TIME* softkey defines the stop time for demodulation at the marker(s).
The FSU interrupts the frequency sweep at the marker position and activates the demodulation for the duration of the stop time (see also *MKR DEMOD ON/OFF*).
In the time domain (span = 0) the demodulation is continuously active irrespective of the stop time set.

IEC/IEEE-bus command: `CALC:MARK1:FUNC:DEM:HOLD 3s`

CONT DEMOD

The *CONT DEMOD* softkey switches on the continuous demodulation in the frequency domain. If the sweep time is long enough, the set frequency range can be monitored acoustically.

IEC/IEEE-bus command: `CALC:MARK1:FUNC:DEM:CONT ON`

Selecting the Trace

Menu *MKR FCTN*:

MRK → TRACE

The *MKR→TRACE* softkey sets the active marker to different traces. Only those traces can be selected which are visible on the screen in the same window.

The function of the softkey is identical to that of the softkey with the same name in the MKR-> menu.

Example:
Three traces are displayed on the screen. The marker is always on Trace 1 on switching on.

[*MKR ->TRACE*]
"1"<ENTER> The marker jumps to Trace 2, but remains at the previous frequency or time.

[*MKR ->TRACE*]
"3"<ENTER> The marker jumps to Trace 3.

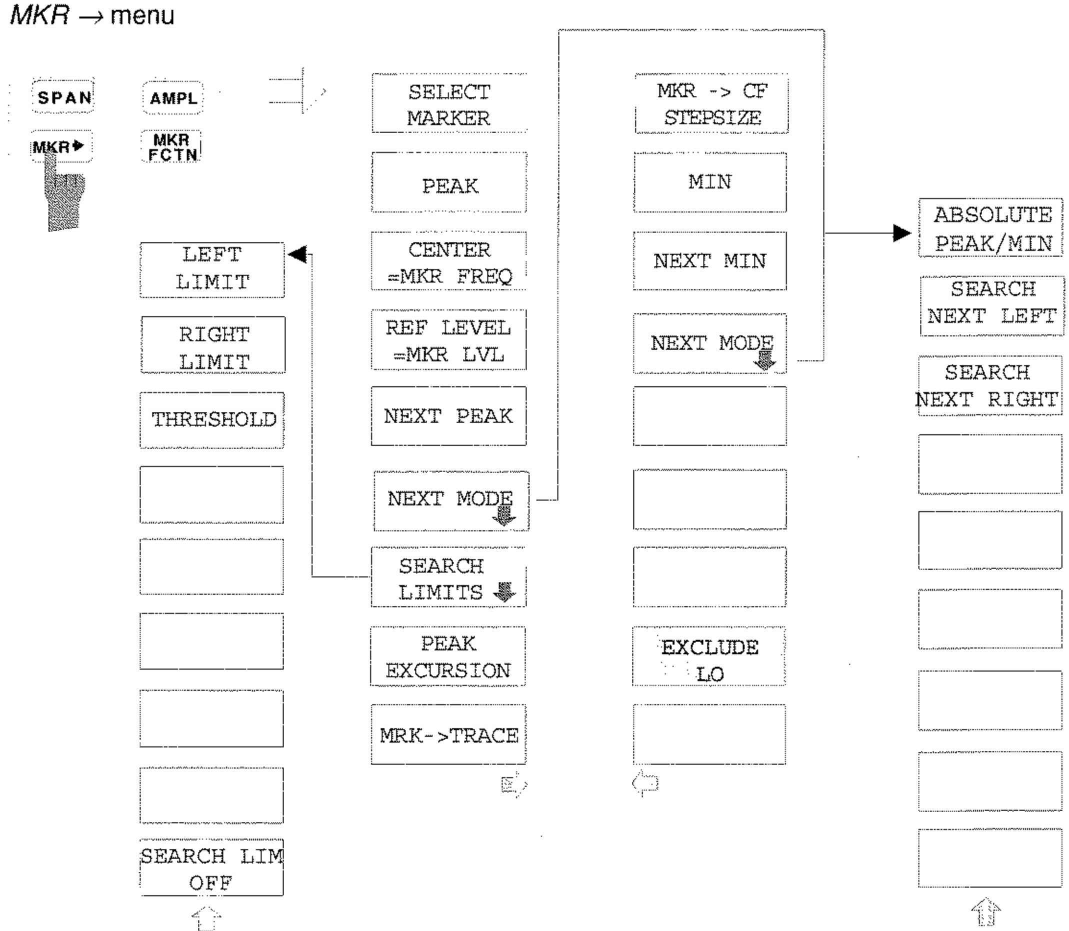
IEC/IEEE-bus command: `CALC:MARK:TRAC 2`

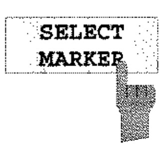
Change of Settings via Markers – *MKR* ⇒ Key

The *MKR* → menu offers functions through which instrument parameters can be changed with the aid of the currently active marker. The functions can be used on markers and delta markers.

On opening the menu, the entry for the last active marker is activated; if no marker was enabled, *MARKER 1* is activated and a peak search is performed.

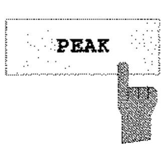
MKR → menu





The *SELECT MARKER* softkey activates the numerical selection of the marker in the data entry field. Delta marker 1 is selected by input of ' 0 '.

IEC/IEEE-bus command: `CALC:MARK1 ON;`
`CALC:MARK1:X <value>;`
`CALC:MARK1:Y?`



The *PEAK* softkey sets the active marker or delta marker to the peak of the trace.
If no marker is active when **MKR->** menu is called, *MARKER 1* is automatically switched on and the peak search is performed.

IEC/IEEE-bus command: `CALC:MARK:MAX`
`CALC:DELT:MAX`

The *CENTER = MKR FREQ* softkey sets the center frequency to the current marker or delta marker frequency.
A signal can thus be set to the center of the frequency display range, for example, so that it can then be examined in detail with a smaller span.

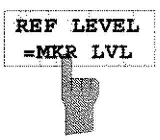
The softkey is not available in the time domain (zero span).

IEC/IEEE-bus command: `CALC:MARK:FUNC:CENT`

Example:

A spectrum is displayed with a large span after PRESET. A signal off the center is to be examined in detail:

[**PRESET**]	FSU is set to the default setting.
[**MKR->**]	*MARKER 1* is switched on and automatically jumps to the largest signal of the trace.
[*CENTER =MKR FREQ*]	The center frequency is set to the marker frequency. The span is adapted in such a way that the minimum frequency (= 0 Hz) or the maximum frequency is not exceeded.
[*SPAN*]	The span can, for example, be reduced using the rollkey.



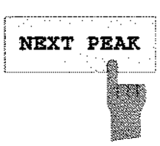
The *REF LEVEL = MKR LVL* softkey sets the reference level to the current marker level.

IEC/IEEE-bus command: `CALC:MARK:FUNC:REF`

Example:

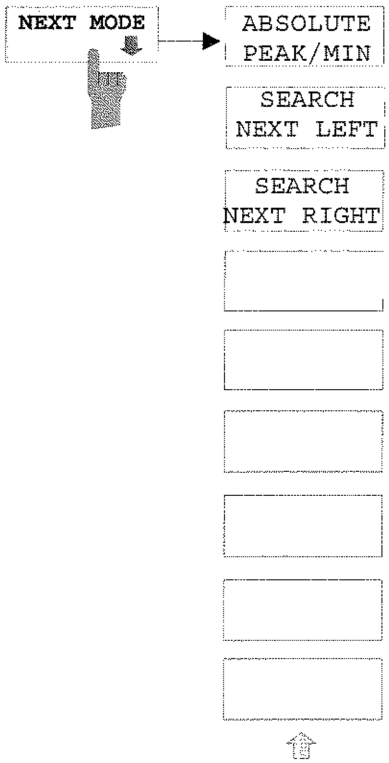
A spectrum is displayed with a large span after PRESET. A signal off the center is to be examined in detail:

[**PRESET**]	FSU is set to the default setting.
[**MKR->**]	*MARKER 1* is switched on and automatically jumps to the largest signal of the trace.
[*CENTER =MKR FREQ*]	The center frequency is set to the marker frequency. The span is adapted in such a way that the minimum frequency (= 0 Hz) or the maximum frequency is not exceeded.
[*REF LEVEL = MKR LVL*]	The reference level is set to the measured marker level.
[**SPAN**]	The span can, for example, be reduced using the rollkey.



The *NEXT PEAK* softkey sets the active marker/delta marker to the next lower peak value on the trace. The search direction is defined in the *NEXT MODE* submenu (see below).

IEC/IEEE-bus command: `CALC:MARK:MAX:NEXT`
`CALC:DELT:MAX:NEXT`



The *NEXT MODE* softkey opens a sub menu for definition of the search direction for *NEXT PEAK and NEXT MIN.*

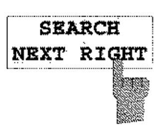
The softkeys are selection switches, ie only one of them can be active at any one time.

The *ABSOLUTE PEAK/MIN* softkey defines that the next higher maximum or minimum is searched for on the whole trace.

IEC-Bus-Befehle:
```
CALC:MARK:MAX:NEXT
CALC:DELT:MAX:NEXT
CALC:MARK:MIN:NEXT
CALC:DELT:MIN:NEXT
```

The *SEARCH NEXT LEFT* softkey defines that the next higher maximum or minimum on the left of the active marker is searched for, ie only frequencies or time values smaller than the current marker frequency or time are taken into account.

IEC-Bus-Befehle:
```
CALC:MARK:MAX:LEFT
CALC:DELT:MAX:LEFT
CALC:MARK:MIN:LEFT
CALC:DELT:MIN:LEFT
```



The *SEARCH NEXT RIGHT* softkey defines that the the next higher maximum or minimum on the right of the active marker is searched for, ie only frequencies or time values higher than the current marker frequency or time are taken into account.

IEC-Bus-Befehle:
```
CALC:MARK:MAX:RIGH
CALC:DELT:MAX:RIGH
CALC:MARK:MIN:RIGH
CALC:DELT:MIN:RIGH
```

SEARCH LIMITS → LEFT LIMIT | RIGHT LIMIT | THRESHOLD | SEARCH LIM OFF

The *SEARCH LIMITS* softkey limits the search range for maximum or minimum search. The softkey switches to a submenu in which the search range limits can be set in the x and y direction.

LEFT LIMIT

RIGHT LIMIT

The *LEFT LIMIT* und *RIGHT LIMIT* softkeys define the two vertical lines F1 and F2 in the frequency domain (span > 0) and T1 / T2 in the time domain (span = 0). The search is performed between these lines in the frequency and time domain
If only one line is enabled, line F1/T1 is the lower limit and the upper limit corresponds to the stop frequency. If F2/T2 is also enabled, it determines the upper limit.

IEC/IEEE-bus command: `CALC:MARK:X:SLIM:LEFT 1MHZ`
`CALC:MARK:X:SLIM:RIGH 10MHZ`
`CALC:MARK:X:SLIM ON`

THRESHOLD

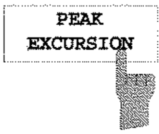
The *THRESHOLD* softkey defines the threshold line.
The threshold line represents a limit for the level range of the max. search at the lower end and that of the min. search at the upper end.

IEC/IEEE-bus command: `CALC:THR -20dBm`
`CALC:THR ON`

SEARCH LIMIT OFF

The *SEARCH LIMIT OFF* softkey disables all limits of the search range.

IEC/IEEE-bus command: `CALC:MARK:X:SLIM OFF`
`CALC:THR OFF`



The *PEAK EXCURSION* softkey activates an entry box for selecting the minimum amount by which a signal level must decrease/increase before it is recognized by the *NEXT PEAK* and *NEXT MIN* search functions as a maximum or minimum.

Input values from 0 to 80 dB are allowed, the resolution being 0.1 dB.

IEC/IEEE-bus command: `CALC:MARK:PEXC 10dB`

The peak excursion is preset to 6 dB. This is sufficient for the *NEXT PEAK* (or *NEXT MIN*) functions in the *NEXT MODE ABS* setting as always the next smaller (or larger) signal is searched for.

In the *SEARCH NEXT LEFT* or *SEARCH NEXT RIGHT* setting, functions *NEXT PEAK* and *NEXT MIN* search for the next relative maximum or minimum on the right or left of the current marker position irrespective of the instantaneous signal amplitude. A relative maximum is given when the signal amplitude on both sides of the maximum is reduced by a certain amount, ie the peak excursion.
The preset 6 dB level change can already be reached by the noise indication of the analyzer. Noise maxima are identified as peaks. In this case, *PEAK EXCURSION* has to be selected with a higher value than the difference between the highest and lowest noise indication values.

The following example shows the effect of different *PEAK EXCURSION* settings.

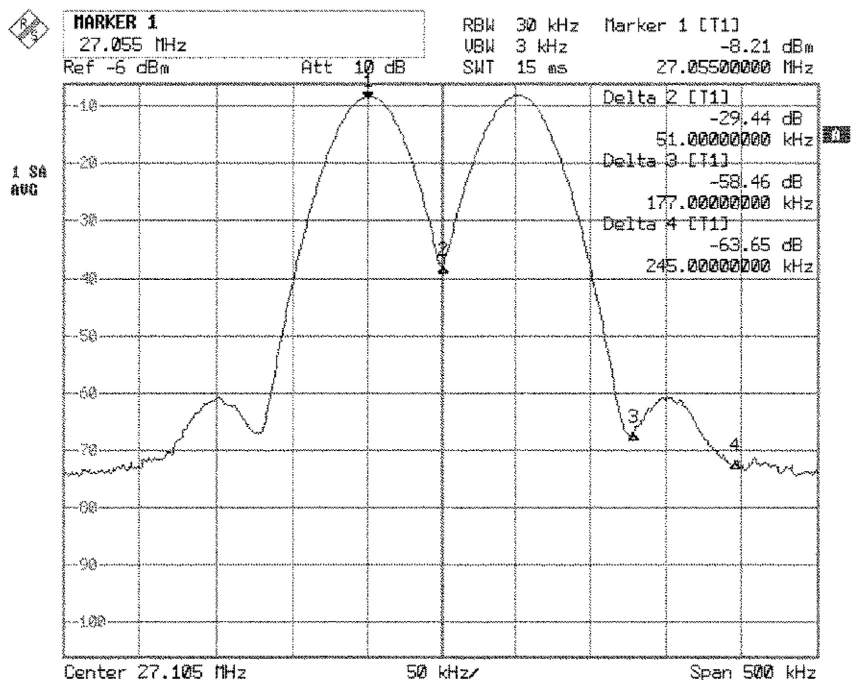


Fig. 4-7 Example for level measurements at different peak excursion settings

Maximum relative level change of the measured signals:

Signal 2:	42 dB
Signal 3	30 dB
Signal 4:	46 dB

The setting **Peak Excursion 40 dB** causes signals 2 and 4 to be detected with *NEXT PEAK* or *NEXT PEAK RIGHT*. Signal 3 is not detected since it only decreases by 30 dB before the level rises again.

Order of signals found:

PEAK:	Signal 1
NEXT PEAK:	Signal 2
NEXT PEAK:	Signal 4

or

PEAK:	Signal 1
NEXT PEAK RIGHT:	Signal 2
NEXT PEAK RIGHT:	Signal 4

The setting **Peak Excursion 20 dB** causes signal 3 to be detected as well since its highest level change of 30 dB is now higher than the set peak excursion.

Order of signals found:

PEAK:	Signal 1
NEXT PEAK:	Signal 2
NEXT PEAK:	Signal 4
NEXT PEAK:	Signal 3

or

PEAK:	Signal 1
NEXT PEAK RIGHT:	Signal 2
NEXT PEAK RIGHT:	Signal 3
NEXT PEAK RIGHT:	Signal 4

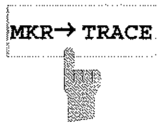
The setting **Peak Excursion 6 dB** detects all the signals, *NEXT PEAK RIGHT* does not work as required.

Order of signals found:

PEAK:	Signal 1
NEXT PEAK:	Signal 2
NEXT PEAK:	Signal 4
NEXT PEAK:	Signal 3

or

PEAK:	Signal 1
NEXT PEAK RIGHT:	Marker in noise between signal 1 and signal 2
NEXT PEAK RIGHT:	Marker in noise between signal 1 and signal 2



The *MKR→TRACE* softkey sets the active marker to a new trace. If only one trace is available on the screen, the softkey does not appear. If several traces are available on the screen, only these are offered.

IEC/IEEE-bus command: `CALC:MARK:TRAC 2`

Example:

Three traces are displayed on the screen. The marker is always on Trace 1 after switching on.

[*MKR ->TRACE] "2" <ENTER>*	The marker jumps to Trace 2 but remains at the previous frequency or time.
[*MKR ->TRACE*] "3" *<ENTER>*	The marker jumps to Trace 3.

The *MKR→CF STEPSIZE* softkey sets the step size for the center frequency variation to the current marker frequency, and also sets step size adaptation to *MANUAL. CF STEPSIZE* remains at this value until the center frequency entry mode in the STEP menu is switched from *MANUAL* to *AUTO* again.

The *MKR→CF STEPSIZE* function is, above all, useful in the measurement of harmonics with large dynamic range (narrow bandwidth and narrow span).

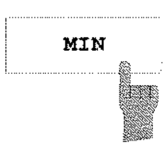
The softkey is not available in the time domain (span = 0 Hz).

IEC/IEEE-bus command: `CALC:MARK:FUNC:CST`

Example:

The harmonics levels of a CW carrier are to be measured at 100 MHz.

[**PRESET**]	FSU is set to the default setting.
[**CENTER**: 100 **MHz**]	FSU sets the center frequency to 100 MHz. The span is set to 200 MHz.
[**SPAN**: 1 **MHz**]	The span is set to 100 MHz.
[**MKR->**]	*MARKER 1* is switched on and set to the maximum value of the signal.
[**NEXT**]	FSU switches to the submenu.
[*MKR->CF STEPSIZE*]	The step size of the center frequency setting equals the marker frequency (100 MHz).
[**CENTER**]	The center frequency entry mode is activated.
[**Right key**]	The center frequency is set to 200 MHz. The first harmonic of the test signal is displayed.
[**MKR->:** *PEAK*]	The marker is set to the harmonic and the level of the latter is output in the marker info field.



The *MIN* softkey sets the active marker to the minimum value on the corresponding trace.

IEC/IEEE-bus command: `CALC:MARK:MIN`
`CALC:DELT:MIN`

NEXT MIN

The *NEXT MIN* softkey sets the active marker to the next higher minimum value on the corresponding trace. The search direction is defined in the *NEXT MODE* submenu (see above).

IEC/IEEE-bus command: `CALC:MARK:MIN:NEXT`
`CALC:DELT:MIN:NEXT`

EXCLUDE LO

The *EXCLUDE LO* softkey limits the frequency range for the marker search functions or disables the limit.

activated	Because of the feedthrough of the first local oscillator to the first intermediate frequency at the input mixer, the LO is represented as a signal at 0 Hz. To avoid the marker jumping to the LO at 0 Hz with the peak function when setting the display range, this frequency is excluded. The minimum frequency to which the marker jumps, is $\geq 6 \times$ resolution bandwidth (RBW).
deactivated	No restriction to the search range. The frequency 0 Hz is included in the marker search functions.

IEC/IEEE-bus command: `CALC:MARK:LOEX ON`

Power Measurements – Hardkey *MEAS*

With its power measurement functions the FSU is able to measure all the necessary parameters with high accuracy in a wide dynamic range.

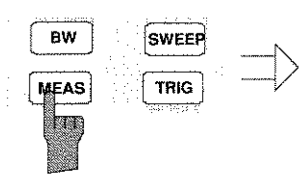
A modulated carrier is almost always used (except eg: SSB-AM) for high-frequency transmission of information. Due to the information modulated upon the carrier, the latter covers a spectrum which is defined by the modulation, the transmission data rate and the signal filtering. Within a transmission band each carrier is assigned a channel taking into account these parameters. In order to ensure error-free transmission, each transmitter must be conforming to the specified parameters. These include among others:

- the output power,
- the occupied bandwidth, ie the bandwidth which must contain a defined percentage of the power and
- the power dissipation allowed in the adjacent channels.

Additionally the menu contains functions to determine the modulation depth of AM modulated signals and to measure the 3rd order intercept point.

The measurements and the corresponding settings are selected in the *MEAS* menu.

MEAS menu:



TIME DOM POWER

CHAN PWR ACP

OCCUPIED BANDWIDTH

SIGNAL STATISTIC

MODULATION DEPTH

TOI

SELECT MARKER

The *MEAS* key opens the menu to select and set the power measurement.

The following measurements can be selected:

- Power in time domain (*TIME DOM POWER*)
- Channel power and adjacent-channel power in frequency domain (*CHAN PWR /ACP*)
- Occupied bandwidth (*OCCUPIED BANDWIDTH*)
- Amplitude probability distribution (*SIGNAL STATISTICS*)
- Modulation depth (*MODULATION DEPTH*)
- 3rd order intercept (*TOI*)

The above measurements are carried out alternatively.

Power Measurement in Time Domain

With the aid of the power measurement function the FSU determines the power of the signal in the time domain (SPAN = 0 Hz) by summing up the power at the individual pixels and dividing the result by the number of pixels. In this way it is possible to measure for example the power of TDMA signals during transmission or during the muting phase. Both the mean power and the rms power can be measured by means of the individual power values.
The result is displayed in the marker info field.

The measured values are updated after each sweep or averaged over a user-defined number of sweeps (*AVERAGE ON/OFF* and *NUMBER OF SWEEPS*) in order to determine eg the mean power over several bursts. For determination of the peak value (*PEAK HOLD ON*) the maximum value from several sweeps is displayed.

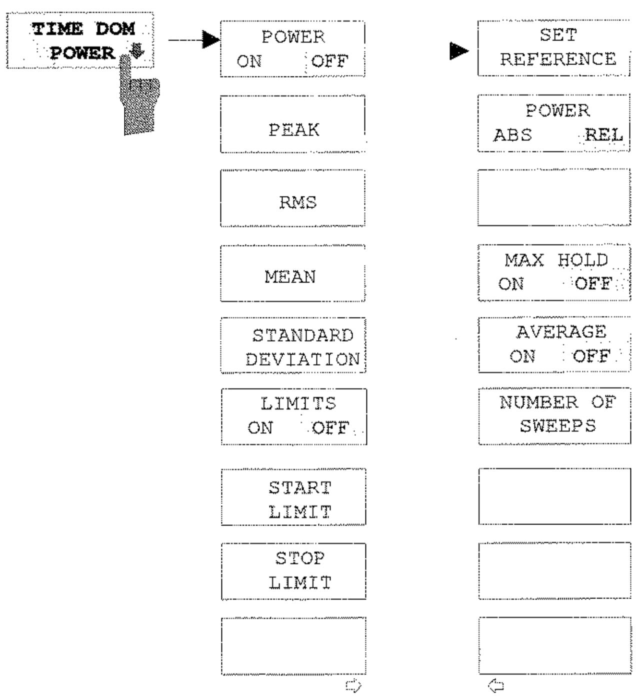
Example:
Marker info field for: *MEAN* selected, *AVERAGE ON* and *PEAK HOLD ON*:

```
MEAN HOLD      -2.33 dBm
MEAN AV        -2.39 dBm
```

If both the on and off phase of a burst signal are displayed, the measurement range can be limited to the transmission or to the muting phase with the aid of vertical lines. The ratio between signal and noise power of a TDMA signal for instance can be measured by using a measurement as a reference value and after that varying the measurement range.

Upon switching on power measurement the sample detector is activated (*TRACE-DETECTOR-SAMPLE)*.

Submenu *MEAS - TIME DOM POWER*:

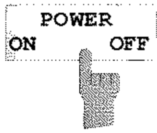


The *TIME DOM POWER* softkey activates the power measurement in the time domain and opens a submenu for configuration of the power measurement.

The submenu allows selection of the type of power measurement (rms or mean power), the settings for max hold and averaging as well as the definition of limits.

The power evaluation range can be limited by input of limit values.

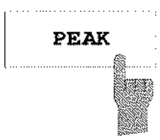
Note: *This softkey is only available in time domain (SPAN = 0).*



The *POWER ON/OFF* softkey switches the power measurement on and off. When entering the submenu it is *ON* since the power measurement is already switched on with the *TIME DOM POWER* softkey in the main menu.

Note: *The measurement is performed on the trace on which marker 1 is placed. To evaluate another trace, marker 1 should be set on another trace using the SELECT TRACE softkey in menu MKR.*

IEC/IEEE-bus command:
```
CALC:MARK:FUNC:SUMM:PPE ON
CALC:MARK:FUNC:SUMM:PPE:RES?
CALC:MARK:FUNC:SUMM:RMS ON
CALC:MARK:FUNC:SUMM:RMS:RES?
CALC:MARK:FUNC:SUMM:MEAN ON
CALC:MARK:FUNC:SUMM:MEAN:RES?
CALC:MARK:FUNC:SUMM:SDEV ON
CALC:MARK:FUNC:SUMM:SDEV:RES?
```



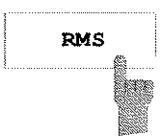
The *PEAK* softkey switches on the calculation of the peak value from the points of the displayed trace or a segment thereof.

For the maximum peak, the largest peak value obtained since the activation of *MAX HOLD ON* is displayed.

With *AVERAGE ON*, the peak values of a trace are averaged over several sweeps and displayed.

The number of sweeps over which the average or the maximum value is calculated is set with the *NUMBER OF SWEEPS* softkey.

IEC/IEEE-bus command:
```
CALC:MARK:FUNC:SUMM:PPE ON
CALC:MARK:FUNC:SUMM:PPE:RES?
```



The *RMS* softkey switches on the calculation of the rms value from the points of the displayed trace or a segment of it.

For the maximum peak, the largest rms value obtained since the activation of *MAX HOLD ON* is displayed.

With *AVERAGE ON*, the rms values of a trace are averaged over several sweeps and displayed.

The number of sweeps over which the average or the maximum value is calculated is set with the *NUMBER OF SWEEPS* softkey.

IEC/IEEE-bus command:
```
CALC:MARK:FUNC:SUMM:RMS ON
CALC:MARK:FUNC:SUMM:RMS:RES?
```

MEAN

The *MEAN* softkey switches on the calculation of the mean value from the points of the displayed trace or a segment of it. The linear mean value of the equivalent voltages is calculated.

This can be used for instance to measure the mean power during a GSM burst.

For the maximum peak, the largest mean value obtained since the activation of *MAX HOLD ON* is displayed.

With *AVERAGE ON*, the mean values of a trace are averaged over several sweeps and displayed.

The number of sweeps over which the average or the maximum value is calculated is set with the *NUMBER OF SWEEPS* softkey.

IEC/IEEE-bus command: `CALC:MARK:FUNC:SUMM:MEAN ON`
`CALC:MARK:FUNC:SUMM:MEAN:RES?`

STANDARD DEVIATION

The *STANDARD DEVIATION* softkey switches on the calculation of the standard deviation of trace points from the mean value and outputs them as measured value. The measurement of the mean power is automatically switched on at the same time.

For the maximum peak, the largest standard deviation obtained since the activation of *MAX HOLD ON* is displayed.

With *AVERAGE ON*, the standard deviations of a trace are averaged over several sweeps and displayed.

The number of sweeps over which the average or the maximum value is calculated is set with the *NUMBER OF SWEEPS* softkey.

IEC/IEEE-bus command: `CALC:MARK:FUNC:SUMM:SDEV ON`
`CALC:MARK:FUNC:SUMM:SDEV:RES?`

LIMIT ON OFF

The *LIMIT ON/OFF* softkey selects the limited (*ON*) or non-limited (*OFF*) evaluation range.

The evaluation range is defined by the *START LIMIT* and *STOP LIMIT* softkeys. If *LIMIT = ON*, signals are only searched between the two lines.

If only one limit line is switched on, time line 1 is the lower limit and the upper limit corresponds to the stop frequency. If time line 2 is also switched on, it defines the upper limit.

If no limit line is switched on, the evaluation range is not limited.

The default setting is *LIMIT = OFF*.

IEC/IEEE-bus command: `CALC:MARK:X:SLIM OFF`

START LIMIT

The *START LIMIT* softkey activates the entry of the lower limit of the evaluation range.

IEC/IEEE-bus command: `CALC:MARK:X:SLIM:LEFT <value>`

STOP LIMIT

The *STOP LIMIT* softkey activates the entry of the upper limit of the evaluation range.

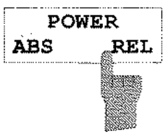
IEC/IEEE-bus command: `CALC:MARK:X:SLIM:RIGH <value>`

The *SET REFERENCE* softkey sets the power values currently measured as reference values for the calculation of the mean value *(MEAN)* and the rms value *(RMS)*. The reference values are used to perform relative measurements.

If the calculation of the mean value *(MEAN)* and rms value *(RMS)* is not switched on, 0 dBM is used as a reference value.

If the average value *(AVERAGE)* or maximum value *(MAX HOLD)* is calculated over several sweeps, the current value is the measured value summed up at the actual time.

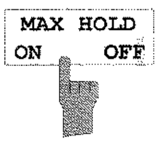
IEC/IEEE-bus command: `CALC:MARK:FUNC:SUMM:REF:AUTO ONCE`



The *POWER ABS/REL* softkey selects the absolute power measurement (default setting) or relative power measurement. The reference value for the relative power is defined by *SET REFERENCE.*

The value 0 dBm is used if the reference value is not defined.

IEC/IEEE-bus command: `CALC:MARK:FUNC:SUMM:MODE ABS`



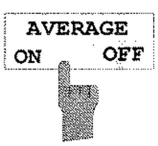
The *MAX HOLD ON/OFF* softkey switches the display of the maximum peak obtained from measurements at successive sweeps on and off.

The displayed maximum peak is only updated at the end of a sweep if a higher value has occurred.

The maximum value can be reset by switching the *MAX HOLD ON / OFF* softkey off and on again.

IEC/IEEE-bus command:

```
CALC:MARK:FUNC:SUMM:PHOL ON
CALC:MARK:FUNC:SUMM:PPE:PHOL:RES?
CALC:MARK:FUNC:SUMM:RMS:PHOL:RES?
CALC:MARK:FUNC:SUMM:MEAN:PHOL:RES?
CALC:MARK:FUNC:SUMM:SDEV:PHOL:RES?
```



The *AVERAGE ON/OFF* softkey switches averaging over successive sweep measurements on and off.

The measured values can be reset by switching the *AVERAGE ON / OFF* softkey off and on again.

IEC/IEEE-bus command:

```
CALC:MARK:FUNC:SUMM:AVER ON
CALC:MARK:FUNC:SUMM:PPE:AVER:RES?
CALC:MARK:FUNC:SUMM:RMS:AVER:RES?
CALC:MARK:FUNC:SUMM:MEAN:AVER:RES?
CALC:MARK:FUNC:SUMM:SDEV:AVER:RES?
```

NUMBER OF SWEEPS

The *NUMBER OF SWEEPS* softkey activates the entry of the number of sweeps for maximum or average value calculation.

SINGLE SWEEP mode	The FSU performs sweeps until the selected number of sweeps is reached and stops then.
CONTINUOUS SWEEP mode	Averaging is carried out until the selected number of sweeps is reached. After that, averaging is performed in continuous mode. and is then continued as running averaging. Calculation of the maximum peak (*MAX HOLD*) is performed continuously irrespective of the selected number of sweeps.

The valid range values is 0 to 32767.

Depending on the specified number of sweeps, averaging is carried out according to the following rules:

NUMBER OF SWEEPS = 0	Continuous averaging is carried out over 10 measured values.
NUMBER OF SWEEPS = 1	No averaging is carried out.
NUMBER OF SWEEPS > 1	Averaging is carried out over the set number of measured values.

Note: *This setting is equivalent to the setting of the sweep count in the TRACE menu.*

IEC/IEEE-bus command: `SWE:COUN <value>`

Example:

The mean power of a GSM burst with 0 dBm nominal power at 800 MHz is to be measured.

[**PRESET**]	Set the FSU to the default setting.
[**FREQ:** *CENTER*: 800 **MHz**]	Set the center frequency to 800 MHz.
[**SPAN**: *ZERO SPAN*]	Select time domain display (span = 0 Hz).
[**AMPT**: 0 **dBm**]	Set the reference level to 0 dBm.
[**BW**: *RES BW MANUAL*: 30 **kHz**]	Set the resolution bandwidth to 30 kHz in line with the requirements of the GSM standard.
[**SWEEP**: *SWEEPTIME MANUAL* 600 µs]	Set the sweep time to 600 µs.
[**TRIG**: *VIDEO*: 50 **%**]	Use the video signal as trigger source.
[**MEAS**]	Call the menu for the measurement functions.
[*TIME DOM POWER*]	Select power measurement in the time domain. The FSU calculates the mean power from the points of the whole trace. The submenu for configuration of the power measurement is opened. *MEAN* is already switched on.
[*LIMITS ON*]	Activate the limitation of the time domain of the power measurement .
[*START LIMIT*: 250 **µs**]	Set the start of the power measurement at 250 µs.
[*STOP LIMIT*: 500 **µs**]	Set the end of the power measurement at 500 µs.

Note: *The GSM specifications require the power to be measured between 50% and 90% of the TDMA burst. The time limits set above approximately correspond to the required time domain.*

Channel and Adjacent-Channel Power Measurements

For all channel and adjacent-channel power measurements a specified channel configuration is assumed which is for instance based on a specific radiocommunication system.
This configuration is defined by the nominal channel frequency (= center frequency of the FSU), channel bandwidth, adjacent-channel bandwidth and adjacent-channel spacing. The FSU is able to simultaneously measure the power in up to three adjacent channels (7 channels: transmission channel, 3 lower and 3 upper adjacent channels).
It offers two methods for channel and adjacent-channel power measurement:

- The integrated bandwidth method (IBW method), ie the integration of trace pixels within the bandwidth of the channel to be measured to the total power of the channel,
- The measurement in time domain (Fast ACP) by means of steep resolution filters simulating the channel.

The two measurements yield the same results. The measurement in time domain can be performed much faster since the complete signal is measured within a channel at the same time. With the IBW method, the channel is divided into subspectra. This is done by means of a bandwidth which is small compared to the channel bandwidth. These subspectra are then combined by integration of the trace pixels.

With the IBW method, the transmission channel or adjacent channels are marked by vertical lines at a distance of half the channel bandwidth to the left and to the right of the corresponding channel center frequency. (see Fig. 4-6).
In the time-domain method, the power trace in the different channels is shown. (see Bild 4-7).
For both methods, the results are listed in tables in the lower half of the screen.
The FSU offers predefined standard settings which can be selected from a table for the common mobile radio standards. Thus, channel configuration is performed automatically without the need to enter the corresponding parameters manually.
For some standards, the channel power and the adjacent-channel power are to be weighted by means of a root-raised cosine filter corresponding to a receive filter. This type of filtering is switched on automatically for both methods on selecting the standard (eg NADC, TETRA or 3GPP W-CDMA).

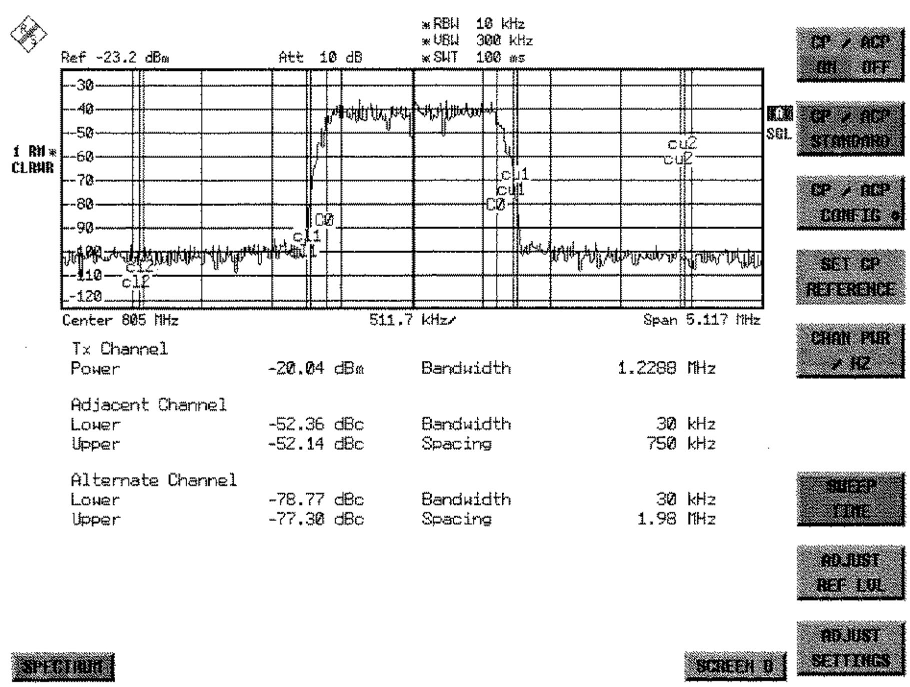


Fig. 4-6 Screen display of adjacent-channel power measurement using the IBW method

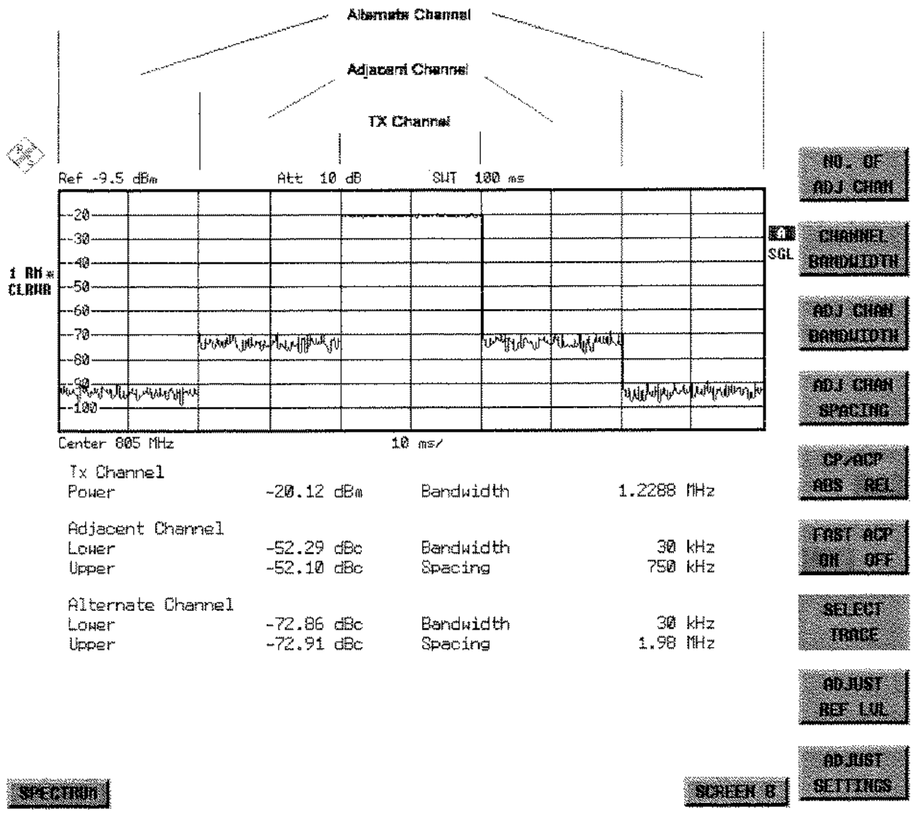
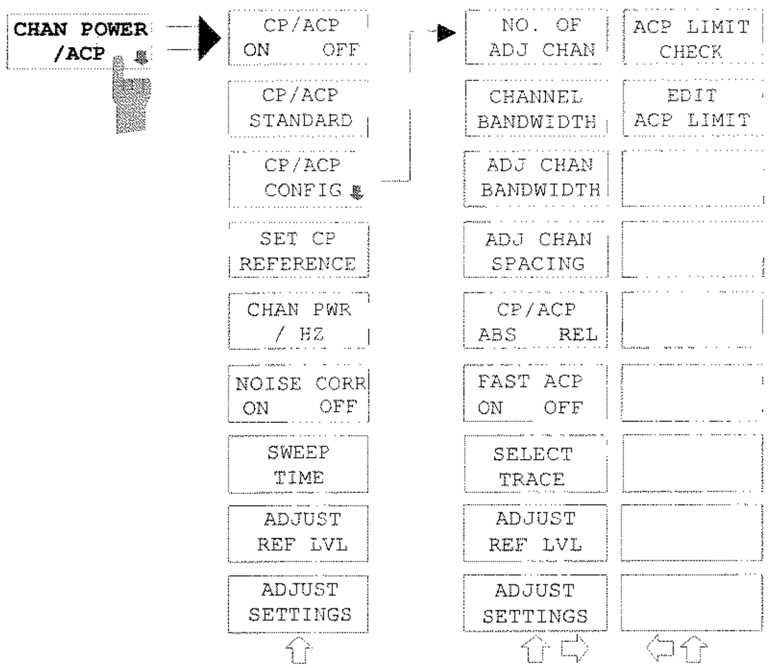


Fig. 4-7 Screen display of adjacent-channel power measurement using the time-domain method

Limit values for the adjacent-channel power can be defined for the measurement. If limit checking is switched on, a pass/fail information indicating that the power has been exceeded is displayed during the measurement in the table in the lower half of the screen.

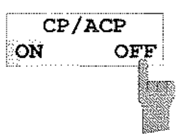
Note: *With the CP/ACP measurement switched on the functions SPLIT SCREEN and FULL SCREEN are inhibited.*

The channel configuration is defined in the *MEAS CHAN POWER/ACP* menu.



The *CHAN POWER /ACP* softkey switches on the channel power measurement or adjacent-channel power measurement according to the current configuration. At the same time it opens the submenu for defining the channel power measurement. The softkey is highlighted to show that channel or adjacent-channel power measurement is on.

Note: *This softkey can only be operated in frequency domain (SPAN > 0).*



The *CP/ACP ON/OFF* softkey switches the calculation of the channel power or adjacent-channel power on or off.

With default settings the measurement is performed by integrating the powers at the display points within the specified channels (IBW method).

The adjacent-channel power can be either absolute or relative related to the transmission channel power. The default setting is relative measurement (see softkey *CP/ACP ABS/ REL*).

IEC/IEEE-bus command:

```
CALC:MARK:FUNC:POW:SEL CPOW|ACP
CALC:MARK:FUNC:POW:RES? CPOW|ACP
CALC:MARK:FUNC:POW OFF
```

CP/ACP STANDARD

The *CP/ACP STANDARD* softkey opens a table for the selection of the settings according to predefined standards. The test parameters for the channel and adjacent-channel measurements are set according to the mobile radio standard.

ACP STANDARD
✓NONE
NADC IS136
TETRA
PDC
PHS
CDPD
CDMA IS95A FWD
CDMA IS95A REV
CDMA IS95C Class 0 FWD
CDMA IS95C Class 0 REV
CDMA J-STD008 FWD
CDMA J-STD008 REV
CDMA IS95C Class 1 FWD
CDMA IS95C Class 1 REV
W-CDMA 4.096 FWD
W-CDMA 4.096 REV
W-CDMA 3GPP FWD
W-CDMA 3GPP REV
CDMA 2000 DS
CDMA 2000 MC1
CDMA 2000 MC3

The standards available are listed in the table on the left.

Note: *For the FSU, the channel spacing is defined as the distance between the center frequency of the adjacent channel and the center frequency of the transmission channel. The definition of the adjacent-channel spacing in standards IS95 B and C, IS97 B and C and IS98 B and C is different. These standards define the adjacent-channel spacing from the center of the transmission channel to the closest border of the adjacent channel. This definition is also used for the FSU when the following standard settings are selected:*
CDMA IS95 Class 0 FWD
CDMA IS95 Class 0 REV
CDMA IS95 Class 1 FWD
CDMA IS95 Class 1 REV

The selection of the standard influences the following parameters:

- channel spacing
- channel bandwidth and type of filtering
- resolution bandwidth
- video bandwidth
- detector
- # of adjacent channels

Trace mathematics and trace averaging are switched off.
The reference level is not influenced by the selection of a standard. To achieve an optimum dynamic range, the reference level has to be set in a way that places the signal maximum close to the reference level without forcing an overload message.

The default setting is CP/*ACP STANDARD NONE*.

IEC/IEEE-bus command: `CALC:MARK:FUNC:POW:PRES <standard>`

CP/ACP CONFIG

See following section "Setting the Channel Configuration"

SET CP REFERENCE

With channel power measurement activated, the *SET CP REFERENCE* softkey defines the currently measured channel power as the reference value. The reference value is displayed in the *CH PWR REF* field; the default value is 0 dBm.

During the adjacent-channel power measurement the power in the transmission channel becomes the reference value. The display *CH PWR REF* is not required.

IEC/IEEE-bus command: `POW:ACH:REF:AUTO ONCE`

CHAN PWR / HZ

The *CHAN PWR / HZ* softkey selects the measurement of the total channel power or the measurement of the channel power referred to 1 Hz bandwidth. The conversion factor is $10 \cdot \lg \frac{1}{\text{Channel} \cdot \text{Bandwidth}}$.

This function allows for instance measurement of the noise power density or, in conjunction with the *CP/ACP REL* and *SET CP REFERENCE* functions, measurement of the signal-to-noise ratio.

IEC/IEEE-bus command: `CALC:MARK:FUNC:POW:RES:PHZ ON|OFF`

SWEEP TIME

The *SWEEP TIME* softkey activates the entry of the sweep time. With the RMS detector, a longer sweep time increases the stability of the measurement results. The function of the softkey is identical to the softkey *SWEEP TIME MANUAL* in the menu *BW*.

IEC/IEEE-bus command: `SWE:TIM <value>`

ADJUST REF LVL

The *ADJUST REF LVL* softkey adjusts the reference level of the FSU to the measured channel power. This ensures that the settings of the RF attenuation and the reference level are optimally adjusted to the signal level without overloading the FSU or limiting the dynamic range by a too small S/N ratio.
Since the measurement bandwidth for channel power measurements is significantly lower than the signal bandwidth, the signal path may be overloaded although the trace is still significantly below the reference level.

IEC/IEEE-bus command: `SENS:POW:ACH:PRES:RLEV`

ADJUST SETTINGS

The *ADJUST SETTINGS* softkey automatically optimizes the analyzer settings for the selected power measurement (see below).
All analyzer settings relevant for a power measurement within a specific frequency range (channel bandwidth) are optimized for the selected channel configuration (channel bandwidth, channel spacing):

- Frequency span:

  The frequency span has to cover at least all channels to be considered. When measuring the channel power, 2 x channel bandwidth is set as span. The setting of the span during adjacent-channel power measurement is dependent on the channel spacing and channel bandwidth of the adjacent channel ADJ, ALT1 or ALT2 with the largest distance from the transmission channel.

• Resolution bandwidth	RBW ≤ 1/40 of channel bandwidth
• Video bandwidth	VBW ≥ 3 × RBW
• Detector	RMS detector

Trace math and trace averaging functions are switched off.
The reference level is not influenced by *ADJUST SETTINGS.* It can be separately adjusted with *ADJUST REF LVL.*

The adjustment is carried out only once; if necessary, the instrument settings can be changed later.

IEC/IEEE-bus command: `SENS:POW:ACH:PRES ACP|CPOW|OBW`

For manual setting of the test parameters different from the settings made with *ADJUST SETTINGS* the following should be observed:

Frequency span

The frequency span has to cover at least all channels to be measured. For channel power measurement this is the channel bandwidth. If the frequency span is large compared to the frequency section (or frequency sections) under test, only a few pixels are available to be measured.

Resolution bandwidth (RBW)

To ensure both an acceptable measurement speed and the required selection (to suppress spectral components outside the channel to be measured, especially of the adjacent channels), the resolution bandwidth must not be selected too small or too large. As a general approach, the resolution bandwidth is to be set to values between 1% and 4% of the channel bandwidth. A larger resolution bandwidth can be selected if the spectrum within the channel to be measured and around it has a flat characteristic. In the standard setting, eg for standard IS95A REV at an adjacent channel bandwidth of 30 kHz, a resolution bandwidth of 30 kHz is used. This yields correct results since the spectrum in the neighbourhood of the adjacent channels normally has a constant level. For standard NADC/IS136 this is not possible for example, since the spectrum of the transmit signal penetrates into the adjacent channels and a too large resolution bandwidth causes a too low selection of the channel filter. The adjacent-channel power would thus be measured too high.

With the exception of the IS95 CDMA standards, the *ADJUST SETTINGS* softkey sets the resolution bandwidth (RBW) as a function of the channel bandwidth:

RBW $\leq$ 1/40 of channel bandwidth.

The maximum possible resolution bandwidth (with respect to the requirement RBW $\leq$ 1/40) resulting from the available RBW steps (1, 3) is selected .

Video bandwidth (VBW)

For a correct power measurement, the video signal must not be limited in bandwidth. A restricted bandwidth of the logarithmic video signal would cause signal averaging and thus result in a too low indication of the power (-2.51 dB at very low video bandwidths). The video bandwidth should therefore be selected at least three times the resolution bandwidth.

The *ADJUST SETTINGS* softkey sets the video bandwidth (VBW) as a function of the channel bandwidth as follows:

VBW $\geq 3 \times$ RBW.

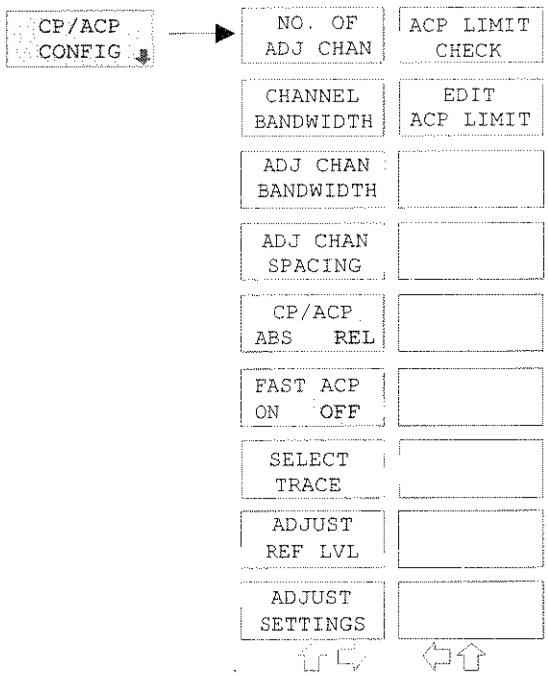
The smallest possible VBW with regard to the available step size will be selected.

Detector

The *ADJUST SETTINGS* softkey selects the RMS detector.
The RMS detector is selected since it correctly indicates the power irrespective of the characteristics of the signal to be measured. In principle, the sample detector would be possible as well. Due to the limited number of trace pixels used to calculate the power in the channel, the sample detector would yield less stable results. Averaging, which is often performed to stabilize the measurement results, leads to a too low level indication and should therefore be avoided. The reduction in the displayed power depends on the number of averages and the signal characteristics in the channel to be measured.

Setting the Channel Configuration

MEAS - CP/ACP CONFIG submenu:



The *CP/ACP CONFIG* softkey opens a submenu for configuration of the channel power and adjacent channel power measurement independent from the offered standards.

The channel configuration consists of the number of adjacent channels to be measured, the channel bandwidth (*CHANNEL BANDWIDTH*), the bandwidth of the adjacent channels (*ADJ CHANNEL BANDWIDTH*) and the distance of the adjacent channels from the center frequency of the transmission channel (*ADJ CHANNEL SPACING*).

Limit values can additionally be specified for the adjacent-channel power (*ACP LIMIT CHECK* and *EDIT ACP LIMITS*) which are checked for compliance during the measurement.

The *NO. OF ADJ CHAN* softkey activates the entry of the number ±n of adjacent channels to be considered in the adjacent-channel power measurement.
Numbers from 0 to 3 can be entered.

The following measurements are performed depending on the number of the channels.

0 Only the channel power is measured.

1 The channel power and the power of the upper and lower adjacent channel are measured.

2 The channel power, the power of the upper and lower adjacent channel and of the next higher and lower channel (alternate channel 1) are measured.

3 The channel power, the power of the upper and lower adjacent channel, the power of the next higher and lower channel (alternate channel 1) and of the next but one higher and lower adjacent channel (alternate channel 2) are measured.

IEC/IEEE-bus command: `POW:ACH:ACP 1`

CHANNEL BANDWIDTH

The *CHANNEL BANDWIDTH* softkey activates the entry of the channel bandwidth for the transmission channel.

The useful channel bandwidth is generally defined by the transmission method. It is automatically adjusted correctly on measurements according to a given standard (see *CP/ACP STANDARD* softkey).

When measuring according to the IBW method (*FAST ACP OFF)* the channel bandwidth is displayed by two vertical lines to the left and right of the screen center. It can thus be visually checked whether the whole power of the signal to be measured is within the selected channel bandwidth.

With the time domain method (*FAST ACP ON)* the measurement is performed in zero span. The channel limits are not marked in this case. The FSU offers all available channel filters for selection of the channel bandwidth. Deviating channel bandwidths cannot be set. If deviating channel bandwidths are required, the IBW method should be used.

The list of available channel filters is included in section "Setting of Bandwidths and Sweep Time – *BW key".*

The default setting is 14 kHz.

IEC/IEEE-bus command: `SENS:POW:ACH:BWID 14kHz`

ADJ CHAN BANDWIDTH

The ADJ *CHAN BANDWIDTH* softkey opens a table for defining the channel bandwidths for the adjacent channels.

ACP CHANNEL BW	
CHAN	BANDWIDTH
ADJ	30 kHz
ALT1	30 kHz
ALT2	30 kHz

When measuring according to the IBW method (FAST ACP OFF) the bandwidths of the different adjacent channels are to be entered numerically. Since all adjacent channels often have the same bandwidth, the other channels Alt1 and Alt2 are set to the bandwidth of the adjacent channel on entering the adjacent-channel bandwidth (ADJ). Thus only one value needs to be entered in case of equal adjacent channel bandwidths. The same holds true for the ALT2 channels (alternate channels 2) when the bandwidth of the ALT1 channel (alternate channel 1) is entered.

Note: *The bandwidths can be selected independent from each other by overwriting the table from top to bottom.*

With the time domain method (FAST ACP ON), the adjacent-channel bandwidths are selected from the list of available channel filters. For deviating adjacent-channel bandwidths the IBW method should be used.

IEC/IEEE-bus command:
```
SENS:POW:ACH:BWID:ACH 1kHz
SENS:POW:ACH:BWID:ALT1 14kHz
SENS:POW:ACH:BWID:ALT2 14kHz
```

ADJ CHAN SPACING

The ADJ *CHAN SPACING* softkey opens a table for defining the channel spacings.

ACP CHANNEL SPACING	
CHAN	SPACING
ADJ	800 kHz
ALT1	1.60 MHz
ALT2	2.40 MHz

Since all the adjacent channels often have the same distance to each other, the entry of the adjacent-channel spacing (ADJ) causes channel spacing ALT1 to be set to twice and channel spacing ALT2 to three times the adjacent-channel spacing. Thus only one value needs to be entered in case of equal channel spacing. The same holds true for the ALT2 channels when the bandwidth of the ALT1 channel is entered.

Note: *The channel spacings can be set separately by overwriting the table from top to bottom.*

IEC/IEEE-bus command:
```
SENS:POW:ACH:SPAC:ACH 20kHz
SENS:POW:ACH:SPAC:ALT1 40kHz
SENS:POW:ACH:SPAC:ALT2 60kHz
```

CP/ACP ABS REL

The *CP/ACP ABS/REL* softkey (channel power absolute/relative) switches between absolute and relative power measurement in the channel.

CP/ACP ABS The absolute power in the transmission channel and in the adjacent channels is displayed in the unit of the Y axis, eg in dBm, dBµV.

CP/ACP REL In case of adjacent-channel power measurement (*NO. OF ADJ CHAN* > 0) the level of the adjacent channels is displayed relative to the level of the transmission channel in dBc.

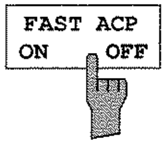
In case of channel power measurement (*NO. OF ADJ CHAN* = 0) the power of a transmission channel is displayed relative to the power of a reference channel defined by *SET CP REFERENCE*. This means:

1. Declare the power of the currently measured channel as the reference value, using the *SET CP REFERENCE* softkey.
2. Select the channel of interest by varying the channel frequency (FSU center frequency).

With linear scaling of the Y axis, the power of the new channel relative to the reference channel (CP/CP_{ref}) is displayed. With dB scaling, the logarithmic ratio 10lg (CP/CP_{ref}) is displayed.

The relative channel power measurement can thus also be used for universal adjacent-channel power measurements. Each channel can be measured individually.

IEC/IEEE-bus command: `SENS:POW:ACH:MODE ABS`



The *FAST ACP* softkey switches between the IBW method (FAST ACP OFF) and the time domain method (FAST ACP ON).

With FAST ACP ON the power measurement is performed in the different channels in time domain. The FSU sets the center frequency consecutively to the different channel center frequencies and measures the power with the selected measurement time (= sweep time/number of channels). The RBW filter suitable for the selected standard and frequency offset are automatically used (eg root raised cos with IS 136). The list of available channel filters is included in section "Setting of Bandwidths and Sweep Time – *BW key*".

The RMS detector is used for obtaining correct power measurement results. Therefore this requires no software correction factors.

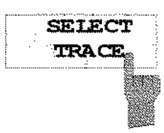
The measured values are displayed in a table, the power in the useful channel being displayed in dBm and the power in the adjacent channels in dBm (CP/ACP ABS) or dB (CP/ACP REL).

The sweep time is selected depending on the desired reproducibility of results. Reproducibility increases with sweep time since power measurement is then performed over a longer time period.

As a general approach, it can be assumed that approx. 500 non-correlated measured values are required for a reproducibility of 0.5 dB (99% of the measurements are within 0.5 dB of the true measured value). This holds true for white noise. The measured values are considered as non-correlated when their time interval corresponds to the reciprocal of the measured bandwidth.

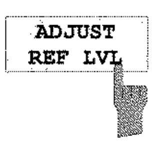
With IS 136 the measurement bandwidth is approx. 25 Hz, ie measured values at an interval of 40 µs are considered as non-correlated. A measurement time of 10 ms is thus required per channel for 1000 measured values. This is the default sweep time which the FSU sets in coupled mode. Approx. 5000 measured values are required for a reproducibility of 0.1 dB (99%), ie the measurement time is to be increased to 200 ms.

IEC/IEEE-bus command `SENS:POW:HSP ON`

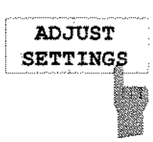


The *SELECT TRACE* softkey selects the trace, on which the CP/ACP measurement is performed. Only traces can be selected, which are switched on (= not set to BLANK).

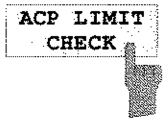
IEC/IEEE-bus command: `SENS:POW:TRAC 1`



See main menu *CHAN PWR ACP.*



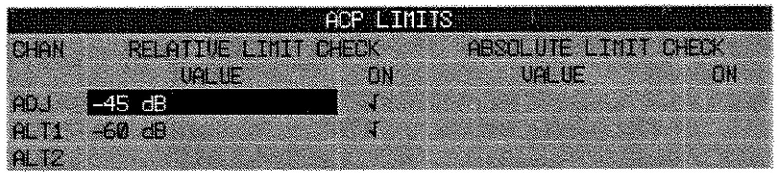
See main menu *CHAN PWR ACP.*



The *ACP LIMIT CHECK* softkey switches the limit check for the ACP measurement on and off.

IEC/IEEE-bus command:
```
CALC:LIM:ACP ON
CALC:LIM:ACP:ACH:RES?
CALC:LIM:ACP:ALT:RES?
```

The *EDIT ACP LIMITS* softkey opens a table for defining the limits for the ACP measurement.



ACP LIMITS

CHAN	RELATIVE LIMIT CHECK VALUE	ON	ABSOLUTE LIMIT CHECK VALUE	ON
ADJ	-45 dB	√		
ALT1	-60 dB	√		
ALT2				

The following rules apply for the limits:

- A separate limit can be defined for each adjacent channel. The limit applies to both the upper and the lower adjacent channel.
- A relative and/or absolute limit can be defined. The check of both limit values can be activated independently.
- The FSU checks adherence to the limits irrespective of whether the limits are absolute or relative or wether the measurement is carried out with absolute or relative levels. If both limits are active and if the higher of both limit values is exceeded, the measured value is marked accordingly.

Note: *Measured values exceeding the limit are marked by a preceding asterisk.*

IEC/IEEE-bus command:
```
CALC:LIM:ACP ON
CALC:LIM:ACP:ACH 0dB,0dB
CALC:LIM:ACP:ACH:STAT ON
CALC:LIM:ACP:ACH:ABS -10dBm,-10dBm
CALC:LIM:ACP:ACH:ABS:STAT ON
CALC:LIM:ACP:ALT1 0dB,0dB
CALC:LIM:ACP:ALT1:STAT ON
CALC:LIM:ACP:ALT1:ABS -10dBm,-10dBm
CALC:LIM:ACP:ALT1:ABS:STAT ON
CALC:LIM:ACP:ALT2 0dB,0dB
CALC:LIM:ACP:ALT2:STAT ON
CALC:LIM:ACP:ALT2:ABS -10dBm,-10dBm
CALC:LIM:ACP:ALT2:ABS:STAT ON
```

Examples:

1. Measurement of adjacent-channel power for a specific standard:

The adjacent-channel power is to be measured for a signal at 800 MHz with 0 dBm level in line with IS136.

[**PRESET**]	Set the FSU to the default setting.
[**FREQ**: *CENTER*: 800 **MHz**]	Set the center frequency to 800 MHz.
[**AMPT**: 0 **dBm**]	Set the reference level to 0 dBm.
[**MEAS**]	Call the menu for the measurement functions.
[*CHAN PWR / ACP*]	Select the channel and adjacent-channel power measurement function. The measurement is performed with the default settings or a previously defined setting. The submenu for setting the desired new configuration is opened.
[*CP/ACP STANDARD*: select IS136: **ENTER**]	Select the NADC (IS136) standard.
[*CP/ACP CONFIG*]	Call the submenu for configuration of the adjacent-channel power measurement.
[*NO. OF ADJ CHAN*: 2 **ENTER**]	Select two adjacent channels for the measurement, ie the adjacent channel and the alternate channel are measured.
PREV	Change to the main menu for channel power measurement.
[*ADJUST SETTINGS*]	Set the optimum span, resolution bandwidth (RBW), video bandwidth (VBW) and detector automatically for the measurement. The absolute channel power and the relative power of the adjacent channels are displayed on the screen.
[*ADJUST REF LVL*]	Set the reference level equal to the channel power measured.

2. Measurement with user-specific channel configuration:

Measurement of the adjacent-channel power ratio (ACPR) of an IS95 CDMA signal at 800 MHz, level 0 dBm. Similar to example 1, the setting can be simplified by using *CP/ACP STANDARD.*

[**PRESET**] Set the FSU to the default setting.

[**FREQ:** *CENTER*: 800 **MHz**] Set the center frequency to 800 MHz.

[**AMPT**: 0 **dBm**] Set the reference level to 0 dBm.

[**MEAS**] Call the menu for the measurement functions.

[*CHAN PWR / ACP*] Select the channel and adjacent-channel power measurement function. The measurement is carried out with the default settings or a previously defined setting. The submenu for setting the desired new configuration is opened.

[*CP/ACP CONFIG*] Call the submenu for defining the channel configuration.

[*NO. OF ADJ CHAN*: 2 **ENTER**] Select two adjacent channels for the measurement, ie the adjacent channel and the alternate channel are measured.

[*CHANNEL BANDWIDTH*: 1.23 **MHz**] Set the channel bandwidth to 1.23 MHz according to IS95.

[*ADJ CHAN BANDWIDTH:* 30 **kHz**] Open the list for setting the bandwidth of the adjacent channels.

ACP CHANNEL BW

CHAN	BANDWIDTH
ADJ	30 kHz
ALT1	30 kHz
ALT2	30 kHz

Upon entry of 30 kHz for the adjacent channel the alternate channels are also set to 30 kHz.

[*ADJ CHAN SPACING*: 885 **kHz:** : 1.98 **MHz**] Open the list for entering the adjacent-channel spacings.

ACP CHANNEL SPACING

CHAN	SPACING
ADJ	885 kHz
ALT1	1.98 MHz
ALT2	2.97 MHz

Upon entry of 885 kHz for the adjacent channel the channels ALT1 and ALT2 are set to 1770 kHz and 2655 kHz. Upon entry of 1.98 MHz for the alternate channel 1 the alternate channel 2 is set to 2.97 MHz.

PREV In dasHauptmenü für die Kanalleistungsmessung wechseln.

[*ADJUST SETTINGS*] Automatically set the optimum span (= 5 MHz), resolution bandwidth (RBW = 30 kHz), video bandwidth (VBW = 300 kHz) and detector (RMS) for the measurement. The absolute channel power and the relative power of the adjacent channels and alternate channels are displayed on the screen.

[*ADJUST REF LVL*] Set the reference level equal to the channel power measured.

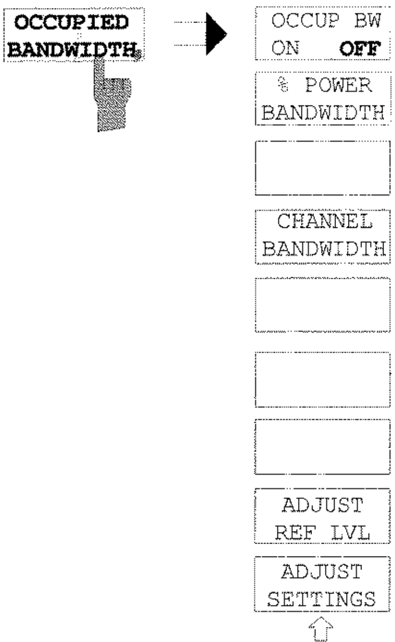
3. Measurement of signal/noise power density (C/No) of an IS95 CDMA signal (frequency 800 MHz, level 0 dBm)

[**PRESET**]	Set the FSU to the default setting.
[**FREQ:** *CENTER*: 800 **MHz**]	Set the center frequency to 800 MHz.
[**AMPT**: 0 **dBm**]	Set the reference level to 0 dBm.
MEAS]	Call the menu for the measurement functions.
[*CHAN PWR / ACP*]	Select the channel and adjacent-channel power measurement. The measurement is performed with the default setting or a previously defined setting. The submenu for setting the desired new configuration is opened.
[*CP/ACP CONFIG*]	Call the submenu for defining the channel configuration.
[*NO. OF ADJ CHAN*: 0 **ENTER**]	Do not select an adjacent channel for the measurement, ie the measurement is carried out in one channel only.
[*CHANNEL BANDWIDTH*: 1.23 **MHz**]	Set the channel bandwidth to 1.23 MHz in line with IS95.
PREV	Change to the main menu for channel power measurement
[*ADJUST SETTINGS*]	Set the optimum span (= 5 MHz), resolution bandwidth (RBW = 30 kHz), video bandwidth (VBW = 300 kHz) and detector (RMS) for the measurement automatically. The absolute channel power and the relative power of the adjacent channels and alternate channels are displayed on the screen.
[*ADJUST REF LVL*]	Set the reference level equal to the channel power measured.
[*SET CP REFERENCE*]	Set the measured channel power as a reference for the subsequent measurements.
[*CP/ACP ABS / REL*]	Select relative measurement related to the reference power set with *SET REFERENCE* (result 0 dB).
[*CHAN PWR / HZ*]	Select power measurement related to 1 Hz bandwidth (result -60.9 dB).
[**FREQ:** *CENTER*: 805 **MHz**]	Set the center frequency to 805 MHz. The FSU measures the channel power at 1.23 MHz bandwidth and outputs the result in dB relative to the reference power and 1 Hz bandwidth.

Measurement of Occupied Bandwidth

An important characteristics of a modulated signal is its occupied bandwidth. In a radio communications system for instance the occupied bandwidth must be limited to enable distortion-free transmission in adjacent channels. The occupied bandwidth is defined as the bandwidth containing a defined percentage of the total transmitted power. A percentage between 10% and 99.9% can be set on the FSU.

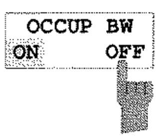
MEAS OCCUPIED BANDWIDTH menu:



The *OCCUPIED BANDWIDTH* softkey activates measurement of the occupied bandwidth according to the current configuration and opens the submenu for configuring the measurement. The softkey is available only in frequency domain (span > 0) and is highlighted when the measurement is switched on.

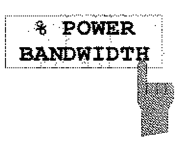
In the spectrum display mode, this measurement determines the bandwidth that contains a predefined percentage of the power of the displayed frequency range (*% POWER BANDWIDTH* softkey). The occupied bandwidth is output in the marker display field and marked on the trace by temporary markers.

Note:
- *The softkey is only available in frequency domain (span > 0).*
- *The measurement is performed on the trace with marker 1. In order to evaluate another trace, marker 1 must be placed on another trace by means of SELECT TRACE in the MKR menu*



The *OCCUP BW ON/OFF* softkey switches measurement of the occupied bandwidth on or off.

IEC/IEEE-bus command:
```
CALC:MARK:FUNC:POW:SEL OBW
CALC:MARK:FUNC:POW:RES? OBW
CALC:MARK:FUNC:POW OFF
```



The *% POWER BANDWIDTH* softkey opens the entry of the percentage of power related to the total power in the displayed frequency range which defines the occupied bandwidth (percentage of total power).
The valid range of values is 10% to 99.9%.

IEC/IEEE-bus command:
```
SENS:POW:BWID 99PCT
```

CHANNEL BANDWIDTH

The *CHANNEL BANDWIDTH* softkey opens an input window for defining the channel bandwidth for the transmission channel. For measurements in line with a specific transmission standard, the bandwidth specified by the standard for the transmission channel must be entered.
The default setting is 14 kHz.
The specified channel bandwidth is used for optimization of the test parameters of the FSU with *ADJUST SETTINGS.*

IEC/IEEE-bus command: `SENS:POW:ACH:BWID 14kHz`

ADJUST REF LVL

The *ADJUST REF LVL* softkey adjusts the reference level of the FSU to the measured total power of the signal. The softkey is activated after the first sweep with the measurement of the occupied bandwidth has been completed and the total power of the signal is thus known.
Adjusting the reference level ensures that the signal path of the FSU will not be overloaded and the dynamic range not limited by too low a reference level.
Since the measurement bandwidth for channel power measurements is significantly lower than the signal bandwidth, the signal path may be overloaded although the trace is distinctly below the reference level. If the measured channel power is equal to the reference level, the signal path cannot be overloaded.

IEC/IEEE-bus command: `SENS:POW:ACH:PRES:RLEV`

ADJUST SETTINGS

The *ADJUST SETTINGS* softkey optimizes the analyzer settings for the measurement of the occupied bandwidth according to the specified channel bandwidth.
All analyzer settings relevant for power measurement within a specific frequency range, such as

- frequency span — 3 x channel bandwidth
- resolution bandwidth — RBW $\leq$ 1/40 of channel bandwidth
- video bandwidth — VBW $\geq 3 \times$ RBW
- detector — RMS

are optimized.

The reference level is not influenced by *ADJUST SETTINGS.* For an optimum dynamic range it should be selected in a way that the signal maximum is close to the reference level.

The adjustment is carried out only once; if necessary, the instrument settings may be changed later.

IEC/IEEE-bus command: `SENS:POW:PRES OBW`

Measurement principle:

For example, the bandwidth containing 99% of the signal power is to be determined. The routine first calculates the total power of all displayed points of the trace. In the next step, the points from the right edge of the trace are summed up until 0.5% of the total power is reached. Auxiliary marker 1 is positioned at the corresponding frequency. Then the FSU sums up the points from the left edge of the trace until 0.5% of the power is reached. Auxiliary marker 2 is positioned at this point. 99% of the power is now between the two markers. The distance between the two frequency markers is the occupied bandwidth which is displayed in the marker info field.
A prerequisite for correct measurement is that only the signal to be measured is visible on the screen of the FSU. An additional signal would invalidate the measurement.

To ensure correct power measurement especially for noise signals and to obtain the correct occupied bandwidth, the following settings should be selected:

RBW	<< occupied bandwidth (approx. 1/20 of occupied bandwidth, for voice communication type. 300 Hz or 1 kHz)
VBW	≥ 3 x RBW
Detector	RMS or sample
Span	≥2 to 3 x occupied bandwidth

Some of the measurement specifications (eg PDC, RCR STD-27B) require measurement of the occupied bandwidth using a peak detector. The detector setting of the FSU has to be changed accordingly then.

Example:
Measurement of occupied bandwidth of a PDC signal at 800 MHz, level 0 dBm

[**PRESET**]	Set the FSU to the default setting.
[**FREQ**: *CENTER*: 800 MHz]	Set the center frequency to 800 MHz.
[**AMPT**: 0 dBm]	Set the reference level to 0 dBm.
[**MEAS**]	Call the menu for the measurement functions.
[*OCCUPIED BANDWIDTH*]	Select measurement of the occupied bandwidth and open the submenu for configuring the measurement.
[*% POWER BANDWIDTH*: 99 **%**]	Select 99% for the bandwidth to be measured.
[*CHANNEL BANDWIDTH*: 21 **kHz**]	Enter the channel bandwidth of 21 kHz specified by PDC.
[*ADJUST SETTINGS*]	Optimize the measurement parameters for the specified channel bandwidth.
	Allow for a complete frequency sweep so that the FSU can determine the total signal power.
[*ADJUST REF LVL*]	Adjust the reference level to the measured signal power.
[**TRACE**: *DETECTOR*: *DETECTOR MAX PEAK*]	PDC requires measurement of the occupied bandwidth using a peak detector. Therefore, switch on the peak detector instead of the RMS detector selected by *ADJUST SETTINGS*.

Measurement of Signal Amplitude Statistics

Digital modulated signals are similar to white noise within the transmit channel, but are different in their amplitude distribution. In order to transmit the modulated signal without distortion all amplitudes of the signal have to be transmitted linearly, e. g. from the output power amplifier. Most critical are the peak amplitude values, of course.

Degradation in transmit quality caused by a transmitter two port network is dependent on the amplitude of the peak values as well as on their probability.

The probability of amplitude values can be measured with the APD function (Amplitude Probability Distribution). During a selectable measurement time all occurring amplitude values are assigned to an amplitude range. The number of amplitude values in the specific ranges is counted and the result is displayed as a histogram. Each bar of the histogram represents the percentage of measured amplitudes within the specific amplitude range.

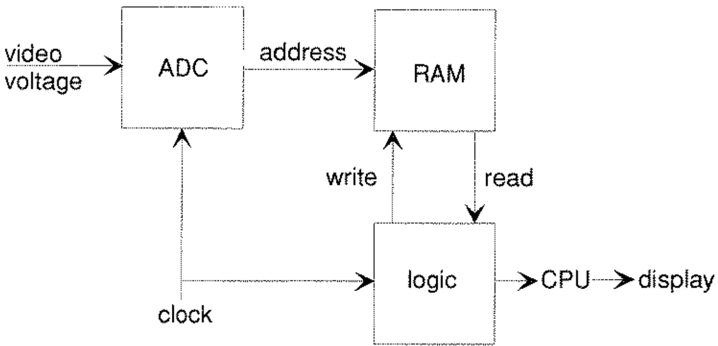


Fig. 4-8 Simplified block diagram for APD measurement

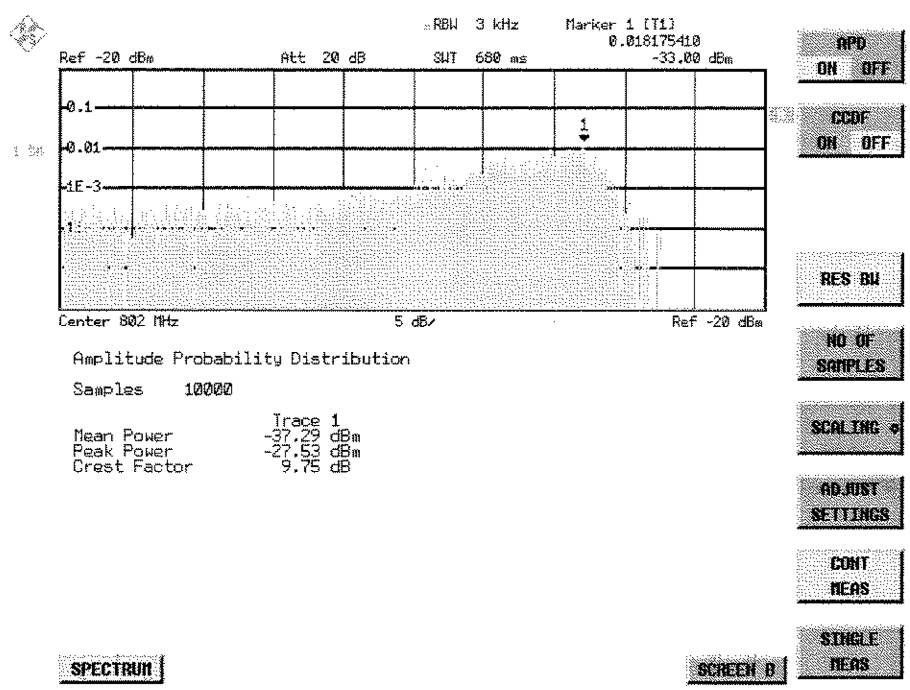


Fig. 4-9 Display of the amplitude probability distribution

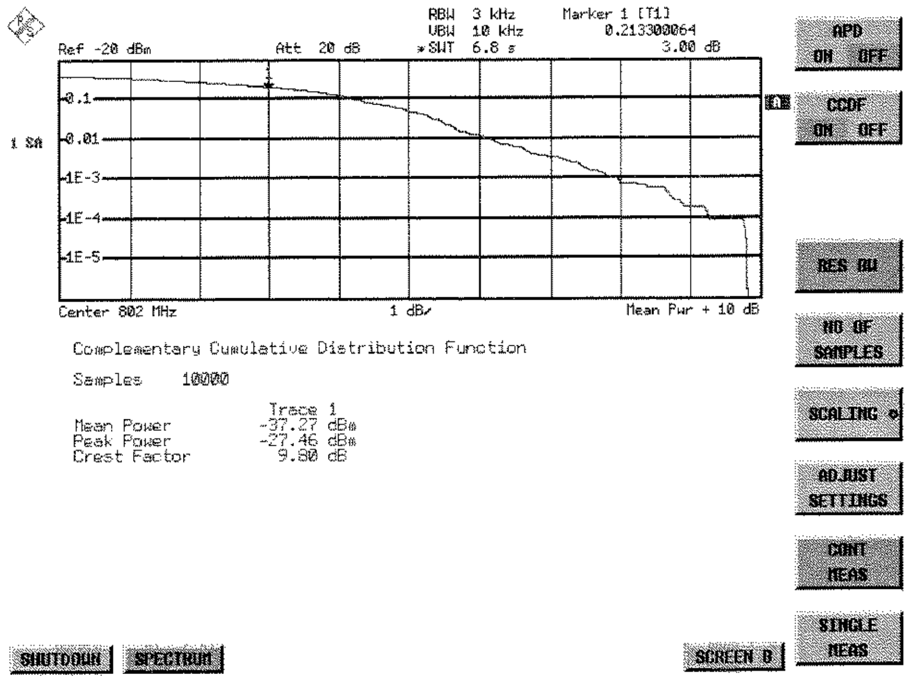


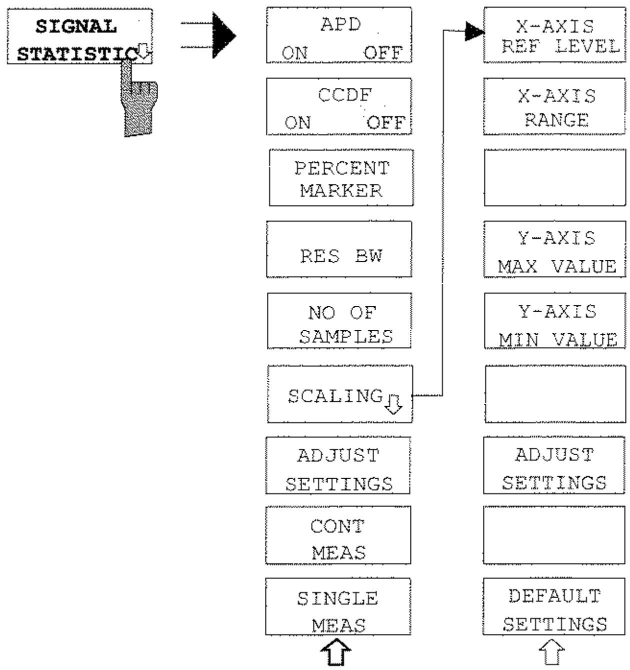
Fig. 4-10 Display of the complementary cumulative distribution function (CCDF)

Alternate to the histogram display of the APD the Complementary Cumulative Distribution Function (CCDF) can be displayed. It shows the probability of an amplitude exceeding a specific value.
For the APD function the x-axis is scaled in absolute values in dBm, whereas for the CCDF function the x-axis is scaled relative to the MEAN POWER measured.

Definitions:
Crest Factor = Peak Voltage to rms
CCDF: Complementary Cumulative Distribution Function

Note: *During an active statistic measurement the functions FULL SCREEN, SPLIT SCREEN and selection of the active diagram via SCREEN A / SCREEN B are disabled.*

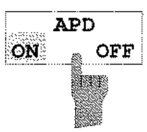
MEAS SIGNAL STATISTIC submenu :



The *SIGNAL STATISTIC* softkey opens a submenu for measurement of signal statistics.
In the submenu measurement of amplitude probability density (*APD*) and complementary cumulative distribution (*CCDF*) can be selected alternately. Only one of the signal statistic functions can be switched on at a time.

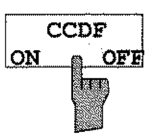
In default mode all statistic functions are switched off.
With a statistic function switched on the FSU is set into zero span mode automatically.

The FSU measures the statistics of the signal applied to the RF input with the resolution bandwidth set. In order not to influence the peak amplitudes the video bandwidth is automatically set to 10 times the resolution bandwidth. The sample detector is used for detecting the video voltage.



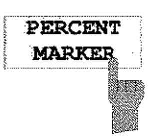
The *APD ON/OFF* softkey switches on or off the amplitude probability distribution function.
When the APD function is switched on, the CCDF function is switched off automatically.

IEC/IEEE-bus command: `CALC:STAT:APD ON`



The *CCDF ON/OFF* softkey switches on or off the complementary cumulative distribution function.
When the CCDF function is switched on, the APD function is switched off automatically.

IEC/IEEE-bus command: `CALC:STAT:CCDF ON`



If the CCDF function is active, the *PERCENT MARKER* softkey allows to position marker 1 by entering a probability value. Thus, the power which is exceeded with a given probability can be determined very easily.
If marker 1 is in the switched-off state, it will be switched on automatically.

IEC/IEEE-bus command: `CALC:MARK:Y:PERC 0...100%`

RES BW

The *RES BW* softkey sets the resolution bandwidth in the menu *STATISTIC FUNCTION* directly without switching to the corresponding menu (BW). The function of the softkey is identical to the softkey *RES BW MANUAL* in the menu *BW*.
For correct measurement of the signal statistics the resolution bandwidth has to be wider than the signal bandwidth in order to transmit the actual peaks of the signal amplitude correctly. Video bandwidth is set to 10 MHz automatically with a statistic function switched on.

IEC/IEEE-bus command: `BAND 3 MHz`

NO OF SAMPLES

The *NO OF SAMPLES* softkey sets the number of power measurements taken into account for the statistics.
Please note that the overall measurement time is influenced by the number of samples selected as well as by the resolution bandwidth set up for the measurement as the resolution bandwidth directly influences the sampling rate.

IEC/IEEE-bus command: `CALC:STAT:NSAM <value>`

SCALING

X-AXIS REF LEVEL
X-AXIS RANGE
Y-AXIS MAX VALUE
Y-AXIS MIN VALUE
ADJUST SETTINGS
DEFAULT SETTINGS

The *SCALING* softkey opens a sub menu that allows changing the scaling parameters for both the x- and the y-axis.

X-AXIS REF LEVEL

The *X-AXIS REF LEVEL* softkey changes the level settings of the instrument and sets the maximum power to be measured.
The function is identical to softkey *REF LEVEL* in menu *AMPT*.
For the *APD* function this value is mapped to the right diagram border. For the *CCDF* function there is no direct representation of this value on the diagram as the x-axis is scaled relatively to the *MEAN POWER* measured.

IEC/IEEE command: `CALC:STAT:SCAL:X:RLEV <value>`

X-AXIS RANGE

The *X-AXIS RANGE* softkey changes the level range to be covered by the statistics measurement selected.
The function is identical to softkey *RANGE LOG MANUAL* in menu *AMPT.*

IEC/IEEE command: CALC:STAT:SCAL:X:RANG <value>

Y-AXIS MAX VALUE

The *Y-AXIS MAX VALUE* softkey defines the upper limit of the displayed probability range.
Values on the y-axis are normalized which means that the maximum value is 1.0. As the y-axis scaling has a logarithmic axis the distance between max and min value must be at least one decade.

IEC/IEEE command: CALC:STAT:SCAL:Y:UPP <value>

Y-AXIS MIN VALUE

The *Y-AXIS MIN VALUE* softkey defines the lower limit of the displayed probability range.
As the y-axis scaling has a logarithmic axis the distance between max and min value must be at least one decade. Valid values are in the range 0 < value < 1.

IEC/IEEE command: CALC:STAT:SCAL:Y:LOW <value>

ADJUST SETTINGS

see below

DEFAULT SETTINGS

The *DEFAULT SETTINGS* softkey resets the x- and y-axis scalings to their PRESET values.

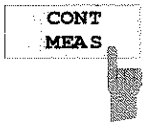
x-axis ref level:	-20 dBm
x-axis range APD:	100 dB
x-axis range CCDF:	20 dB
y-axis upper limit:	1.0
y-axis lower limit:	1E-6

IEC/IEEE-bus command: CALC:STAT:PRES

ADJUST SETTINGS

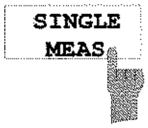
The *ADJUST SETTINGS* softkey optimizes the level settings of the FSU according to the measured peak power in order to gain maximum sensitivity of the instrument.
The level range is adjusted according to the measured difference between peak and minimum power for APD measurement and peak and mean power for CCDF measurement in order to obtain maximum power resolution.
Additionally the probability scale is adapted to the selected number of samples.

IEC/IEEE-bus command: CALC:STAT:SCAL:AUTO ONCE



The *CONT MEAS* softkey starts collecting a new sequence of sample data and calculating the APD or CCDF curve depending on the selected measurement. The next measurement is started automatically as soon as the indicated number of samples has been reached ("CONTinuous MEASurement").

IEC/IEEE-bus command: `INIT:CONT ON;`
`INIT:IMM`



The *SINGLE MEAS* softkey starts collecting a new sequence of sample data and calculating the APD or CCDF curve depending on the selected measurement. At the beginning of the measurement previously obtained measurement results are discarded.

IEC/IEEE-bus command: `INIT:CONT OFF;`
`INIT:IMM`

Hint for usage of the marker functions with measurement of signal statistics:

With the signal statistic measurement level always is displayed on x-axis. Y-axis always is a normalized value between 0 and 1. In contrary to use of marker in frequency or time domain marker is input in level values and the output is in percentage values.

Example:

Measurement of CCDF of a IS95 BTS signal, level 0 dBm, frequency 800 MHz

[**PRESET**]	Switch on preset settings.
[**FREQ**: *CENTER*: 800 MHz]	Set center frequency to 800 MHz.
[**AMPT**: 10 dBm]	Set reference level to 10 dBm.
[**BW**: 3 MHz]	Set resolution bandwidth to 3 MHz (resolution bandwidth shall be wider then signal bandwidth (1.25 MHz) in order to have the complete signal within the resolution bandwidth).
[**MEAS**]	Call the menu for measurement functions.
[*SIGNAL STATISTIC*]	Call the menu for signal statistics measurement.
[*CCDF ON /OFF*]	Switch on measurement of the complementary cumulative distribution function. The FSU switches to zero span mode. The power of the signal and the CCDF is calculated for the number of samples selected. With the CCDF function sample detector and video bandwidth are set automatically.
[NO OF SAMPLES: 10000]	Set the number of measurement samples to 10000.
[SINGLE MEAS]	Start the measurement sequence. At the end the resulting trace will display the CCDF for the measured 10000 samples.

Measurement of the AM Modulation Depth

MODULATION DEPTH

The *MODULATION DEPTH* softkey switches on the measurement of the AM modulation depth. An AM-modulated carrier is required on the screen for ensuring correct operation.
The level value of *MARKER 1* is taken as the carrier level. When this function is activated, *MARKER 2* and *MARKER 3* are automatically set symmetrically to the carrier on the adjacent peak values of the trace as delta markers and *MARKER 2* is activated for the entry.
When the position of *MARKER 2* (delta) is changed, *MARKER 3* (delta) is moved symmetrically with respect to the reference marker (*MARKER 1*).
If the data entry is activated for *MARKER 3* (*MARKER 1 2 3 4* softkey), the latter can be moved for fine adjustment irrespective of *MARKER 2*.

The FSU calculates the power at the marker positions from the measured levels. The AM modulation depth is calculated from the ratio between the power values at the reference marker and at the delta markers. When the powers of the two AM side bands are unequal, the mean value of the two power values is used for AM modulation depth calculation.

Measurement example:

The AM modulation depth of a carrier modulated with 1 kHz is to be measured at 100 MHz.

[**PRESET**]	The FSU is set to the default setting.
[**CENTER**: 100 **MHz**]	The center frequency is set to 100 MHz.
[**SPAN**: 5 **kHz**]	The span is set to 5 kHz.
[**AMPT**: 0 **dBm**]	The reference level is set to 0 dBm.
[**MKR FCTN**]	*MARKER 1* is switched on and positioned at the maximum of the displayed trace.
[*MODULATION DEPTH*: 1 **kHz**]	The measurement of the AM modulation depth is switched on. *MARKERS 2* and *3* (delta markers) are set to the adjacent peak values of the trace and are activated for the frequency entry. The AM modulation depth is output in % in the marker info field. When 1 kHz is entered, *MARKER 2* can be exactly positioned on 1 kHz and *MARKER 3* at -1 kHz from the reference marker.

IEC/IEEE-bus command:

```
CALC:MARK:FUNC:MDEP ON;
CALC:MARK:FUNC:MDEP:RES?
```

Measurement of the Third Order Intercept (TOI)

If several signals are applied to a transmission twoport with nonlinear characteristic, intermodulation products appear at its output by the sums and differences of the signals. The nonlinear characteristic produces harmonics of the useful signals which intermodulate at the characteristic. The intermodulation products of lower order have a special effect since their level is largest and they are near the useful signals. The intermodulation product of third order causes the highest interference. It is the intermodulation product generated from one of the useful signals and the 2nd harmonic of the second useful signal in case of two-tone modulation.
The frequencies of the intermodulation products are above and below the useful signals. Fig. 4-11 shows intermodulation products P_{I1} and P_{I2} generated by the two useful signals P_{U1} and P_{U2}.

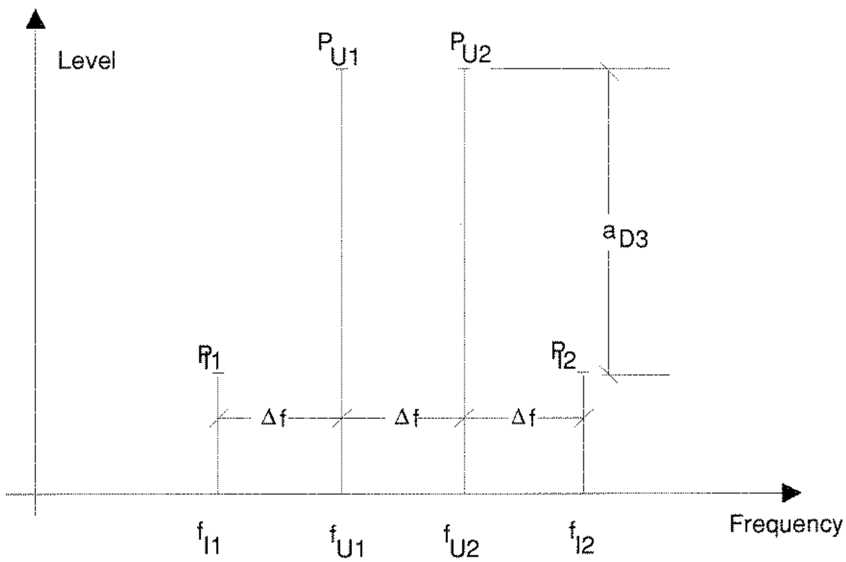


Fig. 4-11 Intermodulation products P_{U1} and P_{U2}

The intermodulation product at f_{I2} is generated by mixing the 2nd harmonic of useful signal P_{U2} and signal P_{U1}, the intermodulation product at f_{I1} by mixing the 2nd harmonic of useful signal P_{U1} and signal P_{U2}.

$f_{I1} = 2 \times f_{u1} - f_{u2}$ (1)

$f_{I2} = 2 \times f_{u2} - f_{u1}$ (2)

The level of the intermodulation products depends on the level of the useful signals. If the two useful signals are increased by 1 dB, the level of the intermodulation products increases by 3 dB, which means that spacing a_{D3} between intermodulation signals and useful signals is reduced by 2 dB. This is illustrated in Fig. 4-12.

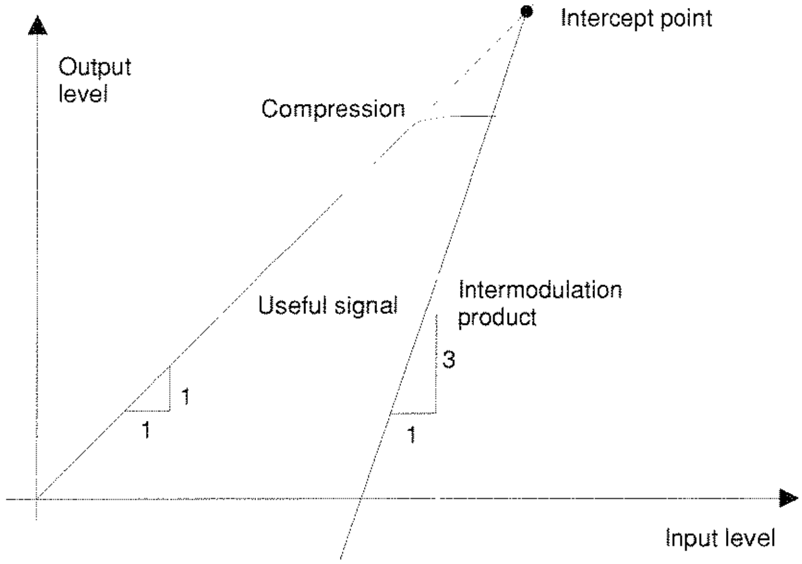


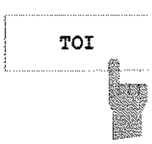
Fig. 4-12 Dependence of intermodulation level on useful signal level

The useful signals at the twoport output increase proportionally with the input level as long as the twoport is in the linear range. A level change of 1 dB at the input causes a level change of 1 dB at the output. Beyond a certain input level, the twoport goes into compression and the output level stops increasing. The intermodulation products of the third order increase three times as much as the useful signals. The intercept point is the fictitious level where the two lines intersect. It cannot be measured directly since the useful level is previously limited by the maximum twoport output power.
It can be calculated from the known line slopes and the measured spacing a_{D3} at a given level according to the following formula.

$$IP3 = \frac{a_{D3}}{2} + P_N \qquad (3)$$

The 3rd order intercept point IP3, for example, is calculated for an intermodulation of 60 dB and an input level P_U of -20 dBm according to the following formula:

$$IP3 = \frac{60}{2} + (-20dBm) = 10dBm. \qquad (4)$$



The *TOI* softkey enables the measurement of the 3rd order intercept point.
A two-tone signal with equal carrier levels is expected at the FSU input. *MARKER 1* and *MARKER 2* (both normal markers) are set to the maximum of the two signals. *MARKER 3* and *MARKER 4* (both delta markers) are placed on the intermodulation products. When the function is enabled, the frequency entry is activated for the delta markers. They can be set manually.
The FSU calculates the third order intercept from the level spacing between normal markers and delta markers and outputs it in the marker info field.

IEC/IEEE-bus command: `CALC:MARK:FUNC:TOI ON;`
`CALC:MARK:FUNC:TOI:RES?`

Example:

A two-tone signal with frequencies of 100 MHz and 101 MHz is applied to the RF input of the FSU. The level of the two signals is -10 dBm.

[**PRESET**]	The FSU is set to the default setting.
[**CENTER**: 100.5 **MHz**]	The center frequency is set to 100.5 MHz.
[**SPAN**: 3 **MHz**]	The span is set to 3 MHz.
[**AMPT**: -10 **dBm**]	The reference level is set to -10 dBm.
[*MKR FCTN*]	*MARKER 1* is switched on and set to the signal peak.
[*TOI*]	The FSU sets the 4 markers to the useful signals and the intermodulation products and calculates the third order intercept. The result is output in the marker info field.

The *SELECT MARKER* softkey activates the selection of a marker for functions *MODULATION DEPTH* and *TOI*. Thus, the markers can be fine-adjusted for these functions.
The markers are numerically selected in a data entry field. Delta marker 1 is selected by entering '0'.
If the marker is in the switch-off state, it will be switched on and can thus be shifted.

IEC/IEEE-bus command:

```
CALC:MARK1 ON;
CALC:MARK1:X <value>;
CALC:MARK1:Y?
```

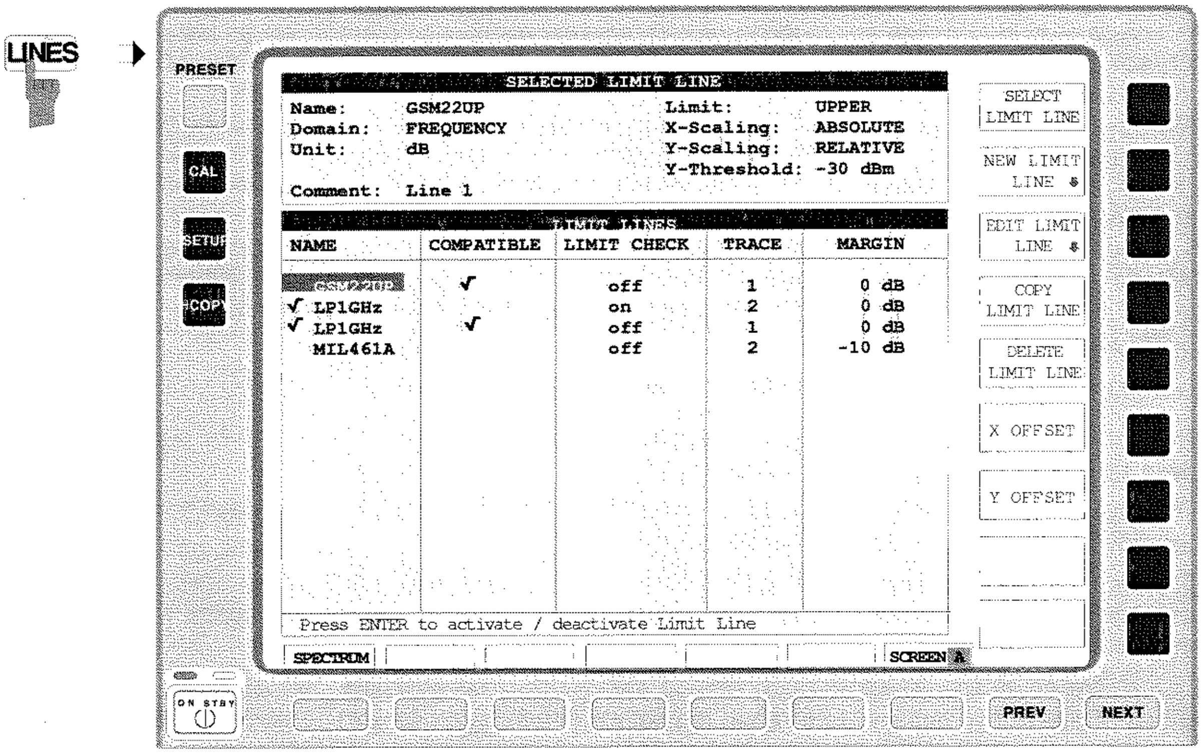
Setup of Limit Lines – *LINES* Key

Limit lines are used to define amplitude curves or spectral distribution boundaries on the display screen which are not to be exceeded. They indicate, for example, the upper limits for interference radiation or spurious waves which are allowed from a Unit Under Test (UUT). For transmission of information in TDMA (e.g., GSM), the amplitude of the bursts in a time slot must adhere to a curve which must fall within a specified tolerance band. The lower and upper limits may each be specified by a limit line. Then, the amplitude curve can be controlled either visually or automatically for any violations of the upper or lower limits (GO/NOGO test).
The instrument supports limit lines with a maximum of 50 data points. 8 of the limit lines stored in the instrument can be used simultaneously and activated in the split-screen mode either in Screen A, Screen B or in the two windows. The number of limit lines stored in the instrument is only limited by the capacity of the flashdisk used.

For each limit line, the following characteristics must be defined:

- The name of the limit line. The limit line data are stored under this name and can be examined in the table *LIMIT LINES.*
- The domain in which the limit line is to be used. Here, a distinction is made between the time domain (span = 0 Hz) and the frequency domain (span > 0 Hz).
- The reference of the interpolation points to the X-axis. The limit line may be specified either for absolute frequencies or times or for frequencies which are related to the set center frequency and times related to the time on the left edge of the diagram.
- The reference of the interpolation points to the Y-axis. The limit line can be selected either for absolute levels or voltages or referred to the set maximum level (Ref Lvl). The position on the display depends on the REF LEVEL POSITION.
- With relative reference values for the Y axis, it is possible to enter an absolute threshold (THRESHOLD) which lowers the relative limit values (see below).
- The type of limit line (upper or lower limit). With this information and the active limit checking function (Table LIMIT LINES, column *LIMIT CHECK*), the FSU checks for compliance with each limit.
- The limit line units to be used. The units of the limit line must be compatible with the level axis in the active measurement window.
- The measurement curve (trace) to which the limit line is assigned. For the FSU, this defines the curve to which the limit is to be applied when several traces are simultaneously displayed.
- For each limit line, a margin can be defined which serves as a threshold for automatic evaluation.
- In addition, commentary can be written for each limit line, e.g., a description of the application.

LINES menu



The *LINES* key calls up the menu for setup of the limit lines.

The *SELECTED LIMIT LINE* display field provides information concerning the characteristics of the marked limit lines.

In the *LIMIT LINES* table, the limit lines compatible to the settings of the active screen can be enabled.

New limit lines can be specified and edited in the *NEW LIMIT LINE and EDIT LIMIT LINE* sub-menus, respectively.

Limit Line Selection

LINES menu

The *SELECTED LIMIT LINES* table provides information about the characteristics of the marked limit line :

Name	name
Domain	frequency or time
Unit	vertical scale
Limit	upper/lower limit
X-Scaling	absolute or relative frequencies/times
Y-Scaling	absolute or relative Y-units
Threshold	absolute limit with relative Y-units
Comment	commentary

The characteristics of the limit line are set in the *EDIT LIMIT LINE (=NEW LIMIT LINE)* sub-menu.

SELECT LIMIT LINE

The *SELECT LIMIT LINE* softkey activates the *LIMIT LINES* table and the selection bar jumps to the uppermost name in the table.

The following information is offered in the columns of the table:

Name	Enable the limit line.
Compatible	Indicates if the limit line is compatible with the measurement window of the given trace.
Limit Check	Activate automatic violation check for upper/lower limits.
Trace	Select the measurement curve to which the limit is assigned.
Margin	Define margin.

Name and Compatible **- Enabling limit lines**

A maximum of 8 limit lines can be enabled at any one time. In split screen mode, they may be assigned to screen A, screen B or to both screens. A check mark at the left edge of a cell indicates that this limit line is enabled.
A limit line can only be enabled when it has a check mark in the *Compatible* column, i.e., only when the horizontal display (time or frequency) and vertical scales are ***identical*** to those of the display in the measurement window.
Lines with the unit dB are compatible to all dB(..) settings of the Y-axis.

If the scale of the y-axis or the domain (frequency or time axis) are changed, all non-compatible limit lines are automatically switched off in order to avoid misinterpretation. The limit lines must be enabled anew when the original display is re-displayed.

IEC/IEEE-bus command:

```
CALC:LIM3:NAME "GSM1"
CALC:LIM3:UPP:STAT ON
CALC:LIM4:LOW:STAT ON
```

***Limit Check* - Activate automatic limit violation check**

When *LIMIT CHECK ON* is activated, a GO/NOGO test is performed in the active screen. In the center of the diagram, a display window appears which indicates the results of the limit check test:

LIMIT CHECK: PASSED	No violations of active limits.
LIMIT CHECK: FAILED	One or more active limit lines were violated. The message contains the names of the limit lines which were violated or whose margins were not complied with.
LIMIT CHECK: MARGIN	The margin of at least one active limit lines was not complied with, however, no limit line was violated. The message contains the names of the limit lines whose margins were not complied with.

The following example shows two active limit lines:

```
LIMIT CHECK: FAILED

LINE VHF_MASK: Failed
LINE UHF2MASK: Margin
```

A check for violations of limit lines takes place only if the limit line of the assigned measurement curve (trace) is enabled.
If *LIM CHECK* is set to *OFF* for all active limit lines, then the limit line check is not executed and the display window is activated.

IEC/IEEE-bus command: `CALC:LIM:STAT ON`
`INIT;*WAI`
`CALC:LIM:FAIL?`

***Trace* - Select the measurement curve to which the limit line is assigned.**

The selection of the measurement curve (trace) takes place in an entry window. Allowed are the integer entries 1, 2 or 3. The default setting is trace 1. If the selected limit line is not compatible with the assigned measurement curve, then the limit line is disabled (display and limit check).

IEC/IEEE-bus command: `CALC:LIM:TRAC 1`

NEW LIMIT LINE

See following Section "Entry and Editing of Limit Lines".

EDIT LIMIT LINE

COPY LIMIT LINE

The *COPY LIMIT LINE* softkey copies the data file describing the marked limit line and saves it under a new name. In this way, a new limit line can be easily generated by parallel translation or editing of an existing limit line. The name can be arbitrarily chosen and input via an entry window (max. of 8 characters).

IEC/IEEE-bus command: `CALC:LIM3:COPY 2` or
`CALC:LIM3:COPY "GSM2"`

DELETE LIMIT LINE

The *DELETE LIMIT LINE* softkey erases the selected limit line. Before deletion, a message appears requesting confirmation.

IEC/IEEE-bus command: `CALC:LIM3:DEL`

X OFFSET

The *X OFFSET* softkey horizontally shifts a limit line, which has been specified for relative frequencies or times (X-axis). The softkey opens an entry window, where the value for shifting may be entered numerically or via the roll-key.

Note: *When changing the start or stop frequencies, the line on the display is only retained, if SPAN FIXED is set.*

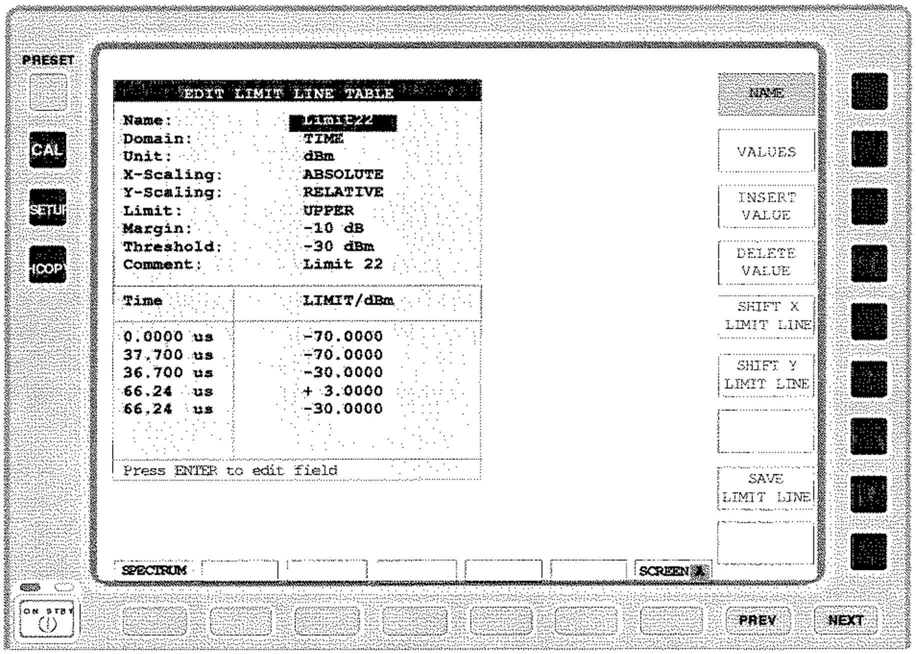
IEC/IEEE-bus command: `CALC:LIM3:CONT:OFFS 10kHz`

Y OFFSET

The *Y OFFSET* softkey vertically shifts a limit line, which has relative values for the Y-axis (levels or linear units such as volt). The softkey opens an entry window where the value for shifting may be entered numerically or via the roll-key.

IEC/IEEE-bus command: `CALC:LIM3:LOW:OFFS 3dB`
`CALC:LIM3:UPP:OFFS 3dB`

Entry and Editing of Limit Lines



A limit line is characterized by

- its name
- the assignment of domain (frequency or time)
- the scaling in absolute or relative times or frequencies
- the vertical unit
- the vertical scaling
- the vertical threshold (only with relative vertical scaling)
- the margin
- the definition of the limit line as either upper or lower limit.
- the data points for frequency/time and level

At the time of entry, the FSU immediately checks that all limit lines are in accordance with certain guidelines. These guidelines must be observed if specified operation is to be guaranteed.

- The frequencies/times for each data point must be entered in ascending order, however, for any single frequency/time, two data points may be input (vertical segment of a limit line).

  The data points are allocated in order of ascending frequency/time. Gaps are not allowed. If gaps are desired, two separate limit lines must be defined and then both enabled.

- The entered frequencies/times must not necessarily be selectable in FSU. A limit line may also exceed the specified frequency or time domains. The minimum frequency for a data point is -200 GHz, the maximum frequency is 200 GHz. For the time domain representation, negative times may also be entered. The allowable range is -1000 s to +1000 s.

- The minimum/maximum value for a limit line is -200 dB to +200 dB for the logarithmic or 10^{-20} to 10^{+20} or -99.9% to + 999.9% for the linear amplitude scales.

LINES - EDIT LIMIT LINE menu

EDIT LIMIT LINE

NEW LIMIT LINE

The *EDIT LIMIT LINE* and *NEW LIMIT LINE* softkeys both call the *EDIT LIMIT LINE* sub-menu used for editing limit lines. In the table heading, the characteristics of the limit line can be entered. The data points for frequency/time and level values are entered in the columns.

Name	Enter name.
Domain	Select domain.
Unit	Select units.
Limit	Select upper and lower limit value.
X-Scaling	Entry of absolute or relative values for the X-axis
Y-Scaling	Entry of absolute or relative values for the Y-axis
Margin	Entry of margin.
Threshold	Entry of vertical threshold (only with relative vertical scaling)
Comment	Enter comments.
Time/Frequency	Enter time/frequency for the data points.
Limit/dBm	Enter magnitudes for the data points.

Note: *Domain, unit, X scaling and Y scaling cannot be modified as soon as reference values have been entered in the data section of the table.*

NAME

The *NAME* softkey enables the entry of characteristics in the table heading.

***Name* - Enter name**

A maximum of 8 characters is permitted for each name. All names must be compatible with the MS DOS conventions for file names. The instrument stores all limit lines with the .LIM extension.

IEC/IEEE-bus command: `CALC:LIM3:NAME "GSM1"`

***Domain* - Select time or frequency domain**

The default setting is frequency.
A change in domain (frequency/time) is only permitted when the data point table is empty.

IEC/IEEE-bus command: `CALC:LIM3:CONT:DOM FREQ`

***Scaling* - selection of absolute or relative scaling**

The limit line can either be scaled in absolute (frequency or time) or relative units. Any of the unit keys may be used to toggle between *ABSOLUTE* and *RELATIVE*, the cursor must be positioned in the X-*Scaling* or the *Y-Scaling* line

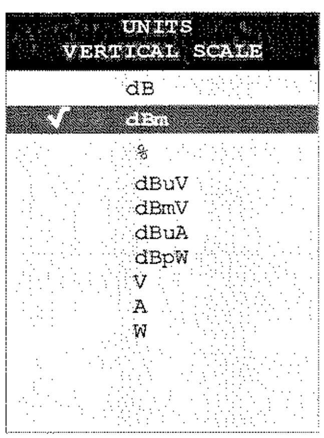
X-Scaling ABSOLUTE	The frequencies or times are interpreted as absolute physical units.
X-Scaling RELATIVE	In the data point table, the frequencies are referred to the currently set center frequency. In time domain mode, the left boundary of the diagram constitutes the reference.
Y-Scaling ABSOLUTE	The limit values refer to absolute levels or voltages.
Y-Scaling RELATIVE	The limit values refer to the reference level (Ref Level) or, in case a reference line is set, to the reference line. Limit values with the unit dB are always relative values.

The *RELATIVE* scaling is always suitable, if masks for bursts are to be defined in the time domain, or if masks for modulated signals are required in the frequency domain.
An X-offset with half the sweep time may be entered in order to shift the mask in the time domain into the center of screen.

IEC/IEEE-bus command: `CALC:LIM3:CONT:MODE ABS`
`CALC:LIM3:UPP:MODE ABS`
`CALC:LIM3:LOW:MODE ABS`

***Unit* - Select the vertical scale units for the limit line**

The selection of units takes place in a selection box. The default setting is dBm.



IEC/IEEE-bus command: `CALC:LIM3:UNIT DBM`

***Limit* - Select upper/lower limit**

A limit line can be defined as either an upper or lower limit.

IEC/IEEE-bus command: --
`(defined by key words :UPPer or :LOWer)`

***Margin* - Setting a margin.**

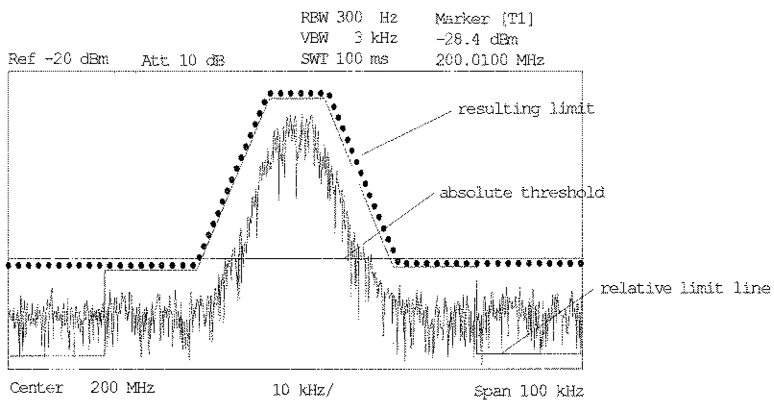
The margin is defined as the signal-level distance to the limit line . When the limit line is defined as an upper limit, the margin means that the level is below the limit line. When the limit line is defined as a lower limit, the margin means that the level is above the limit line. The default setting is 0 dB (i.e., no margin).

IEC/IEEE-bus command: `CALC:LIM3:UPP:MARG 10dB`
`CALC:LIM3:LOW:MARG 10dB`

***Threshold* – Selection of the threshold value with relative Y scaling**

With relative Y scaling, an absolute threshold value can be defined which lowers the relative limit values. The function is useful especially for mobile radio applications provided the limit values are defined in relation to the carrier power as long as they are above an absolute limit value.

Example:



The preset value is at -200 dBm. The field is displayed if the value RELATIVE is entered in the field Y-SCALING.

IEC/IEEE-bus command: `CALC:LIM3:UPP:THR -30 dBm`
or
`CALC:LIM3:LOW:THR -30 dBm`

***Comment* - Enter comments**

Comments are arbitrary, however, they must be less than 41 characters long.

IEC/IEEE-bus command: `CALC:LIM3:COMM "Upper limit"`

VALUES

The *VALUES* softkey activates the entry of the data points in the table columns *Time/Frequency* and *Limit/dB*. Which table columns appear depends upon the *Domain* selection in the table heading.

The desired frequency/time data points are entered in ascending order (two repeated frequencies/time values are permitted).

IEC/IEEE-bus command: `CALC:LIM3:CONT:DATA 1MHz,3MHz,30MHz`
`CALC:LIM3:UPP:DATA -10,0,0`
`CALC:LIM3:LOW:DATA -30,-40,-40`

INSERT VALUE

The *INSERT VALUE* softkey creates an empty line above the current cursor position where a new data point may be entered. However, during the entry of new values, it is necessary to observe an ascending order for frequency/time.

IEC/IEEE-bus command: --

DELETE VALUE

The *DELETE VALUE* softkey erases the data point (complete line) at the cursor position. All succeeding data points are shifted down accordingly.

IEC/IEEE-bus command: --

SHIFT X LIMIT LINE

The *SHIFT X LIMIT LINE* softkey calls an entry window where the complete limit line may be shifted parallel in the horizontal direction.

The shift takes place according to the horizontal scale:

- in the frequency domain in Hz, kHz, MHz or GHz
- in the time domain in ns, µs, ms or s

In this manner, a new limit line can be easily generated based upon an existing limit line which has been shifted horizontally and stored (*SAVE LIMIT LINE* softkey) under a new name (*NAME* softkey).

IEC/IEEE-bus command: `CALC:LIM3:CONT:SHIF 50KHz`

SHIFT Y LIMIT LINE

The *SHIFT Y LIMIT LINE* softkey calls an entry window where the complete limit line may be shifted parallel in the vertical direction.

The shift takes place according to the vertical scale:

- for logarithmic units, relative, in dB
- for linear units, as a factor

In this manner, a new limit line can be easily generated based upon an existing limit line which has been shifted vertically and stored (*SAVE LIMIT LINE* softkey) under a new name (*NAME* softkey).

IEC/IEEE-bus command: `CALC:LIM3:CONT:UPP:SHIF 20dB`
`CALC:LIM3:CONT:LOW:SHIF 20dB`

SAVE LIMIT LINE

The *SAVE LIMIT LINE* softkey stores the currently edited limit line . The name can be entered in an input window (max. 8 characters)

IEC/IEEE-bus command: --

Configuration of Screen Display – *DISP* Key

The *DISPLAY* menu allows the configuration of the diagram display on the screen and also the selection of the display elements and colors. The *POWER SAVE* mode is also configured in this menu for the display.

The test results are displayed on the screen of the FSU either in a full-screen window or in two overlapping windows. The two windows are called diagram A and diagram B.

In the default setting, the two windows are completely decoupled from each other, ie they behave like two separate instruments. This is very useful, for example with harmonics measurements or measurements on frequency-converting DUTs, since the input signal and the output signal lie in different frequency ranges.

However, specific settings of the two windows (reference level, center frequency) can be coupled, if required, so that with *CENTER B = MARKER A* for example, the shift of the marker in diagram A causes the frequency range (zoomed in some cases) to be shifted along diagram B.

New setttings are performed in the diagram selected via hotkey SCREEN A or SCREEN B. If only one window is displayed, it is the diagram in which the measurements are performed; the diagram not displayed is not active for measurements.

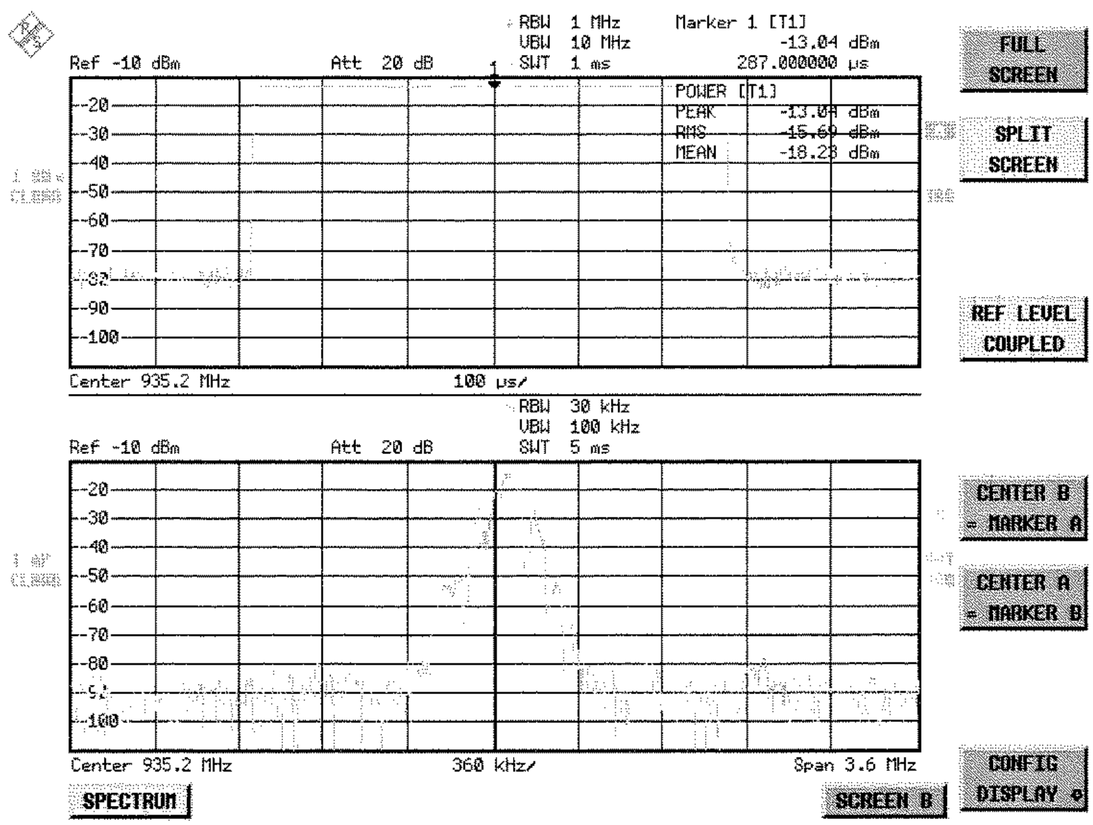
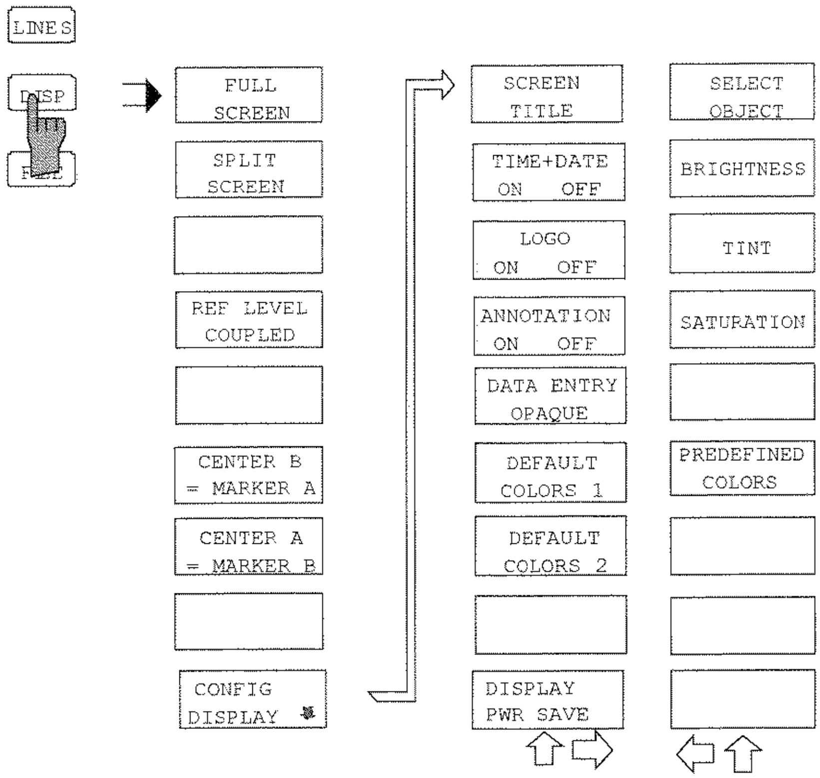
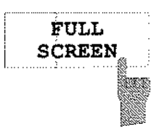


Fig. 4-12 Typical split-screen display, settings are uncoupled

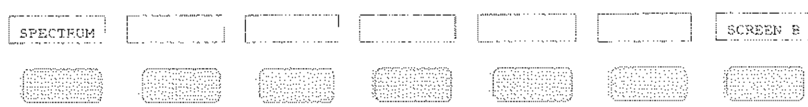
The *DISP* key opens the menu for configuring the screen display and selecting the active diagram in SPLIT SCREEN mode.





The *FULL SCREEN* softkey selects the display of one diagram. This corresponds to the default setting of FSU.

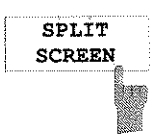
In the *FULL SCREEN* mode it is possible to switch between two different device settings by selecting the active window (screen A or screen B). Switching between *SCREEN A* and *SCREEN B* is performed by means of the corresponding key in the *HOTKEY bar.*



It should be noted that the measurements in the FULL SCREEN mode are performed only in the visible (active) window.

The active window is marked by A or B on the right of the diagram.

IEC/IEEE-bus command: `DISP:FORM SING`
`DISP:WIND<1|2>:SEL`



The *SPLIT SCREEN* softkey selects the display of two diagrams. The upper diagram is designated *SCREEN A*, the lower diagram *SCREEN B.*

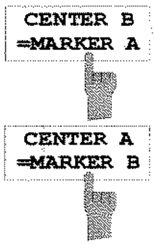
Switching between *SCREEN A* and *SCREEN B* is performed via the corresponding key in the *HOTKEY* bar. The active window is marked by highlighting fields A and B on the right of the diagram.

IEC/IEEE-bus command: `DISP:FORM SPL`

The *REF LEVEL COUPLED* softkey switches the coupling of the reference level on and off. In addition to the reference level, the mixer level and input attenuation are coupled with one another.

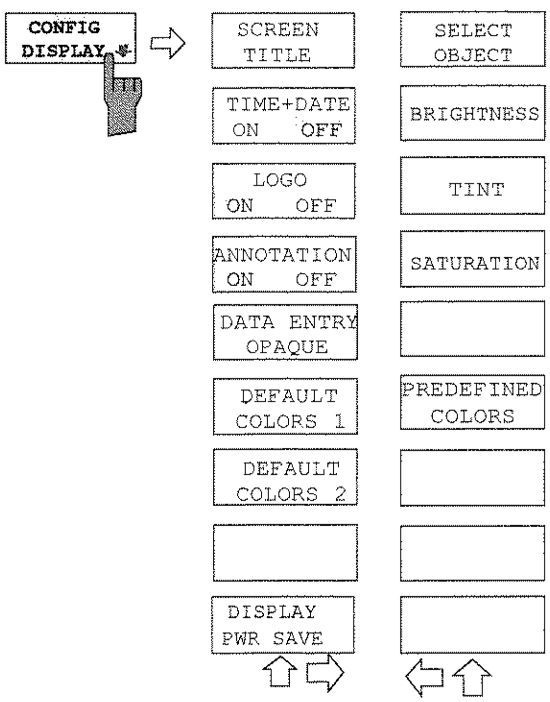
For the level measurement, the same reference level and input attenuation must be set for the two diagrams.

IEC/IEEE-bus command `INST:COUP RLEV`

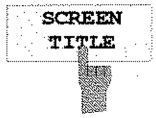


The *CENTER B = MARKER A and CENTER A = MARKER B* softkeys couple the center frequency in diagram B with the frequency of marker 1 in diagram A and the center frequency in diagram B with the frequency of marker 1 in diagram B. The two softkeys are mutually exclusive.
This coupling is useful, eg for viewing the signal at the marker position in diagram A with higher frequency resolution or in the time domain in diagram B.
If marker 1 is off, it is switched on and set to the maximum of the trace in the active diagram.

IEC/IEEE-bus command: `INST:COUP CF_B`
`INST:COUP CF_A`



The CONFIG DISPLAY softkey opens a submenu allowing additional display items to be added to the screen. In addition, the display power-save mode (*DISPLAY PWR SAVE*) and the colors of the display elements can be set here.



The *SCREEN TITLE* softkey activates the entry of a title for the active diagram A or B. It switches on or off a title that is already input. The length of the title is limited to max. 20 characters.

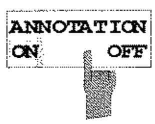
IEC/IEEE-bus command: `DISP:WIND1:TEXT 'Noise Meas'`
`DISP:WIND1:TEXT:STATe ON`

The *TIME+DATE ON/OFF* softkey switches on or off the display of date and time above the diagram.

IEC/IEEE-bus command: `DISP:TIME OFF`

The *LOGO ON/OFF* softkey switches the Rohde & Schwarz company logo displayed in the upper left corner of the display screen on or off.

IEC/IEEE-bus command: `DISP:LOGO ON`

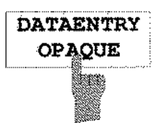


The *ANNOTATION ON/OFF* softkey switches the displaying of frequency information on the screen on and off.

ON Frequency information is displayed.

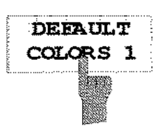
OFF Frequency information is not outputted to the display. This can be used for example to protect confidential data.

IEC/IEEE-bus command: `DISP:ANN:FREQ ON`



The *DATAENTRY OPAQUE* softkey sets the data entry windows to opaque. This means that entry windows are underlayed with the background color for tables.

IEC/IEEE-bus command: --



The *DEFAULT COLORS 1 and 2* softkey restores the default settings for brightness, color tint and color saturation for all display screen elements.
The color schemes have been selected to give optimum visibility of all picture elements at an angle of vision from above or below. *DEFAULT COLORS 1* is active in the default setting of the instrument.

IEC/IEEE-bus command: `DISP:CMAP:DEF1`
`DISP:CMAP:DEF2`

DISPLAY PWR SAVE

The *DISPLAY PWR SAVE* softkey is used to switch on/off the power-save mode for the display and to enter the time for the power-save fuction to respond. After the elapse of this time the display is completely switched off, ie including backlighting.

Note: *This mode is recommended for saving the TFT display especially when the instrument is exclusively operated in remote control.*

The power-save mode is configured as follows:

- The first keystroke activates the power-save mode and opens the editor for the response time (*POWER SAVE TIMEOUT*). The response time is entered in minutes between 1 and 6 minutes and is confirmed by *ENTER*.
- The power-save mode is deactivated by pressing the key again.

On leaving the menu with the power-save mode in the activated state, the softkey is highlighted in color on returning to the menu and opens again the editor for the response time. Pressing again the key switches off the power-save mode.

IEC/IEEE-bus command: `DISP:PSAV ON`
`DISP:PSAV:HOLD 15`

SELECT OBJECT

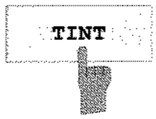
The *SELECT OBJECT* softkey activates the *SELECT DISPLAY* OBJECT table, with which a graphics element can be selected. After selection, the brightness, tint and saturation of the selected element can be changed using the softkeys of the same name. The color changes by means of the *PREDEFINED COLORS* softkey can be seen immediately on the display screen.

SELECT DISPLAY OBJECT
√ Background
Grid
Function field + status field + data entry text
Function field LED on
Function field LED warn
Enhancement label text
Status field background
Trace 1
Trace 2
Trace 3
Marker
Lines
Measurement status + limit check pass
Limit check fail
Table + softkey text
Table + softkey background
Table selected field text
Table selected field background
Table + data entry field opaq titlebar
Data entry field opaq text
Data entry field opaq background
3D shade bright part
3D shade dark part
Softkey state on
Softkey state data entry
Logo

The *BRIGHTNESS* softkey activates entry of the brightness of the selected graphics element.

Values between 0 and 100% can be entered.

IEC/IEEE-bus: DISP:CMAP3:HSL< hue>,<sat>,<lum>



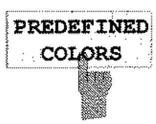
The *TINT* softkey activates the entry of the color tint of the selected element. The entered value is related to a continuous color spectrum ranging from red (0%) to blue (100%).

IEC/IEEE-bus: DISP:CMAP3:HSL <hue>,<sat>,<lum>

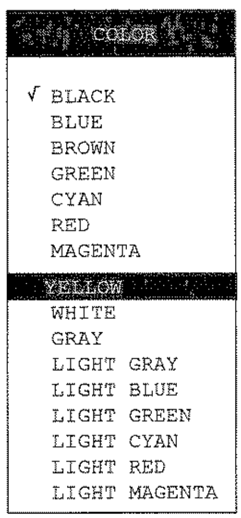
The *SATURATION* softkey activates the entry of the color saturation for the selected element.

The range of inputs is from 0 to 100%.

IEC/IEEE-bus: DISP:CMAP3:HSL <hue>,<sat>,<lum>



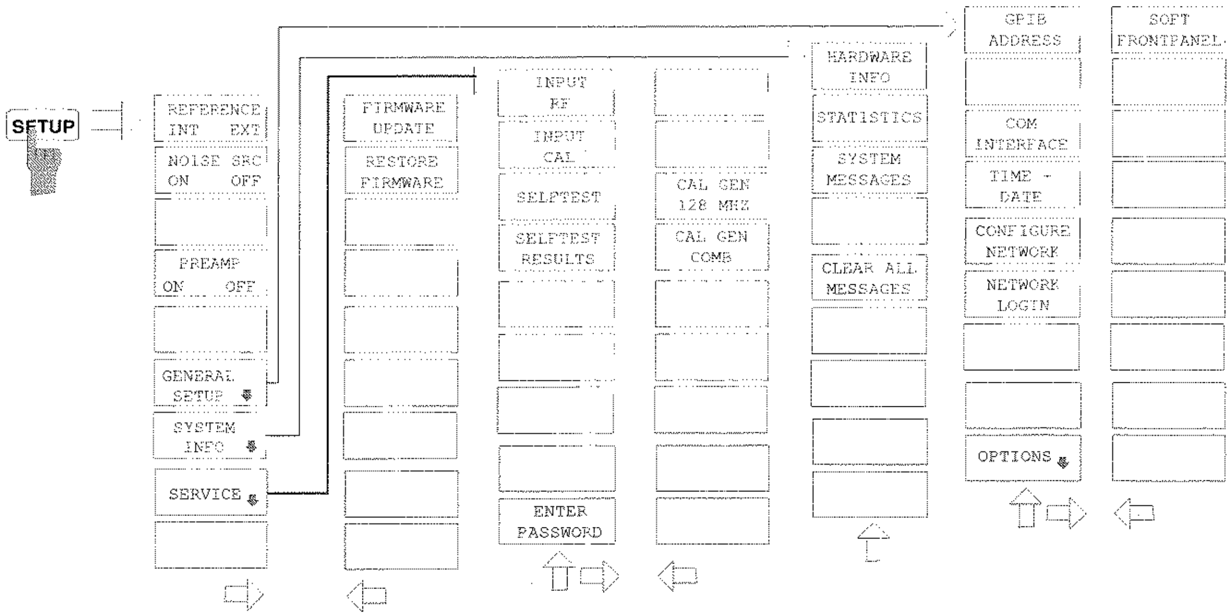
The *PREDEFINED COLORS* softkey activates a table, with which the predefined colors for the diplay screen elements can be selected.



IEC/IEEE-bus command: DISP:CMAP1 to 26:PDEF <color>

Instrument Setup and Interface Configuration – *SETUP* Key

The *SETUP* key opens the menu for configuration of the FSU:



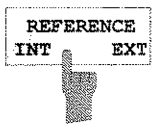
The following settings can be modified here:

- The *REFERENCE INT/EXT* softkey determines the source of the reference
- The *NOISE SRC ON/OFF* softkey switches on and off the voltage supply for an external noise source.
- The PREAMP softkey switches on the RF preamplifier gain. This softkey is only available with option EL. ATTENUATOR (B25).
- The *GENERAL SETUP* softkey opens a submenu for all the general settings such as IEC/IEEE-bus address, date and time as well as the configuration of the device interfaces. *FIRMWARE OPTIONS* can be installed under this menu item.
- The *SYSTEM INFO* softkey opens a submenu for displaying the hardware configuration of the instrument, the switching cycle statistics and system messages.
- The *SERVICE* softkey opens a submenu in which special device functions and system information can be selected for servicing. The password required for service functions can be entered in this submenu.
- The *SERVICE FUNCTIONS* softkey enables additional special settings for servicing and troubleshooting. It is available after entering the corresponding password under the *SERVICE* softkey.

External Reference Oscillator

The FSU can use the internal reference source or an external reference source as frequency standard from which all internal oscillators are derived. A 10 MHz crystal oscillator is used as internal reference source. In the default setting (internal reference), this frequency is available as output signal at rear-panel connector REF OUT, eg to synchronize other instruments to the reference of the FSU.
In the setting REFERENCE EXT, the connector REF IN is used as input connector for an external frequency standard. In this case all internal oscillators of the FSU are synchronized to the external reference frequency (also 10 MHz).

SETUP menu:



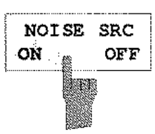
The *REFERENCE INT / EXT* softkey switches between the internal and external reference.

Note: *If the reference signal is missing when switching to external reference, the message "EXREF" appears after a while to indicate that there is no synchronization.*
On switching to internal reference please ensure that the external reference signal is de-activated to avoid interactions with the internal reference signal.

IEC/IEEE-bus command: `ROSC:SOUR INT`

External Noise Source

SETUP menu:

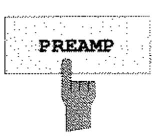


The *NOISE SRC ON/OFF* softkey switches on or off the supply voltage for an external noise source which is connected to the *NOISE SOURCE* connector on the rear panel of the instrument.

IEC/IEEE-bus command: `DIAG:SERV:NSO ON`

RF Preamplifier

To improve the noise figure, a low-noise preamplifier with variable gain at the RF input can be switched into the signal path.
SETUP menu:



The *PREAMP* softkey switches the preamplifier on and activates the entry of the preamplifier gain. The preamplifier is switched off by pressing the softkey again.
The only possible value with option el. attenuator is 20 dB.

IEC/IEEE-bus command: `INP:GAIN 0DB`

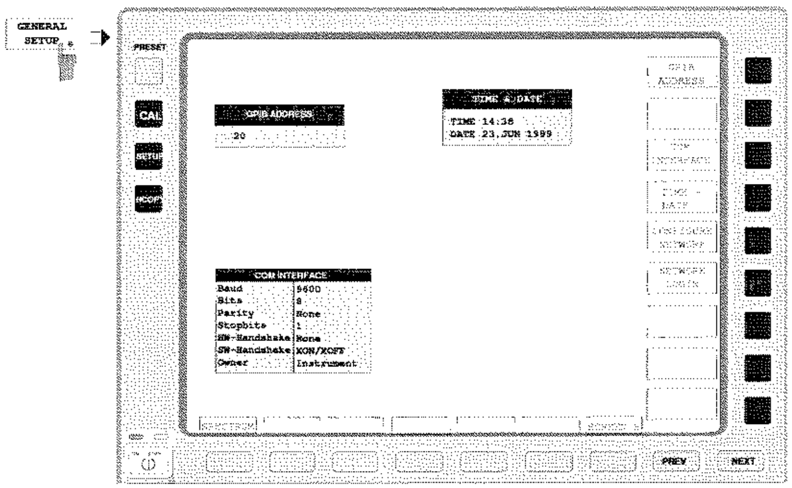
Note: *The PREAMP softkey is only available with option EL. ATTENUATOR (B25).*

Programming the Interface Configuration and Time Setup

The *GENERAL SETUP* softkey opens a sub-menu in which the general instrument parameters can be set up. In addition to the configuration of the digital interfaces (*IECBUS, COM*), the date and time may be entered.

The current settings are displayed in tabular form on the display screen where they may be edited.

SETUP - GENERAL SETUP submenu:



Selecting the IEC/IEEE-bus address

SETUP - GENERAL SETUP submenu:

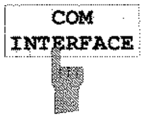
The *GPIB ADDRESS* softkey activates the entry of the IEC Bus address.

Valid addresses are 0 through 30. The default setting is address 20.

IEC/IEEE-bus command: `SYST:COMM:GPIB:ADDR 20`

Serial Interface Configuration

SETUP-GENERAL SETUP submenu:



The *COM INTERFACE* softkey activates the *COM INTERFACE* table for entry of the serial interface parameters.

The following parameters can be configured in the table:

Baud rate	data transmission rate
Bits	number of data bits
Parity	bit parity check
Stop bits	number of stop bits
HW-Handshake	hardware handshake protocol
SW-Handshake	software handshake protocol
Owner	assignment to the measuring instrument or computer

COM INTERFACE	
Baud	9600
Bits	8
Parity	None
Stopbits	1
HW-Handshake	None
SW-Handshake	XON/XOFF
Owner	Instrument

Baud – Data transmission rate

The FSU supports baud rates between 110 and 19200 baud. The default setting is 9600 baud.

BAUD RATE
19200
√ 9600
4800
1200
600
300
110

IEC/IEEE-bus command: `SYST:COMM:SER:BAUD 9600`

***Bits* – Number of data bits per word**

For the transmission of text without special characters, 7 bits are adequate. For binary data as well as for text with special characters, 8 bits must be selected (default setting).

BITS
√ 7
8

IEC/IEEE-bus command: `SYST:COMM:SER:BITS 7`

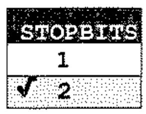
Parity **– Bit parity check**

NONE	no parity check (default setting)
EVEN	even parity check
ODD	odd parity check

IEC/IEEE-bus command: `SYST:COMM:SER:PAR NONE`

Stop bits **– Number of stop bits**

Available are 1 and 2. The default setting is 1 stop bit.



IEC/IEEE-bus command: `SYST:COMM:SER:SBIT 1`

HW-Handshake **– Hardware handshake protocol**

The integrity of data transmission can be improved by the use of a hardware handshake mechanism, which effectively prevents uncontrolled transmission of data and the resulting loss of data bytes. For hardware handshake additional interface lines are used to transmit acknowledge signals with which the data transmission can be controlled and, if necessary, stopped until the receiver is ready to receive data again.

A prerequisite for using hardware handshaking is, however, that the interface lines (DTR and RTS) are connected on both transmitter and receiver. For a simple 3-wire connection, this is not the case and hardware handshake cannot be used here.

Default setting is *NONE*.

IEC/IEEE-bus command:
```
SYST:COMM:SER:CONT:DTR OFF
SYST:COMM:SER:CONT:RTS OFF
```

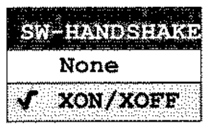
SW-Handshake – Software handshake protocol

Besides the hardware handshake mechanism using interface lines, it is also possible to achieve the same effect by using a software handshake protocol. Here, control bytes are transmitted in addition to the normal data bytes. These control bytes can be used, as necessary, to stop data transmission until the receiver is ready to receive data again.

In contrast to hardware handshaking, software handshaking can be realized even for a simple 3-wire connection.

One limitation is, however, that software handshaking cannot be used for the transmission of binary data, since the control characters XON and XOFF require bit combinations that are also used for binary data transmission.

Default setting is *NONE*.



IEC/IEEE-bus command: `SYST:COMM:SER:PACE NONE`

Owner – Assignment of the interface

The serial interface can be assigned alternatively to the measuring instrument section or to the computer section

If the interface is assigned to one section of the instrument, it is not available to the other section.

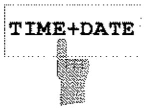
INSTRUMENT — The interface is assigned to the measuring instrument section. Outputs to the interface from the computer section are not possible will get lost.

OS — The interface is assigned to the computer section. It cannot be used by the measuring instrument section. This means that remote control of the instrument via the interface is not possible.

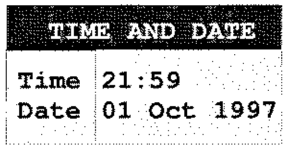
IEC/IEEE-bus command: --

Setting Date and Time

SETUP-GENERAL SETUP submenu:



The *TIME+DATE* softkey activates the entry of time and date for the internal real time clock.



Time - Input of time

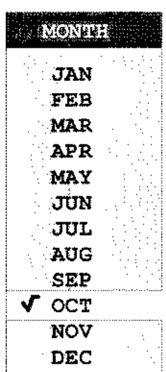
In the corresponding dialog box, the time is partitioned into two input fields so that hours and minutes can be entered independently.

IEC/IEEE-bus command: `SYST:TIME 21,59`

Date - Input of Date

In the corresponding dialog box, the date is partitioned into 3 input fields so that day, month and year can be input separately.

For the selection of the month, pressing a unit key opens a list of abbreviations wherein the desired month can be selected.



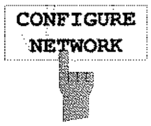
IEC/IEEE-bus command: `SYST:DATE 1999,10,01`

Configuration of network settings (with option FSU-B16 only)

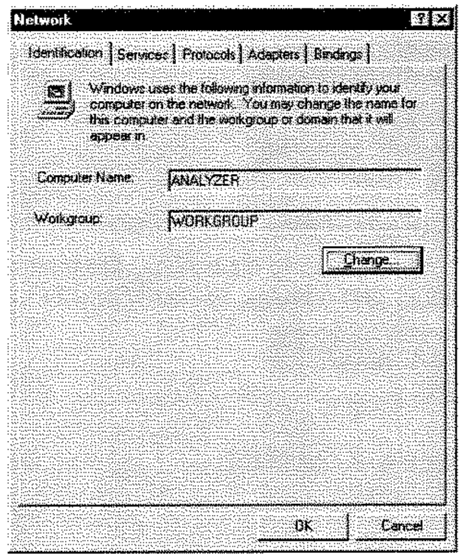
The instrument can be connected to an Ethernet LAN (local area network) by means of the LAN Interface Option FSU-B16. This allows data transmission via the network and the use of network printers. The network card is able to handle both 10 MHz Ethernet IEEE 802.3 and 100 MHz Ethernet IEEE 802.3u.

For more details see section 'LAN Interface - Option FSU-B16'.

SETUP - GENERAL SETUP - menu:



The *CONFIGURE NETWORK* softkey opens the dialog box with the network settings.



Pressing the key for the first time installs the Windows NT network support (see section 'Installation and Configuration of the Driver for the Network Card' in the manual for LAN Interface FSU-B16) .

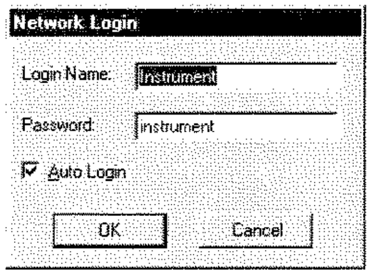
If the softkey is pressed again later, the existing network configuration can be changed after selecting the corresponding configuration folder. After pressing the 'Change' button the computer name and the work group on the 'Identification' folder can be adapted to network requirements.

Note:
A PC keyboard with trackball (or mouse instead) is required for the installation/configuration of the network support.
The softkey is only available with built-in LAN interface option (FSU-B16).

IEC/IEEE-bus command: –

NETWORK LOGIN

The *NETWORK LOGIN* softkey opens the dialog box with the auto login settings.



When a network is installed, the preset user name 'Instrument' and the password 'instrument' can be adapted to a new user (see section 'Defining Users' in the LAN interface manual).
With the 'Auto Login' option active, an automatic registration is performed during booting with the specified user name and password. Otherwise the Windows NT login request is displayed during booting.

Note:
A PC keyboard with trackball (or additional mouse instead) is required for the installation/configuration of the network support.

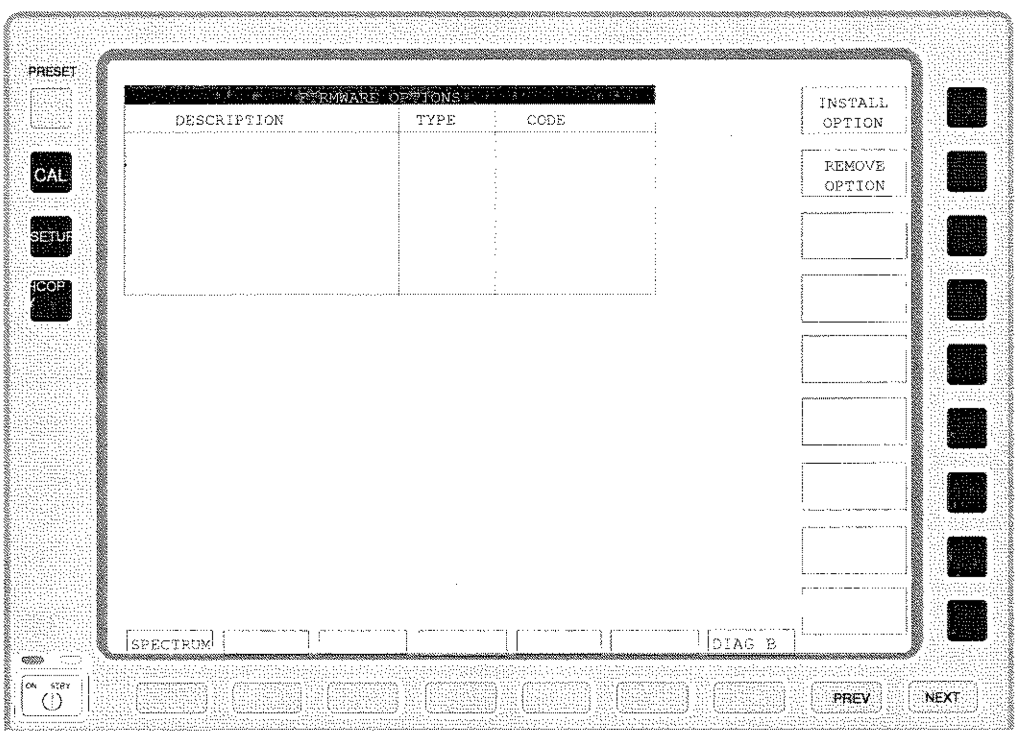
The softkey is only available with built-in LAN interface option (FSU-B16).

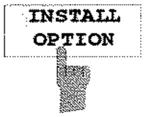
IEC/IEEE-bus command: -

Enabling Firmware Options

Softkey *OPTIONS* opens a submenu that allows license keys for firmware options to be entered. Previously installed options are displayed in a table that opens automatically.

OPTIONS



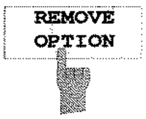


Softkey *INSTALL OPTION* opens the data entry for the license keycode of a firmware option.

On entry of a valid license key the message *OPTION KEY OK* is displayed in the status line and the firmware option appears in table *FIRMWARE OPTIONS* .

On entry of an invalid license key the message *OPTION KEY INVALID* is displayed in the status line.

IEC-Bus-Befehl: --

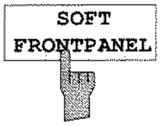


Softkey *REMOVE OPTION* removes all firmware options from the instruments. Execution of this function must be confirmed in a message box in order to avoid removal of the firmware options by mistake.

IEC-Bus-Befehl: --

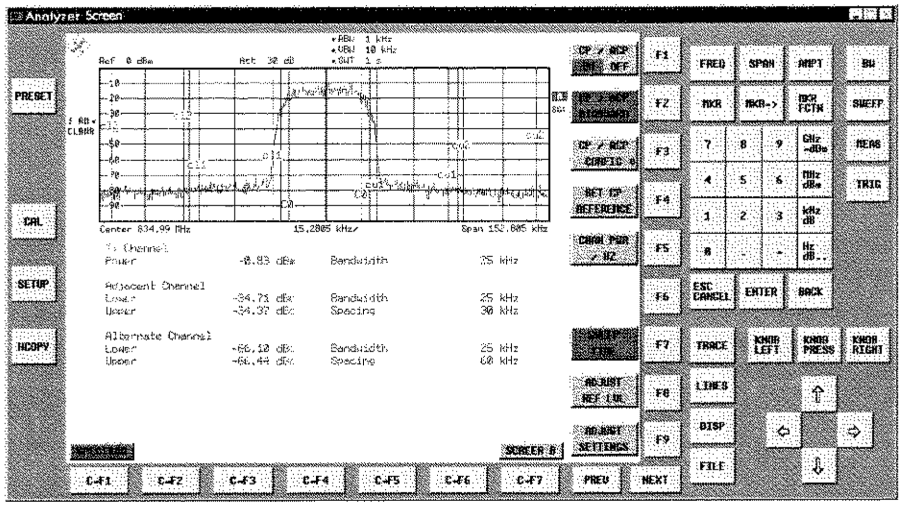
Emulation of the instrument front panel

SETUP - GENERAL SETUP – NEXT menu:



The *SOFT FRONTPANEL* softkey switches the display of the front-panel keys on and off.

When the front-panel keys are displayed on the screen, the instrument can be controlled by clicking the respective button with the mouse. This is especially useful when the instrument in a different site is controlled via a remote-control program, like for instance PCANYWHERE, and the screen contents are transferred to the controller via remote link.



Note:

Display resolution:

When the display of the front-panel keys is switched on, the screen resolution of the instrument changes to 1024x768 pixels. Only a section of the total screen is then displayed on the LC display, which will automatically be shifted on mouse moves.

In order to obtain a complete display of the user interface, an external monitor is to be plugged into the corresponding connector at the rear panel. Prior to performing the resolution change the user is prompted for confirmation whether the required monitor is connected.

Switching off the front-panel display restores the original screen resolution.

Key assignment:

Button labels largely correspond to those of the front-panel keys. The rotation function of the rotary knob is assigned to the 'KNOB LEFT' and 'KNOB RIGHT' buttons, the press function (<ENTER>) to 'KNOB PRESS'.

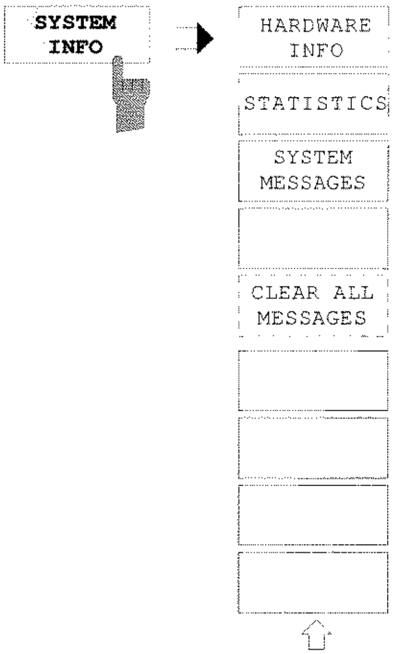
The labels of the softkey buttons (F1 to F9) and of the hotkey buttons (C-F1 to C-F7) indicate that the keys can be operated directly by means of the corresponding function keys F1 to F9 or <CTRL>F1 to <CTRL>F7 of a PS/2 keyboard.

IEC/IEEE-bus command: `SYST:DISP:FPAN ON`

System Information

The *SYSTEM INFO* softkey opens a submenu in which detailed information on module data, device statistics and system messages is displayed.

SETUP menu:



Display of Module Data

SETUP SYSTEM INFO submenu:

HARDWARE INFO

The *HARDWARE INFO* softkey opens a table in which the modules (INSTALLED COMPONENTS) installed in the instrument are listed together with the corresponding hardware revisions.

Table *HARDWARE INFO* consists of six columns:

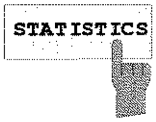
SERIAL #	serial number
COMPONENT	name of module
ORDER #	order number
MODEL	model number of the module
REV	main modification index of the module
SUB REV	secondary modification index of the module

HARDWARE INFO

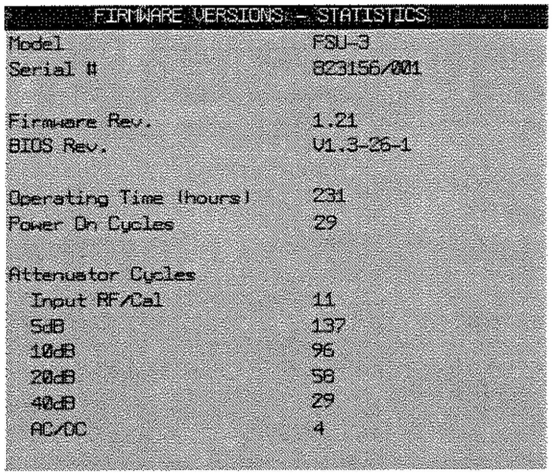
COMPONENT	SERIAL #	ORDER #	MODEL	HWC	REV	SUB REV
DETECTOR	755429/072	1130.2196	02	10	02	02
SYNTHESIZER	755429/005	1130.2096	02	00	04	05
RF-CONVERTER	756775/003	1130.1990	02	00	06	03
IF-FILTER	755058/010	1130.2296	02	00	03	03
RF_ATTEN_8	756778/005	1137.0599	00	00	02	00

Display of Device Statistics

SETUP SYSTEM INFO submenu:



The *STATISTICS* softkey opens the table *STATISTICS*. This table contains the model information, serial number and firmware version, and a list in which the operating time of the instrument, the power-on cycles as well as attenuator switching cycles are displayed.



FIRMWARE VERSIONS - STATISTICS

Model	FSU-3
Serial #	823156/001
Firmware Rev.	1.21
BIOS Rev.	V1.3-26-1
Operating Time (hours)	231
Power On Cycles	29
Attenuator Cycles	
Input RF/Cal	11
5dB	137
10dB	96
20dB	58
40dB	29
AC/DC	4

IEC/IEEE-bus command: --

Display of System Messages

SETUP SYSTEM INFO submenu:

SYSTEM MESSAGES

The *SYSTEM MESSAGES* softkey opens a submenu including a table in which the generated system messages are displayed in the order of their occurrance. The most recent messages are placed at the top of the list.
The following information is available:

No	Device specific error code
MESSAGE	Brief description of the message
COMPONENT	On hardware messages: name of the affected module On Software messages: if needed, the name of the affected software components
DATE/TIME	Date and time of the occurrence of the message

Messages that have occurred since the last call to the *SYSTEM MESSAGES* menu are marked with an asterisk '*'.
The CLEAR ALL MESSAGES softkey is activated and allows clearing of the error buffer.

If the number of error messages exceeds the capacity of the error buffer, the message appearing first is "Message buffer overflow".

SYSTEM INFO

No	MESSAGE	COMPONENT	DATE/TIME
01	No of cycles	Attenuator	05.Jan.99 10:02:00
02	VCO unlock	Frontend	05.Jan.99 10:01:30
03	Calamp range	IF Filter	05.Jan.99 10:00:50
04	3.3V: Voltage	Detector	04.Jan.99 15:58:10
05	I2C-Bus failed	CPU	04.Jan.99 15:58:05

IEC/IEEE-bus command: `SYST:ERR?`

CLEAR ALL MESSAGES

The *CLEAR ALL MESSAGES* softkey deletes all messages in the table.
The softkey is only available when table *SYSTEM INFO* is active.

IEC/IEEE-bus command: `SYST:ERR?`

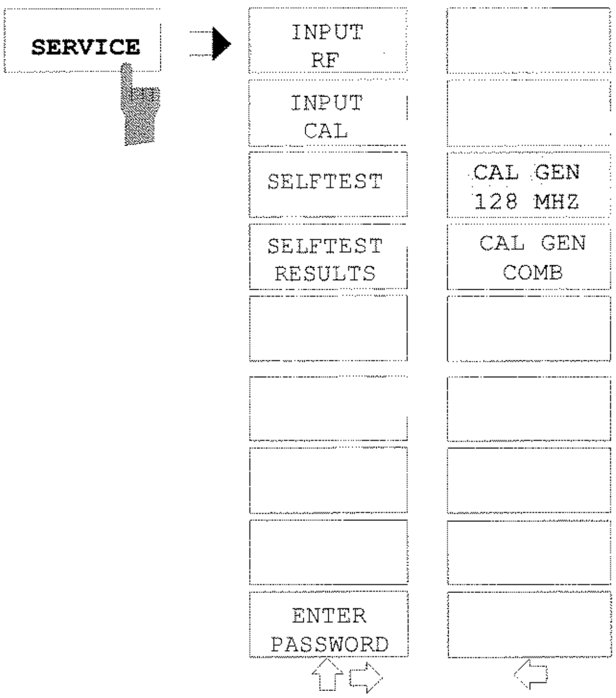
Service Menu

The service menu offers a variety of additional functions which are used for maintenance and/or trouble shooting.

Caution:

The service functions are not necessary for normal measurement operation. However, incorrect use can affect correct operation and/or data integrity of the FSU.
Therefore, many of the functions can only be used after entering a password. They are described in the instrument service manual.

SETUP menu:

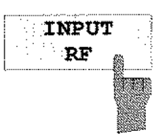


The *SERVICE* softkey opens a submenu for selection of the service function.

The *INPUT RF* and *INPUT CAL* softkeys are mutually exclusive selection switches. Only one switch can be active at any one time.

General Service Functions

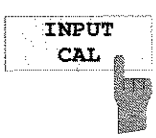
SETUP SERVICE submenu:



The *INPUT RF* softkey switches the input of the FSU to the input connector (normal position).

After *PRESET*, *RECALL* or FSU power on, the *INPUT RF* is always selected.

IEC/IEEE-bus command: `DIAG:SERV:INP RF`



The *INPUT CAL* softkey switches the RF input of the FSU to the internal calibration source (128 MHz) and activates the data entry of the output level of the calibration source. Possible values are 0 dB and –30 dB.

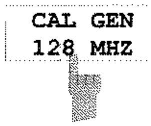
IEC/IEEE-bus command: `DIAG:SERV:INP CAL;`
`DIAG:SERV:INP:CSO 0 DBM`

The *ENTER PASSWORD* softkey allows the entry of a password.

The FSU contains a variety of service functions which, if incorrectly used, can affect correct operation of the analyzer. These functions are normally not accessible and are only usable after the entry of a password (see instrument service manual).

IEC/IEEE-bus command: `SYST:PASS "Password"`

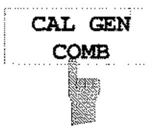
SETUP SERVICE NEXT submenu:



Softkey *CAL GEN 128 MHZ* selects a sinusodial signal at 128 MHz as output signal for the internal calibration source. The internal pulse generator will be switched off.

CAL GEN 128 MHZ is the default setting of the FSU.

IEC/IEEE-bus command: `DIAG:SERV:INP:PULS OFF`



Softkey *CAL GEN COMB* switches the pulse generator of the internal calibration source on. Additionally it allows selection of the pulse frequency. Available pulse frequencies are 10 kHz, 100 kHz, 1 MHz, 128 MHz and 640 MHz.

IEC/IEEE-bus command: `DIAG:SERV:INP:PULS ON;`
`DIAG:SERV:INP:PRAT 128MHZ`

Selftest

SETUP SERVICE submenu:

The *SELFTEST* softkey initiates the selftest of the instrument modules.

With this function the instrument is capable of identifying a defective module in case of failure.
During the selftest a message box appears in which the current test and its result is shown. The test sequence can be aborted by pressing ENTER ABORT.
All modules are checked consecutively and the test result (selftest PASSED or FAILED) is output in the message box.

IEC/IEEE-bus command: `*TST?`

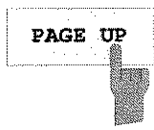
The *SELFTEST RESULTS* softkey calls the *SELFTEST* table in which the results of the module test are displayed.
In case of failure a short description of the failed test, the defective module, the associated value range and the corresponding test results are indicated.

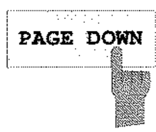
SELFTEST

SELFTEST: FAILED — 24.APR.1999 14:25 — Service level: 0

TEST	RESULT	VALID RANGE	VALUE
Voltages	OK		
Pretune DAC	OK		
Synthesizer	FAIL		
Frontend2 128MHz Ref unlock	FAIL	1.25V...3.5V	1.14V
Frontend1 384MHz Ref Input	OK	0.5...0.6V	0V
Signal Path	OK		

IEC/IEEE-bus command: `DIAG:SERV:STE:RES?`





The *PAGE UP* or *PAGE DOWN* softkey sets the *SELFTEST RESULTS* table to the next or previous page.

IEC/IEEE-bus command --

Hardware Adjustment

Some of the FSU modules can be re-aligned. This re-alignment can become necessary after calibration due to temperature drift or aging of components (see service manual instrument).

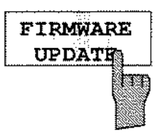
Caution:

The re-alignment should be carried out by qualified personnel since the changes considerably influence the measurement accuracy of the instrument. This is the reason why the softkeys REF FREQUENCY, CAL SIGNAL POWER and SAVE CHANGES can only be accessed after entering a password.

Firmware Update

The installation of a new firmware version can be performed using the built-in diskette drive. The firmware update kit contains several diskettes.
The installation program is called in the *SETUP* menu.

SETUP side menu:



The *FIRMWARE UPDATE* softkey starts the installation program and leads the user through the remaining steps of the update

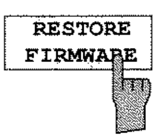
IEC/IEEE-bus command: --

The firmware update is started as follows:

Insert disk 1 into the floppy drive.

Call *SETUP* side menu via ***[SETUP][NEXT]***

Start the update via ***[FIRMWARE UPDATE]***



The *RESTORE FIRMWARE* softkey restores the previous firmware version

IEC/IEEE-bus command: --

Saving and Recalling Data Sets – *FILE* Key

The *FILE* key calls the following functions:

- Storage/loading functions for storing (*SAVE*) instrument settings such as instrument configurations (measurement/display settings, etc.) and measurement results from working memory to permanent storage media, or to load (*RECALL*) stored data into working memory.
- Functions for management of storage media (*FILE MANAGER*). Included are among others functions for listing files, formatting storage media, copying, and deleting/renaming files.

The FSU is capable of internally storing complete instrument settings with instrument configurations and measurement data in the form of data sets. The respective data are stored on the internal hard disk or, if selected, on a floppy. The hard-disk and floppy-disk drives have the following names:

floppy disk	A:
hard disk	D: (hard disk C: is reserved for instrument software)

In addition to the saving and recalling of complete instrument settings, it is also possible to save/recall subsets of settings. Configuration data and measurement values are stored in separate files. These files have the same name as the data set but however have a different extension. A data set thus consists of several files which have the same name but different extensions (see Table 4-2). Default setting for storing the data sets is directory D:\USER\CONFIG.

When saving or loading a data set, the subsets which are to be saved or loaded can be selected in the corresponding tables. This makes it easy to reconstruct specific instrument settings beside the default setting of the instrument.

When saving and loading data, data subsets are selected in table *SEL ITEMS TO SAVE/RECALL.*

The saved files of the data sets can be copied from one storage medium (e.g. drive C:) to another storage medium (e.g. drive A:) or to another directory using the functions found in the *FILE MANAGER* sub menu. File names and extensions must however not be changed. The relationship between the data subsets and the extensions is shown in Table 4-2.

Table 4-2 Relationship between extensions, contents and designations of data subsets

	Designation in the table SEL ITEMS TO SAVE/RECALL	**Contents**	**Extension**
Configuration data:	CURRENTSETTINGS	current settings of the measurement hardware and the related title, if present	.SET
		active limit lines	.LIN
		current configuration of general instrument parameters	.CFG
		configuration for hardcopy output	.HCS
Additional configuration data	ALL LIMIT LINES	all limit lines	.LIA
Measurement results:	ALL TRACES	measurement data trace 1 to trace 3, screen A	.TR1 to TR3
		measurement data trace 1 to trace 3, screen B	.TR4 to TR6

Saving a Data Set

- Select the data subsets to be saved (sub-menu *ITEMS TO SAVE/RCL* (configurations, measurement and calibration data) (softkey *ITEMS TO SAVE/RCL)* .
- Possibly enter a comment (softkey *EDIT COMMENT*)
- Enter the directory in which the data set should be saved in table *SAVE DATA SET* (softkey *SAVE*).
- Enter the name of the data set which should be saved (softkey *SAVE*) and save the data set by pressing the *ENTER* key.

  Data set names may contain both letters and numbers, in the simplest case only numbers.

  If required, the desired directory can be given a prefix to the data set name (the directory is then automatically set for further SAVE and RECALL operations).

  The simplest example for the input of a data set name is illustrated by the following key strokes:

  <SAVE> <1> <units key>

Note: *If the current instrument configuration is to be stored under an existing name, a selection list is available via the DATA SET LIST softkey. The storage is performed as follows.*

- *Press a units key after selecting a data set in table DATA SET LIST*

  The name and the selection of the data subsets for the currently selected data set will be placed in the SAVE DATA SET table.
- *Press the SAVE softkey.*

  The entry field EDIT NAME with the name of the selected data set is opened.
- *Press a units key.*
  The current instrument configuration is saved as a data set under this name.

Recalling a Data Set:

The data set can be loaded in two ways:

1. **Direct entry of the data name:**
   - Select data subsets which should be loaded (configurations, measurement and calibration data) with softkey *ITEMS TO SAVE/RCL* in sub menu *ITEMS TO SAVE/RCL).*
   - Enter the name of the data set to be saved (softkey *RECALL*) and recall the data set by pressing the *ENTER* key*).*

     Data set names may contain both letters and numbers, in the simplest case only numbers. If required, the desired directory can be prefixed to the data set name (the directory is then automatically set for further SAVE and RECALL operations).

     The simplest example for the input of a data set name is illustrated by the following key strokes: <RECALL> <1> <units key>

2. **Selecting the data set from a selection list:**
   - Select from submenu *ITEMS TO SAVE/RCL* the data subsets which should be loaded (configurations, measurement and calibration data) (softkey *ITEMS TO SAVE/RCL).*
   - Select the data set which should be loaded (Softkey *DATA SET LIST*) and confirm with *ENTER*. The data set is taken over in the *RECALL DATA SET* table.
   - Press the RECALL softkey. The entry field for the data set name is opened and contains the desired data set.
   - Initiate the loading of the selected data set by pressing the *ENTER* key.

Note: *If the set directory does not correspond to the required directory for loading, it can be changed as follows:*

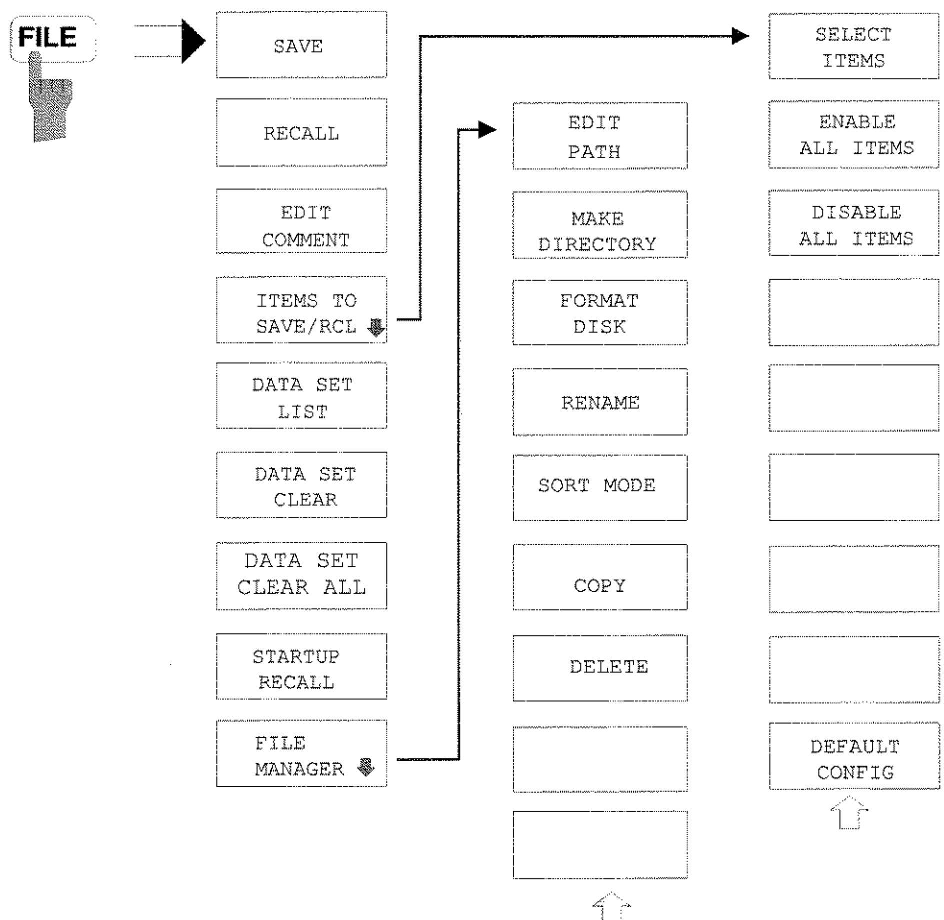
- *Press the RECALL softkey.*
- *Close the entry field for the data set name with ESC.*
- *Select the PATH filed with the cursor keys.*
- *Open the entry field for the directory name with ENTER.*
- *Enter the directory name and confirm with ENTER.*

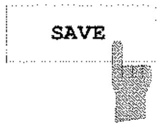
Then proceed with the selection list as described above.

Any settings not restored when data subsets are loaded will remain unchanged in the instrument. During recall operations, the FSU recognises which subsets are present in the recalled data set and ignores selected data subsets that are not available.

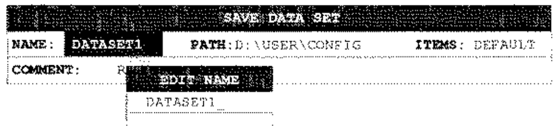
FILE Menu

FILE menu





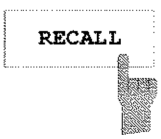
The *SAVE* softkey activates table *SAVE DATA SET*. The data set is stored by pressing the *ENTER* key.



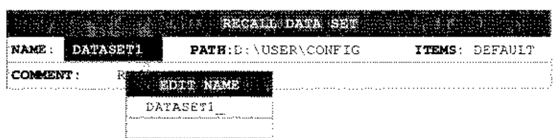
The *SAVE DATA SET* table contains the entry fields for editing the data set:

Name	name of data set The name can be entered with or without drive name and directory; the drive name and directory, if available, are then taken over in the PATH field. The extension of the data name is ignored.
Path	directory in which the data set will be saved
Items	indicates whether the default selection of the data subset (DEFAULT) or a user-defined selection (SELECTED) will be saved
Comment	Commentary regarding the data set

IEC/IEEE command: `MMEM:STOR:STAT 1,"a:\test02"`



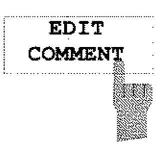
The *RECALL* softkey activates the entry of the path in which the data set is located. The data set is recalled by pressing the *ENTER* key.



The *RECALL DATA SET* table shows the current settings regarding the data set:

Name	name of data set
Path	directory in which the data set is located
Items	indicates whether the default selection of the data subset (DEFAULT) or a user-defined selection (SELECTED) will be recalled
Comment	Commentary regarding the data set

IEC/IEEE command: `MMEM:LOAD:STAT 1,"a:\test02"`

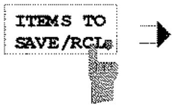


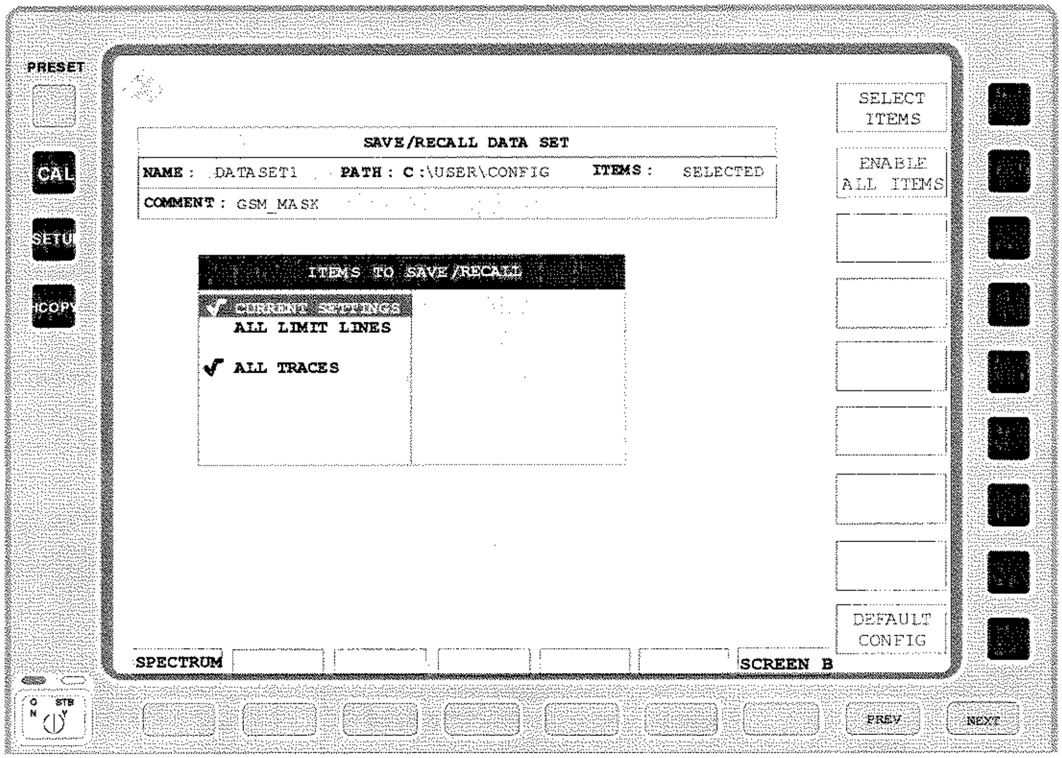
The *EDIT COMMENT* softkey activates the entry of commentary concerning the current data set. A total of 60 characters are available for this purpose.

IEC/IEEE command: `MMEM:COMM "Setup fuer GSM Messung"`

The *SEL ITEMS TO SAVE/RCL* softkey opens a sub-menu for selection of the data subsets.

FILE - ITEMS TO SAVE/RCL sub-menu:



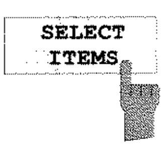


The *ITEMS TO SAVE/RECALL* table offers the following selectable data subsets:

Current Settings these settings include:

- current configuration of general instrument parameters
- current measurement hardware settings
- active limit lines:
  A data set may contain maximum 8 limit lines for each window. It always contain the activated limit lines and the de-activated limit lines used last, if any.
  Consequently, the combination of the restored de-activated limit lines depends on the sequence of use with command `MMEM:LOAD`.
- user-defined color settings
- configuration for hardcopy output
- active transducer*All Limit Lines* all limit lines

All Traces all traces which are not blanked



The *SELECT ITEMS* softkey moves the selection bar to the first line, left column of the table. An entry is selected by pressing the *ENTER* key in the desired line. The selection is cleared by pressing the key again.

IEC/IEEE command:

Current Settings:	`MMEM:SEL:HWS ON`
All Limit Lines:	`MMEM:SEL:LIN:ALL ON`
All Traces:	`MMEM:SEL:TRAC ON`

ENABLE ALL ITEMS

The *ENABLE ALL ITEMS* softkey marks all entries in the table.

IEC/IEEE command: `MMEM:SEL:ALL`

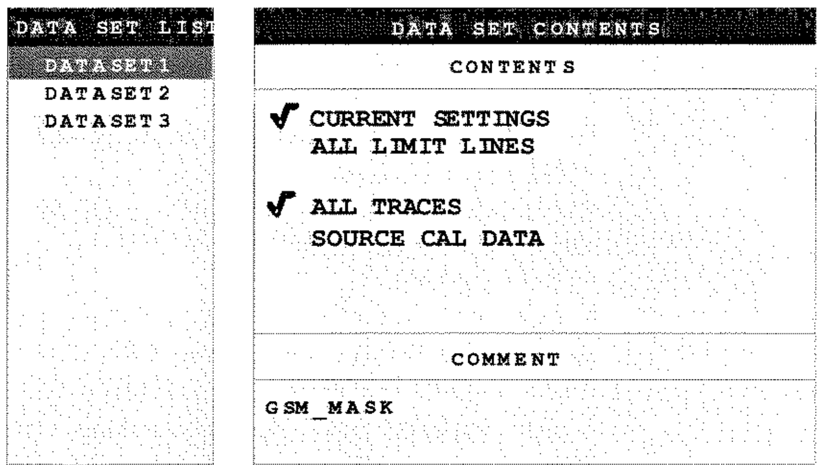
DEFAULT CONFIG

The *DEFAULT CONFIG* softkey establishes the default selection of the data subset to be saved and outputs *DEFAULT* in the *ITEMS* field of the *SAVE/RECALL DATA SET* table.

IEC/IEEE command: `MMEM:SEL:DEF`

DATA SET LIST

The *DATA SET LIST* softkey opens the *DATA SET LIST/CONTENTS* table. In addition, the *DATA SET CLEAR* and *DATA SET CLEAR ALL* softkeys are displayed.



The *DATA SET LIST* column lists all of the data sets which are stored in the selected directory.

The *CONTENTS* and *COMMENT* lines in the *DATA SET CONTENTS* column indicate the saved data subsets and the comment for the currently selected data set. A '-' prefixed to a data subset means that the latter is available in the instrument but that it has not been selected (see *SELECT ITEMS* softkey).

IEC/IEEE command: ---

DATA SET CLEAR

The *DATA SET CLEAR* softkey deletes the selected data set

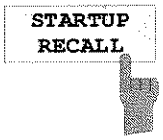
IEC/IEEE command: `MMEM:CLE:STAT 1, "test03"`

DATA SET CLEAR ALL

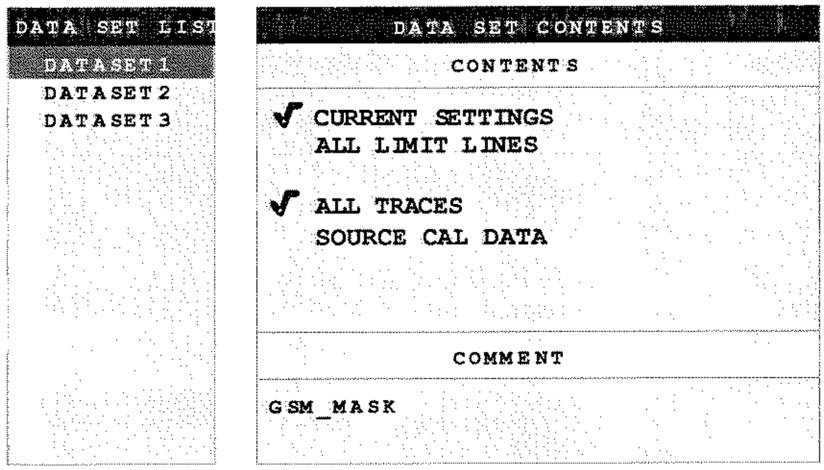
The *DATA SET CLEAR ALL* softkey deletes all data sets in the current directory.

Since, in this case, all available data sets are lost, confirmation by the user is required.

IEC/IEEE command: `MMEM:CLE:ALL`



The *STARTUP RECALL* softkey activates the selection of a data set which is automatically loaded when the instrument is powered on. For that purpose the table *DATA SET LIST/CONTENT* is opened (analog to *DATA SET LIST*).



The *DATA SET LIST* column displays all data sets present in the selected directory

The *CONTENTS* and *COMMENT* lines in the *STARTUP RECALL* column indicate the saved data subsets and the commentary for the currently selected data set.

In addition to the data sets stored by the user, the data set *FACTORY*, which specifies the settings of the instrument before it was last switched off (Standby), is always present.

If a data set other than *FACTORY* is chosen then, at the time of instrument power on, the available data subsets of the selected data set are recalled. The data subsets which are not present in this data set are taken from the *FACTORY* data set.

Note: *The specified data set is also loaded upon PRESET if STARTUP RECALL is active. The preset settiongs can thus be arbitrarily modified.*

IEC/IEEE command: `MMEM:LOAD:AUTO 1,"D:\user\config\test02"`

The *FILE MANAGER* softkey opens a menu for managing storage media and files.

FILE - FILE MANAGER sub-menu:

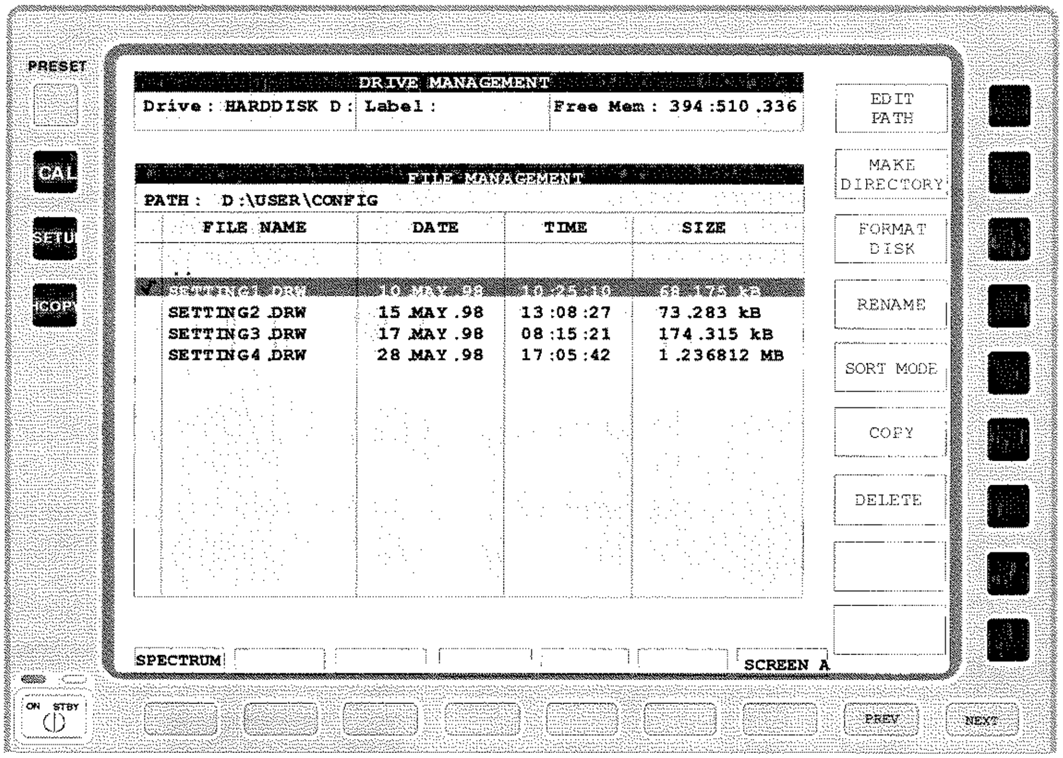
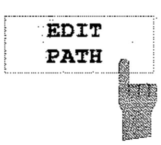


Table *Drive Management* displays the name and label of the storage medium as well as the available storage area.

Table *File Management* displays the files of the current directory and indicates if any subdirectories are present.

If a directory name is selected, the FSU automatically changes to this directory. Selection of the entry '..' moves the FSU to the next higher directory level.

Note: *It is not possible to change menus as long as a file operation is running.*



The *EDIT PATH* softkey activates the input of the directory which will be used in subsequent file operations.

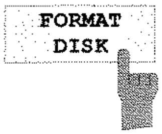
The new path is included in the *FILE MANAGEMENT* table.

IEC/IEEE command: `MMEM:MSIS "a:"`
`MMEM:CDIR "D:\user "`

The *MAKE DIRECTORY* softkey creates directories/sub-directories. Sub-directories are recommended for sorting files on the storage medium so that the structure is easier to comprehend.

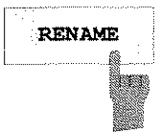
The entry of an absolute path name (e.g.; "\USER\MEAS") as well as the path relative to the current directory (e.g., "..\MEAS") is possible.

IEC/IEEE command: `MMEM:MDIR "D:\user\test"`



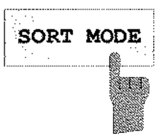
The *FORMAT DISK* softkey formats diskettes located in drive A:.
To prevent accidental destruction of diskette data, confirmation by the user is requested.

IEC/IEEE command: `MMEM:INIT "a:"`

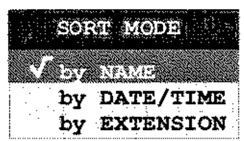


The *RENAME* softkey activates the entry of a new name for the selected file or directory.

IEC/IEEE command: `MMEM:MOVE "test02.cfg","set2.cfg"`

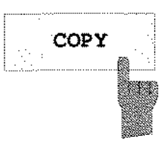


The *SORT MODE* softkey activates the selection of the criteria according to which the files listed in the *FILE MANAGEMENT* table may be sorted.



Directory names are located at the top of the list after the entry for the next higher directory level ("..").

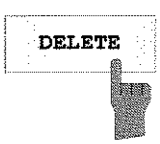
IEC/IEEE command: --



The *COPY* softkey activates the input of the destination of the copy operation.

By entering a predefined disk drive (e.g. C:), a file can also be copied to another storage medium. The files/directories selected by the cursor are copied after the input is confirmed by pressing the *ENTER* key.

IEC/IEEE command: `MMEM:COPY "D:\user\set.cfg","a:"`



The *DELETE* softkey deletes the selected files.
To prevent accidental deletion of data, confirmation by the user is requested.

IEC/IEEE command: `MMEM:DEL "test01.hcp"`
`MMEM:RDIR "D:\user\test"`

Measurement Documentation – *HCOPY* Key

Note: *The installation of additional printers is described in chapter 1, section "Installation and Configuration of Printers".*

Pressing one of the softkeys *PRINT...* in the *HCOPY* menu initiates the print job. The printer parameters defined in the *DEVICE SETTINGS* menu are used for setting up the printer configuration. All of the display items to be printed are written to the printer buffer. Since the printer runs in the background, the instrument may be operated immediately after pressing the *PRINT...* softkey.

With *PRINT SCREEN* selected, all the diagrams with traces and status displays are printed as they occur on the screen. Softkeys, open tables and data entry fields are not printed out. Function *PRINT TRACE* allows printing out individual traces. With *PRINT TABLE* tables can be printed out.

If the *PRINT TO FILE* option in the *DEVICE SETTINGS* table is selected the printout is directed to a file. Upon pressing one of the softkeys *PRINT...*, the file name to which the output data are to be written is requested. For this an entry field is opened for entering the file name.

While a print job is in progress, problems may occur in the output device. If, while printing, the output device issues a PAPER OUT message, i.e., no more paper is available, the user will be prompted by the following message

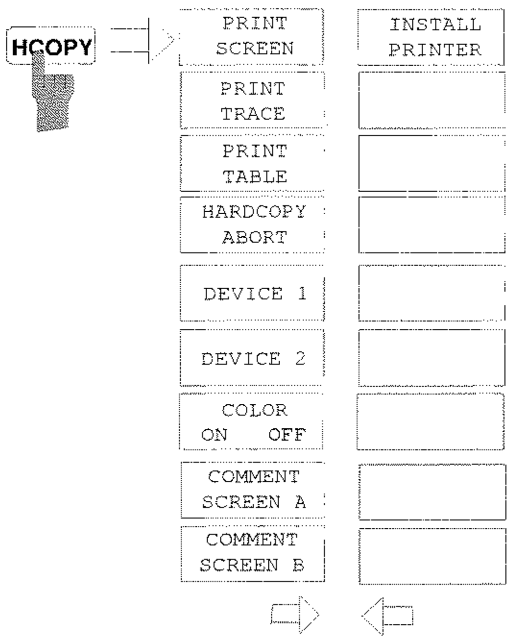
to load paper into the output device. The print job will then be either continued (CONTINUE selected) or aborted (ABORT selected).

Similar *SYSTEM MESSAGES* appear if the printer is offline, etc.

Selection between b/w and colored printouts is possible with softkey *COLOR ON/OFF* provided that the printer connected is able to output such prints. The colors of the printout correspond to those of the screen, i.e. a yellow trace will be output in yellow.
To change the colors of the objects on the printout, the screen colors have to be changed correspondingly in menu *DISPLAY*, submenu *CONFIG DISPLAY*. One exception is the color of the background and of the grid. The output background is always white irrespective of the screen color and the grid is always black.

The *HARDCOPY ABORT* softkey aborts a print job in progress.

HCOPY menu:



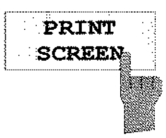
The *HCOPY* key opens the *HARDCOPY* menu for starting and configuring the printout.

The *PRINT SCREEN, PRINT TRACE and PRINT TABLE* softkeys start the desired printout, which can be aborted with HARDCOPY ABORT.

Selection and configuration of the output interface is performed via the DEVICE 1 and 2 softkeys.

The *COMMENT SCREEN A* and *COMMENT SCREEN B softkeys are available for adding comments to the hardcopy* (date and time are automatically added).

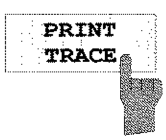
With the *INSTALL PRINTER* softkey other printer drivers can be installed.



The *PRINT SCREEN* softkey starts the output of test results.

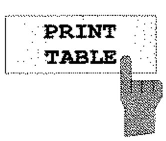
All the diagrams, traces, markers, marker lists, limit lines etc. are printed out as long as they are displayed on the screen. All the softkeys, tables and open data entry fields are not printed out. Moreover, comments, title, date, and time are output at the bottom margin of the printout .

IEC/IEEE-bus command: `HCOP:ITEM:ALL`
`HCOP:IMM`



The *PRINT TRACE* softkey starts the output of all curves visible on the display screen without auxiliary information. Specifically, <u>no</u> markers or display lines are printed.

IEC/IEEE-bus command: `HCOP:ITEM:WIND:TRAC:STAT ON`
`HCOP:IMM`



The *PRINT TABLE* softkey starts the output of all tables and info lists visible on the display screen without the measurement diagrams and other information lying behind.

IEC/IEEE-bus command: `HCOP:ITEM:WIND:TABL:STAT ON`
`HCOP:IMM`

HARDCOPY ABORT

The *HARDCOPY ABORT* softkey aborts the printout.

IEC/IEEE-bus command: `ABOR`

DEVICE 1

DEVICE 2

The *DEVICE 1/DEVICE 2* softkey determines the active output device.
Table *HARDCOPY DEVICE SETTINGS* is simultaneously opened for the configuration of the two possible devices. The selection bar marks the selected line of the table.

HARDCOPY DEVICE SETTINGS	
Device1	WINDOWS METAFILE
Print to File	YES
Orientation	---
Device2	CLIPBOARD
Print to File	---
Orientation	---

Device 1/2 In this lines, the selection of the output device/language for Device1 or Device2 is made.

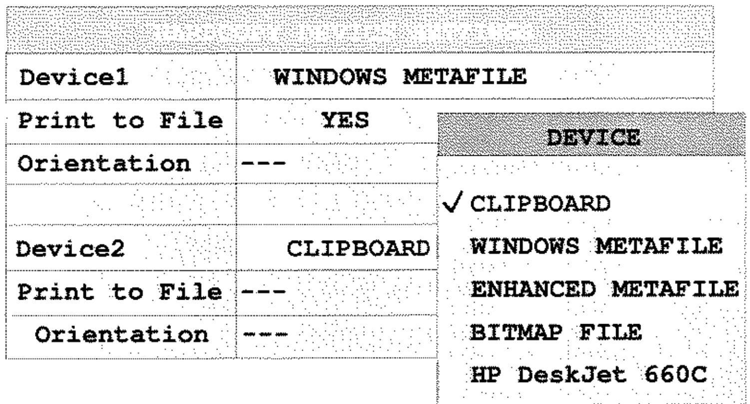
Print to File selects printout to file or printer

Orientation selects the print format of the output page

Device 1/ Device 2

The selection of the output device/language for *Device 1* and *Device 2* is made in this line.
After pressing the *ENTER* key, the list of all installed printers is displayed. Three file formats and the Windows NT clipboard are also available:

CLIPBOARD	output in Windows NT clipboard.
WINDOWS METAFILE or BITMAP FILE	output in file
ENHANCED METAFILE	output in file or Windows NT clipboard.



The installation of additional printers is described in chapter 1, section "Installation and Configuration of Printers".

Notes: *Selecting the type of printer automatically sets the parameters PRINT TO FILE and ORIENTATION to values which correspond to a standard mode with this output device. Other printer-dependent parameters, such as PAPERSIZE, can be modified under Windows NT in the printer properties window (START/SETTINGS/PRINTER/ SETTINGS). For operation of Windows NT, a mouse and an external keyboard have to be connected to instrument (see also Section "Installation and Configuration of Printers")*

IEC/IEEE-bus command:

```
HCOP:DEV:LANG GDI;
SYST:COMM:PRIN:ENUM:FIRS?;
SYST:COMM:PRIN:ENUM:NEXT?;
SYST:COMM:PRIN:SEL 'HP Deskjet 660 on LPT1';
HCOP:DEST "SYST:COMM:PRIN"
```

Print to File

In this line, directing the printout to the printer (OFF) or to a file (ON) is selected. For printout to a file, the user is prompted to enter a file name on starting the print.

Selecting the type of printer automatically sets this parameter to the value which corresponds to a standard mode with this output device.

IEC/IEEE-bus command: `HCOP:DEST "SYST:COMM:PRIN"` or
`HCOP:DEST "SYST:COMM:MMEM"`

Orientation

In this line, the print format of the output page is set to either vertical (= PORTRAIT) or horizontal (= LANDSCAPE).

IEC/IEEE-bus command: `HCOP:PAGE:ORI PORT`

COLOR
ON OFF

The *COLOR ON/ OFF* softkey selects a colored or b/w printout.

Colored background is printed white and colored lines are printed black in order to improve the contrast of the printout.
Default setting is *COLOR OFF*.

IEC/IEEE-bus command: `HCOP:DEV:COL ON`

COMMENT
SCREEN A

COMMENT
SCREEN B

The *COMMENT SCREEN A* or *B* softkey opens an entry field in which a comment of two lines (60 characters per line) can be entered for screen A or B.

If the user enters more than 60 characters, the excess characters appear on the second line on the print-out. At any point, a manual line-feed can be forced by entering the @ character.

The comment is printed below the corresponding diagram. The comment text appears on the print-out, but does not appear on the display screen.

If a comment is not to appear on the printout, it has to be deleted.
By pressing *PRESET*, all comments will be deleted.

IEC/IEEE-bus command: `HCOP:ITEM:WIND2:TEXT 'Comment'`

HCOPY side menu:

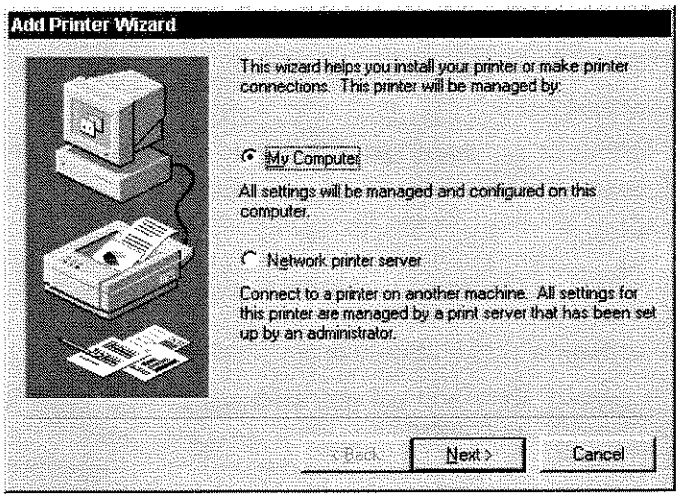
INSTALL
PRINTER

A certain number of printer drivers is already installed on the FSU.
The *INSTALL PRINTER* softkey opens the "Printers" window where further printer drivers can be installed (see section "Installation of a local printer" and "Installation of Network Printer").

IEC/IEC-bus command: –

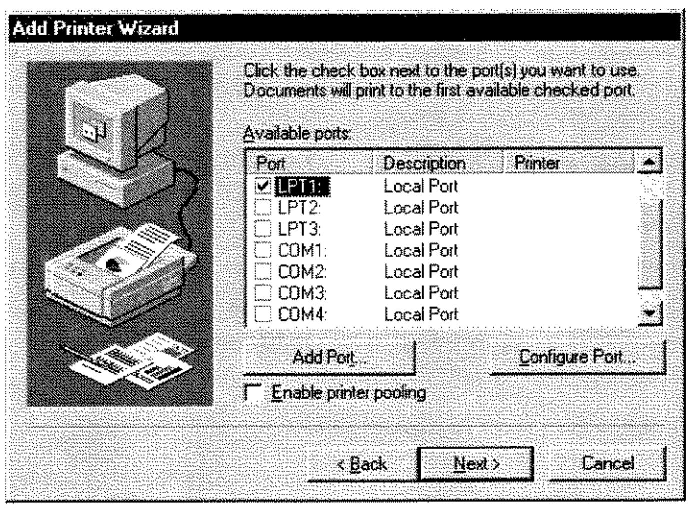
Installation of a local Printer

Note:
For an easy operation of the subsequent dialogs connection of a PS/2 keyboard including trackball to the front panel is recommended. If no trackball is available, a PS/2 mouse should be connected additionally to the rear panel (see section "Connecting a Mouse" and "Connecting a Keyboard").



- ➢ Click on "My Computer" and then "Next".

  The selection of printer ports appears.

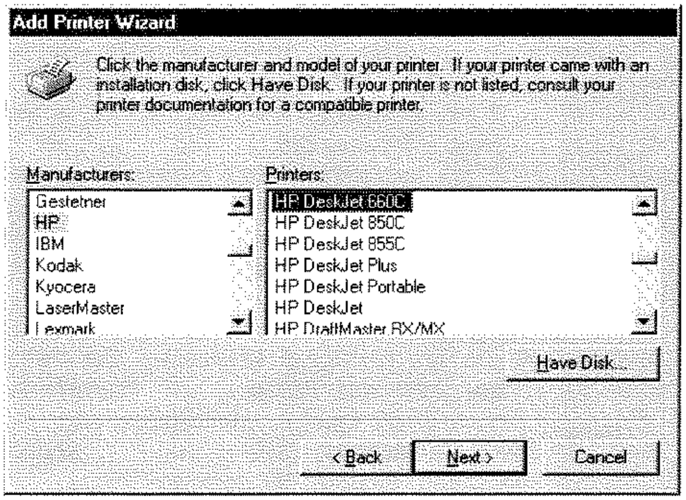


- ➢ Select port LPT1.

  The selection will be marked with a tick.

- ➢ Click on "Next".

  The selection of the printer drivers appears. The left table contains the manufacturers, the right on the available printer drivers.



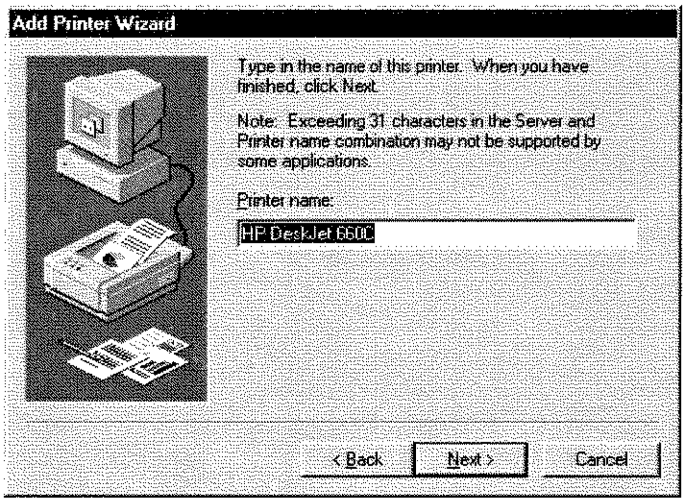
➢ Select the desired manufacturer and the corresponding printer driver.

Note:

If the desired printer type does not appear in the list, then the corresponding driver has not been installed on the instrument so far. In this case click on button "HAVE DISK". This will open a prompt for inserting a disk with the corresponding driver into the floppy drive. Press "OK" and select the desired printer driver.
After the installation the "Service Pack 5" must be re-installed (see section "Installing Windows-NT software").

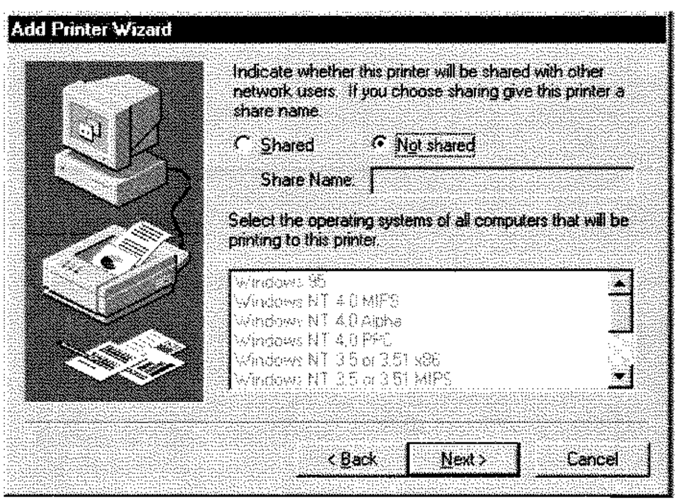
➢ Click on "Next".

The data entry field for the printer name appears.



➢ The name of the printer can be modified in the edit field "Printer name" (max. 60 characters).

If there are already installed printers in the system, there will be a prompt for whether the new printer should be used as the standard printer for Windows NT applications (Do you want your Windows-based programs to use this printer as default printer?). The pre-selection is "No".

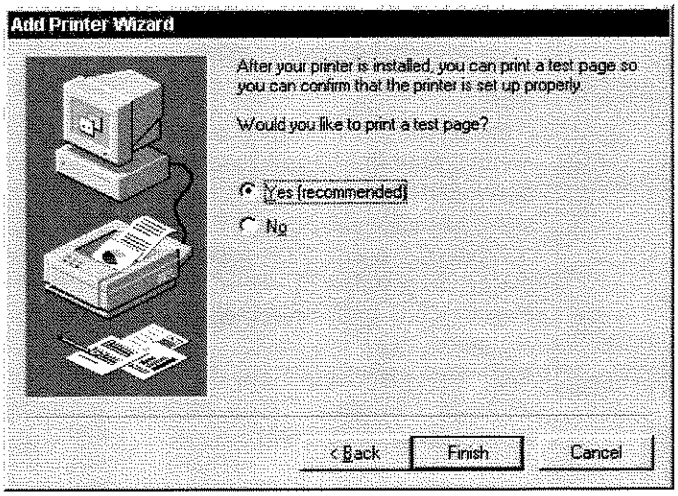


➢ Click on "Next".

A prompt will appear querying the availability of the printer in a network. This query is irrelevant for the installation of a local printer. The answer "Not shared" is pre-selected.

➢ Click on "Next".

The window for printing a test page appears. This allows testing whether the installation was successful.



➢ Click on "Yes (recommended)".

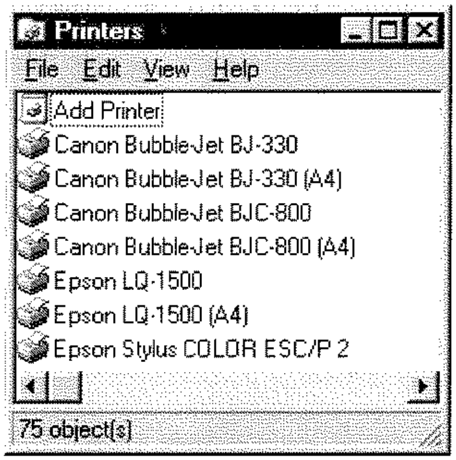
➢ Click on "Finish".

If the installation was successful, a test page will be printed.
If the test page is not printed or printed incorrectly, the Windows NT online help will supply additional support in chapter "Printer - Trouble Shooting".

Note:
If you are prompted to indicate the printer driver path after clicking on "Finish", the Service Pack must be re-installed after this printer installation (see chapter 1, section "Installing Windows NT software").

Finally the instrument must be configured for printouts of the measurement screen with this printer. For details please refer to softkey *DEVICE 1* and *DEVICE 2* in the hardcopy menu.

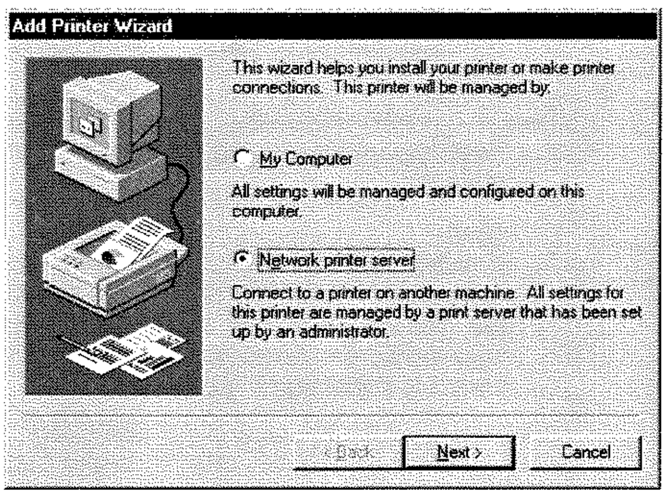
Installation of a Network Printer (with option FSU-B16 only)



After opening the "Printer" dialog window proceed with the installation as follows:

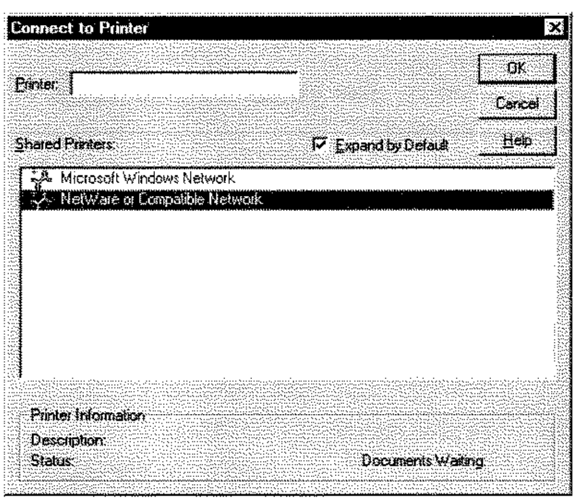
➢ Double-click "Add Printer" line.

The "Add Printer Wizard" window is opened. This window guides the user through the printer driver installation.



➢ Click "Network printer server" and then "Next".

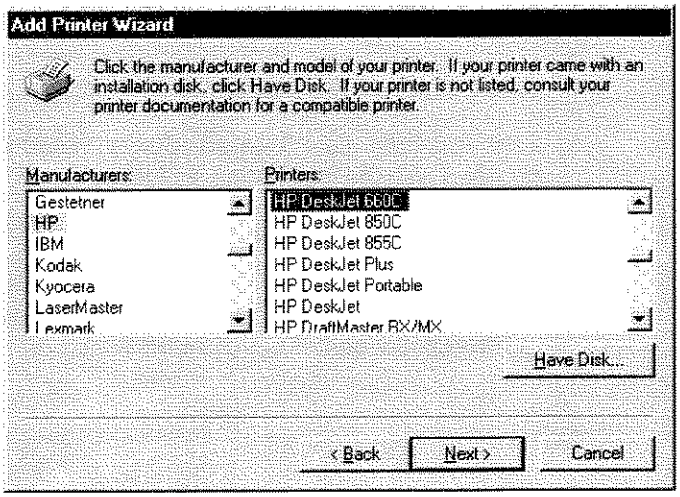
A list of selectable printers is displayed.



➢ Mark printer and select it with OK.

➢ Confirm the following request for the installation of a suitable printer driver with OK.

The list of printer drivers is displayed. The manufacturers are listed in the window at the left, the available printer drivers at the right.

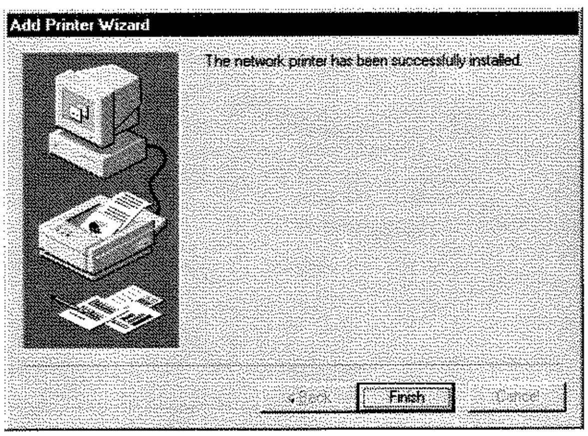


- ➢ Select the manufacturer in the "Manufacturers" window and then the printer driver in the "Printers" window.

Note:
If the desired printer type is not listed, the driver has not been installed. In this case click HAVE DISK. You are requested to insert a floppy with the respective printer driver. Subsequently press OK and select the desired driver. After this the "Service Pack 5" has to be newly installed (see chapter "Install Windows-NT Software)

- ➢ Click "Next"

If one or more printers have been installed, a query is displayed in this window, whether the printer you have just instelled should be used as the standard printer for Windows NT applications. (Do you want your Windows-based programs to use this printer as default printer?). Default setting is "No".



- ➢ Start the printer driver installation with "Finish".

Note:
If after clicking on "Finish" you are requested to enter the printer driver path, the Service Pack has to be re-installed after the printer installation (see chapter 1, Installing Windows NT Software).

Finally the instrument must be configured for printouts of the measurement screen with this printer. For details please refer to softkey *DEVICE 1* and *DEVICE 2* in the hardcopy menu.

Option External Generator Control - FSP-B10

The external generator control option permits to operate a number of commercially available generators as tracking generator on the FSU. Thus, scalar network analysis with the FSU is also possible outside the frequency range of the internal tracking generator when the appropriate generators are used.

The FSU also permits to set a frequency offset for frequency-converting measurements when external generators are used. For harmonics measurements or frequency-converting measurements, it is also possible to enter a factor, by which the generator frequency is increased or reduced compared with the receive frequency of the FSU. Only make sure that the resulting generator frequencies do not exceed the allowed setting range of the generator.

The settable level range also depends on the generator used.
The generator is controlled via the – optional – second IECBUS interface of the FSU (= IEC2, supplied with the option) and, with some Rohde & Schwarz generators, additionally via the TTL synchronization interface included in the AUX interface of the FSU.

Note: *The use of the TTL interface enables considerably higher measurement rates as pure IECBUS control, because the frequency stepping of the FSU is directly coupled with the frequency stepping of the generator.*

Therefore, the frequency sweep differs according to the capabilities of the generator used:

- In the case of generators without TTL interface, the generator frequency is first set for each frequency point via IECBUS, then the setting procedure has to be completed before recording of measured values is possible.

- In the case of generators with TTL interface, a list of the frequencies to be set is entered into the generator before the beginning of the first sweep. Then the sweep is started and the next frequency point selected by means of the TTL handshake line TRIGGER. The recording of measured values is only enabled when the generator signals the end of the setting procedure via the BLANK signal. This method is considerably faster than pure IECBUS control.

With the "SELECT GENERATOR" softkey, a list of the supported generators with the frequency and level range as well as the capabilities used is included.

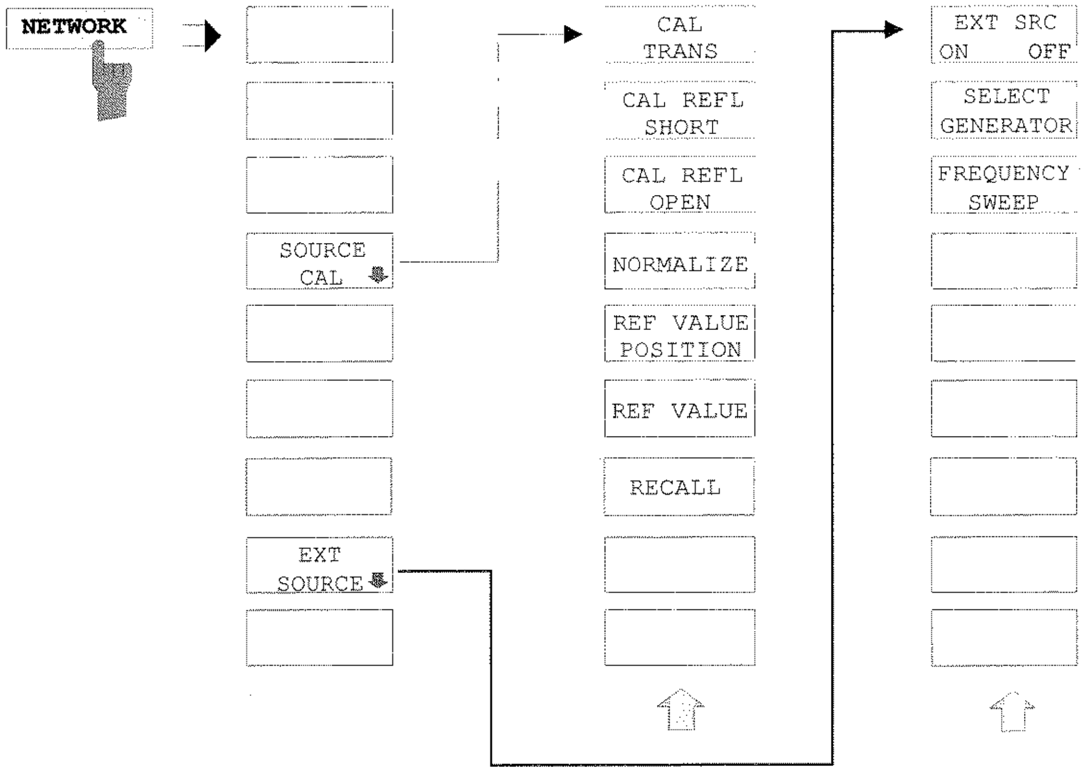
The external generator can be used in all operating modes. Recording of test setup calibration values (*SOURCE CAL*) and normalization with the correction values (*NORMALIZE*) are only possible in the *NETWORK* mode.

Note: *In order to enhance measurement accuracy a common reference frequency should be used for both the FSU and the generator. If no independent 10 MHz reference frequency is available, it is recommended to connect the reference output of the generator with the reference input of the FSU and to enable usage of the external Reference on the FSU via SETUP – REFERENCE EXT.*

Like the internal tracking generator, the external generator is activated by means of the *NETWORK* hotkey in the hotkey bar at the screen bottom:

External Generator Settings

The *NETWORK* hotkey opens the menu for setting the functions of the external generator.



Transmission Measurement

The transmission characteristic of a two-port network is measured . The external generator serves as a signal source. It is connected to the input connector of the DUT. The input of the analyser is fed from the output of the DUT.

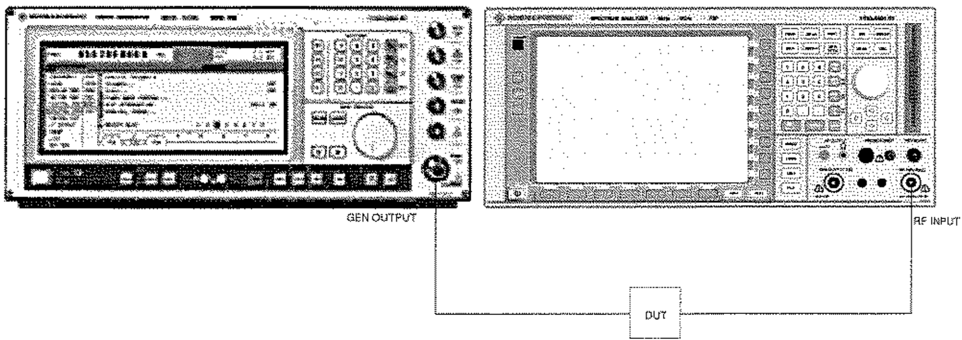


Fig. 4-13 Test setup for transmission measurement

A calibration can be carried out to compensate for the effects of the test setup (eg frequency response of connecting cables).

Calibration of Transmission Measurement

NETWORK menu:

SOURCE CAL → CAL TRANS

CAL REFL SHORT

CAL REFL OPEN

NORMALIZE

REF VALUE POSITION

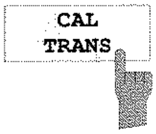
REF VALUE

RECALL

The *SOURCE CAL* softkey opens a submenu comprising the calibration functions for the transmission and reflection measurement.

The calibration of the reflection measurement (*CAL REFL...*) and its functioning are described in separate sections.

To carry out a calibration for transmission measurements the whole test setup is through-connected (THRU).



The *CAL TRANS* softkey triggers the calibration of the transmission measurement.

It starts a sweep that records a reference trace. This trace is then used to obtain the differences to the normalized values.

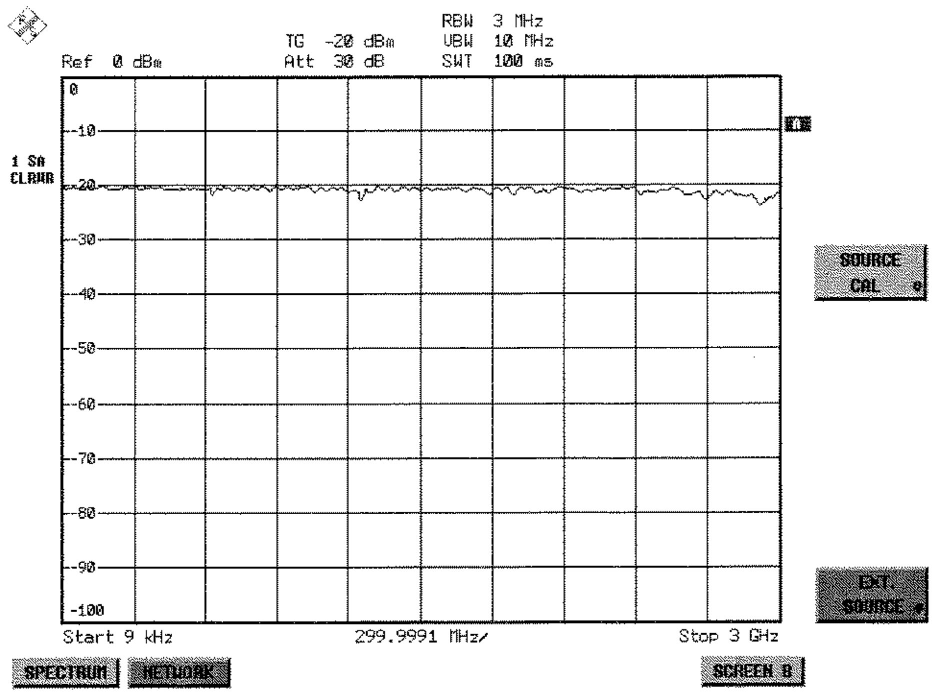
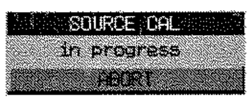


Fig. 4-14 Calibration curve for transmission measurement

During the calibration the following message is displayed:



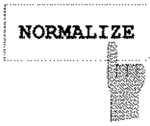
After the calibration sweep the following message is displayed:

This message is cleared after approx. 3 seconds.

IEC-bus command `CORR:METH TRAN`

Normalization:

NETWORK-SOURCE CAL menu:



The *NORMALIZE* softkey switches normalization on or off. The softkey is only available if the memory contains a correction trace.

It is possible to shift the relative reference point within the grid using the *REF VALUE POSITION* softkey. Thus, the trace can be shifted from the top grid margin to the middle of the grid:

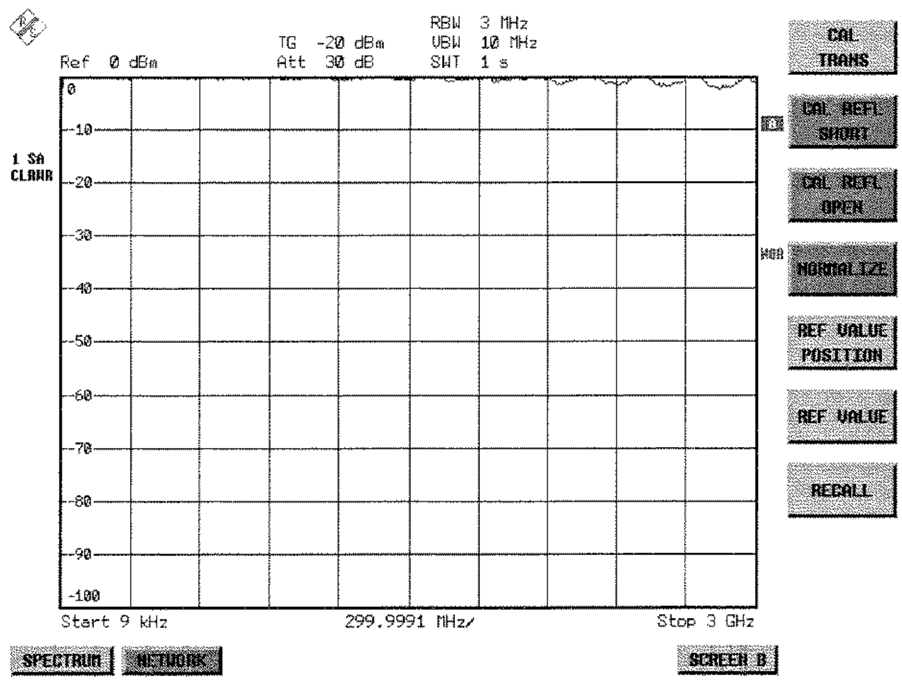
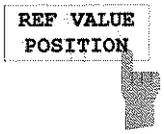


Fig. 4-15 Normalized display

In the *SPLIT SCREEN* setting, the normalization is switched on in the current window. Different normalizations can be active in the two windows.

Normalization is aborted when the *NETWORK* mode is quit.

IEC/IEEE-bus command: `CORR ON`



The *REF VALUE POSITION* softkey (reference position) marks a reference position in the active window on which the normalization (difference formation with a reference curve) is performed.

When pressed for the first time, the softkey switches on the reference line and activates the input of its position. The line can be shifted within the grid limits.

The reference line is switched off by pressing the softkey again.

The function of the reference line is explained in the section "Functioning of Calibration".

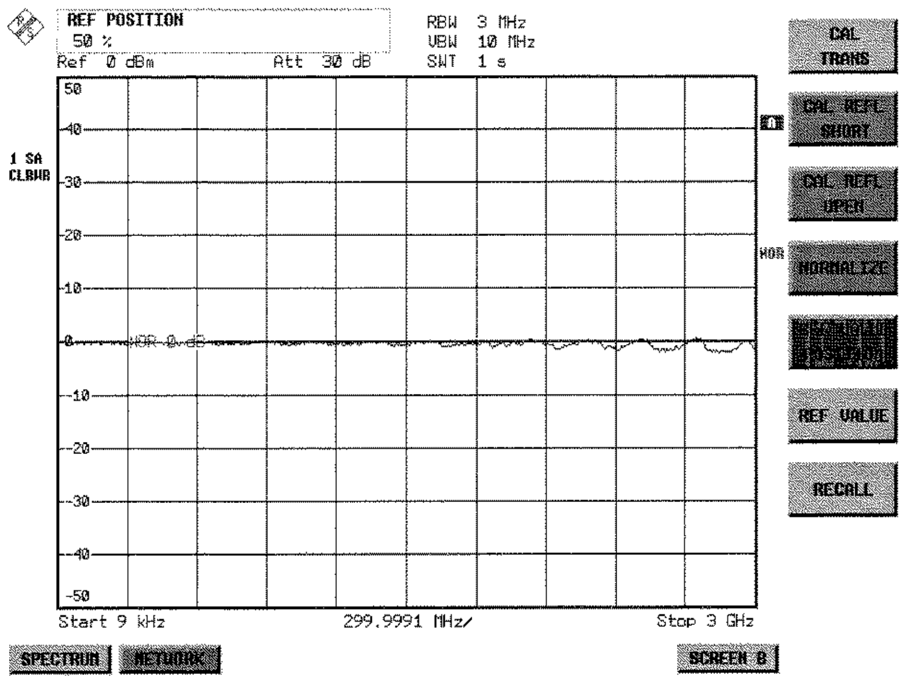


Fig. 4-16 Normalized measurement, shifted with *REF VALUE POSITION* 50 %

IEC-bus command `DISP:WIND:TRAC:Y:RPOS 10PCT`

REF VALUE

The *REF VALUE* softkey activates the input of a level difference which is assigned to the reference line.

In the default setting, the reference line corresponds to a level difference of 0 dB. If e.g. a 10-dB attenuator pad is inserted between DUT and analyzer input between recording of the calibration data and normalization, the trace will be shifted down by 10 dB. By entering a *REF VALUE* of –10 dB the reference line for difference formation can also be shifted down by 10 dB so that it will again coincide with the trace (see Fig. 4-17).

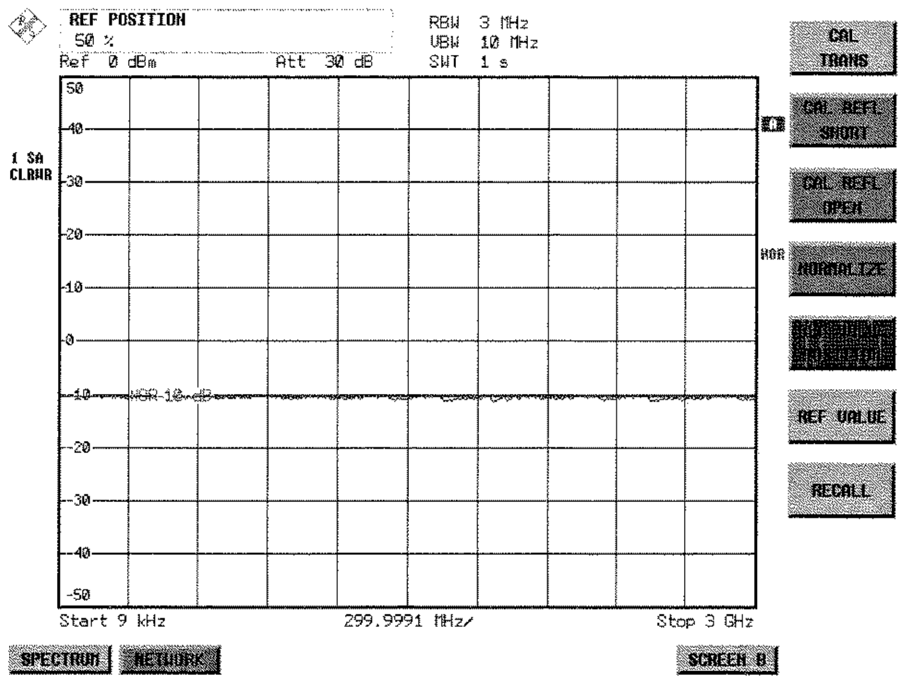


Fig. 4-17 Measurement with REF VALUE -10dB and REF VALUE POSITION 50%

After the reference line has been shifted by entering *REF VALUE* –10 dB, departures from the nominal value can be displayed with high resolution (e.g. 1 dB / Div.). The absolute measured values are still displayed, in the above example, 1 dB below nominal value (reference line) = 11 dB attenuation.

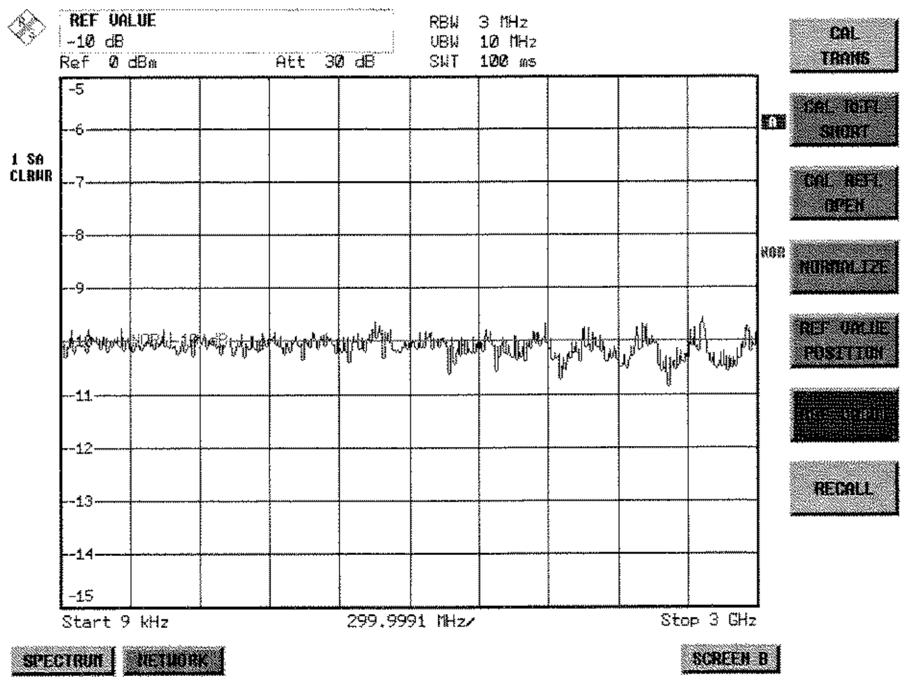
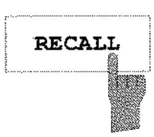


Fig. 4-18 Measurement of a 10-dB attenuator pad with 1dB/DIV

IEC-bus command `DISP:WIND:TRAC:Y:RVAL -10dB`



The *RECALL* softkey restores the analyzer setting with which the calibration was carried out.
This can be useful if the device setting was changed after calibration (eg center frequency setting, frequency deviation, reference level, etc).

The softkey is only available if:

- the *NETWORK* mode has been selected
- the memory contains a calibration data set.

IEC/IEEE-bus command `CORR:REC`

Reflection Measurement

Scalar reflection measurements can be carried out by means of a reflection-coefficient bridge.

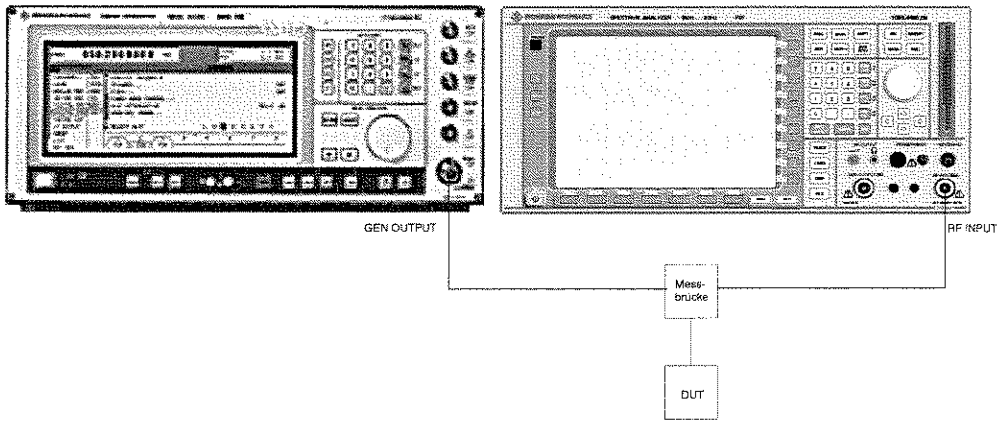
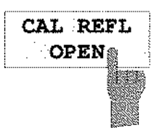


Fig. 4-19 Test setup for reflection measurement

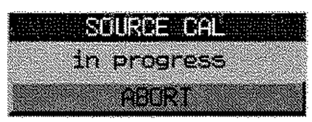
Calibration of Reflection Measurement

The calibration mechanism essentially corresponds to that of the transmission measurement.

NETWORK-SOURCE CAL submenu



The *CAL REFL OPEN* softkey starts the open-circuit calibration. During calibration the following message is displayed:



IEC-bus command `CORR:METH REFL`
`CORR:COLL OPEN`

The *CAL REFL SHORT* softkey starts the short-circuit calibration.

If both calibrations (open circuit, short circuit) are carried out, the calibration curve is formed by averaging the two measurements and stored in the memory. The order of measurements is optional.

After the calibration the following message is displayed:

The display is cleared after approx. 3 seconds.

IEC-bus command `CORR:METH REFL`
`CORR:COLL THR`

Calibration mechanism

Calibration means a calculation of the difference between the currently measured power and a reference curve, independent of the selected type of measurement (transmission/reflection). The hardware settings used for measuring the reference curve are included in the reference dataset.

Even with normalization switched on, the device settings can be changed in a wide area without stopping the normalization. This reduces the necessity to carry out a new normalization to a minimum.

For this purpose the reference dataset (trace with 501 measured values) is stored internally as a table of 501 points (frequency/level).
Differences in level settings between the reference curve and the current device settings are taken into account automatically. If the span is reduced, a linear interpolation of the intermediate values is applied. If the span increases, the values at the left or right border of the reference dataset are extrapolated to the current start or stop frequency, ie the reference dataset is extended by constant values.
An enhancement label is used to mark the different levels of measurement accuracy. This enhancement label is displayed at the right diagram border when normalization is switched on and a deviation from the reference setting occurs. Three accuracy levels are defined:

Table 4-3 Measurement accuracy levels

Accuracy	Enhancement label	Reason/Limitation
High	NOR	No difference between reference setting and measurement
Medium	APX (approximation)	Change of the following settings: • coupling (RBW, VBW, SWT) • reference level, RF attenuation • start or stop frequency • output level of tracking generator • frequency offset of tracking generator • detector (max. peak, min. peak, sample, etc.) Change of frequency: • max. 501 points within the set sweep limits (corresponds to a doubling of the span)
-	Aborted normalization	• more than 500 extrapolated points within the current sweep limits (in case of span doubling)

Note: *At a reference level (REF LEVEL) of -10 dBm and at a tracking generator output level of the same value the analyzer operates without overrange reserve, ie the analyzer is in danger of being overloaded if a signal is applied whose amplitude is higher than the reference line. In this case, either the message "OVLD" for overload is displayed in the status line or the display range is exceeded (clipping of the trace at the upper diagram border = Overrange).*

Overloading can be avoided as follows:

- *Reducing the output level of the tracking generator (SOURCE POWER, NETWORK menu)*
- *Increasing the reference level (REF LEVEL, AMPT menu)*

Frequency-converting Measurements

For frequency-converting measurements (e.g. on converters) the external generator is able to set a constant frequency offset between the output frequency of the generator and the receive frequency of the analyzer and, in addition, the generator frequency as a multiple of the analyzer.

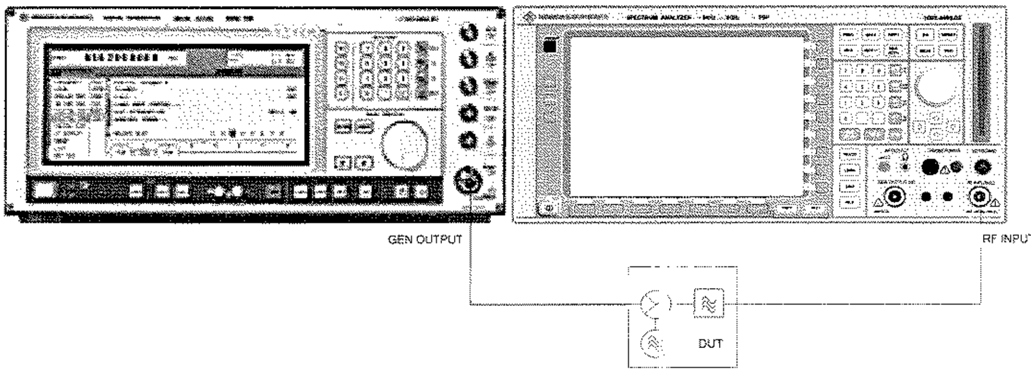
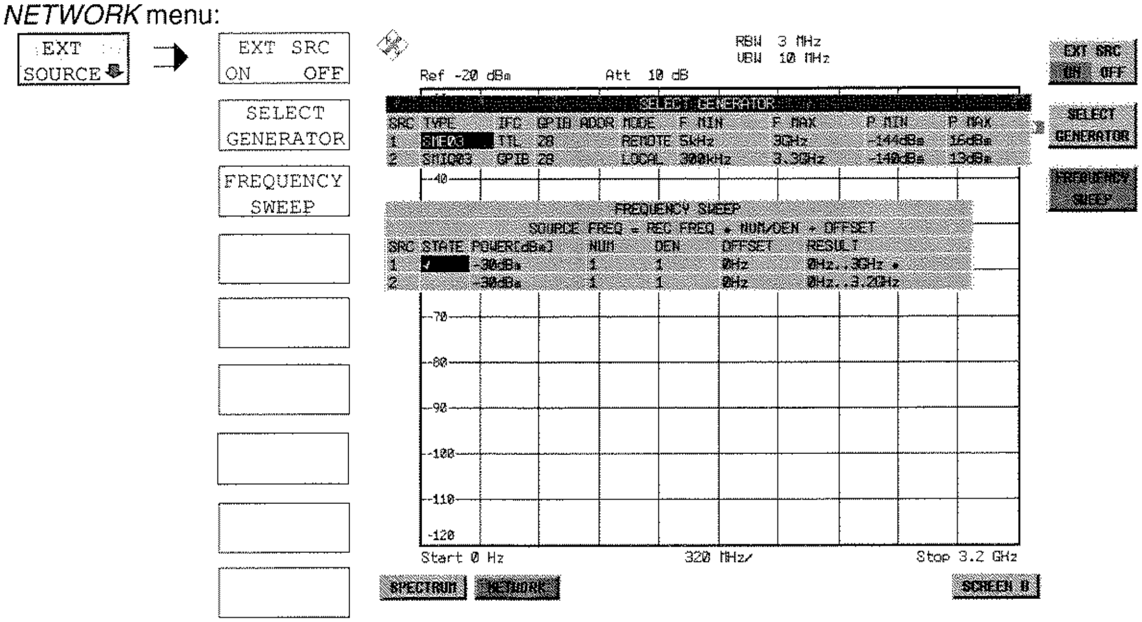


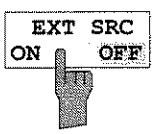
Fig. 4-20 Test setup for frequency-converting measurements

Configuration of an External Generator

NETWORK menu:



The *EXT SOURCE* softkey opens a submenu for configuration of the external generator.
The FSU is able to manage two generators, one of which can be active at the time.



The *EXT SRC ON / OFF* softkey switches the external generator on or off.
It can only be switched on successfully if the generator has been selected by means of *SELECT GENERATOR* and configured correctly by means of *FREQUENCY SWEEP*.
If one of these conditions is not fulfilled, an error message will be output.

Notes:

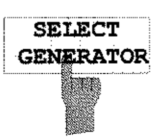
When switching on the external generator, the FSU *switches off the internal tracking generator and starts programming the generator settings via the IECBUS.*

At the same time, the maximum stop frequency is limited to the maximum generator frequency. This upper limit is automatically reduced by the set frequency offset of the generator and a set multiplication factor.

With the external generator switched on, the FFT filters (FILTER TYPE FFT in the menu BW) are not available.

If there is an error on the IECBUS during programming of the external generator, the generator is automatically switched off and the following error message output:

IEC-bus command `SOUR:EXT ON`



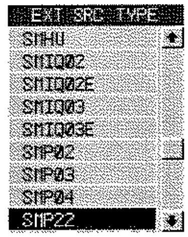
The *SELECT GENERATOR* softkey opens a table for selection of the generator and definition of IECBUS address and control interface.
The table permits configuration of two generators so that switching between two different configurations is easily possible.

SRC	TYPE	IFC	GPIB ADDR	MODE	F MIN	F MAX	P MIN	P MAX
1	SME03	TTL	28	REMOTE	5kHz	3GHz	-144dBm	16dBm
2	SMIQ03	GPIB	28	LOCAL	300kHz	3.3GHz	-140dBm	13dBm

The individual fields contain the following settings:

SRC Index of generator selected

TYPE The field opens the list with the available generators:



After completion of the selection, the remaining fields of the table are filled with the generator characteristics.
A list of generator types supported by the FSU is to be found at the end of section "Softkey *SELECT GENERATOR*".

IFC This field selects the interface type of external generator 1or 2. The following types are available:

GPIB IECBUS only, suitable for all generators of other manufacturers and some Rohde & Schwarz instruments

or

TTL IECBUS and TTL interface for synchronization, for most of the Rohde & Schwarz generators, see table above.

The two operating modes differ in the speed of the control: Whereas, with pure IECBUS operation, each frequency to be set must be individually transferred to the generator, additional use of the TTL interface permits to program a total frequency list at once and subsequently perform the frequency stepping via TTL handshake, which is a big advantage in terms of speed.

Note:
Generators equipped with the TTL interface can also be operated with IECBUS (= GPIB) only.
Only one of the two generators can be operated with TTL interface at a time. The other generator must be configured for IECBUS (GPIB).

GPIB ADDR IECBUS address of the respective generator. Addresses from 0 to 30 are possible.

MODE Operating mode of generator. The generator activated using the FREQUENCY SWEEP softkey is automatically set to remote mode (REMOTE), the other to manual mode (LOCAL).

F MIN F MAX Frequency range of generator. Select the start and stop frequency of the FSU in a way that the specified range is not exceeded.
If the start frequency lies below F MIN, the generator is only switched on when F MIN is reached.
If the stop frequency lies above F MAX, it is limited to F MAX when the generator is switched on using the EXT SRC ON/OFF softkey.

P MIN P MAX Level range of generator. This field defines the allowed input range for the *POWER* column in the *FREQUENCY SWEEP* table.

IEC-bus commands SYST:COMM:RDEV:GEN2:TYPE 'SME02'
SYST:COMM:RDEV:GEN:LINK TTL
SYST:COMM:GPIB:RDEV:GEN1:ADDR 28

List of Generator Types Supported by the FSU

Generator	Interface Type	Generator Min Freq	Generator Max Freq	Generator Min Power dBm	Generator Max Power dBm
SME02	TTL	5 kHz	1.5 GHz	-144	+16
SME03	TTL	5 kHz	3.0 GHz	-144	+16
SME06	TTL	5 kHz	6.0 GHz	-144	+16
SMG	GPIB	100 kHz	1.0 GHz	-137	+13
SMGL	GPIB	9 kHz	1.0 GHz	-118	+30
SMGU	GPIB	100 kHz	2.16 GHz	-140	+13
SMH	GPIB	100 kHz	2.0 GHz	-140	+13
SMHU	GPIB	100 kHz	4.32 GHz	-140	+13
SMIQ02B	TTL	300 kHz	2.2 GHz	-144	+13
SMIQ02E	GPIB	300 kHz	2.2 GHz	-144	+13
SMIQ03B	TTL	300 kHz	3.3 GHz	-144	+13
SMIQ03E	GPIB	300 kHz	3.3 GHz	-144	+13
SMIQ04B	TTL	300 kHz	4.4 GHz	-144	+10
SMIQ06B	TTL	300 kHz	6.4 GHz	-144	+10
SML01	GPIB	9 kHz	1.1 GHz	-140	+13
SMR20	GPIB	1 GHz	20 GHz	-130 [2]	+11 [2]
SMR20B11 [1]	GPIB	10 MHz	20 GHz	-130 [2]	+13 [2]
SMR27	GPIB	1 GHz	27 GHz	-130 [2]	+11 [2]
SMR27B11 [1]	GPIB	10 MHz	27 GHz	-130 [2]	+12 [2]
SMR30	GPIB	1 GHz	30 GHz	-130 [2]	+11 [2]
SMR30B11 [1]	GPIB	10 MHz	30 GHz	-130 [2]	+12 [2]
SMR40	GPIB	1 GHz	40 GHz	-130 [2]	+9 [2]
SMR40B11 [1]	GPIB	10 MHz	40 GHz	-130 [2]	+12 [2]
SMP02	TTL	10 MHz	20 GHz	-130 [3]	+17 [3]
SMP03	TTL	10 MHz	27 GHz	-130 [3]	+13 [3]
SMP04	TTL	10 MHz	40 GHz	-130 [3]	+12 [3]
SMP22	TTL	10 MHz	20 GHz	-130 [3]	+20 [3]
SMT02	GPIB	5.0 kHz	1.5 GHz	-144	+13
SMT03	GPIB	5.0 kHz	3.0 GHz	-144	+13
SMT06	GPIB	5.0 kHz	6.0 GHz	-144	+13
SMX	GPIB	100 kHz	1.0 GHz	-137	+13
SMY01	GPIB	9 kHz	1.04 GHz	-140	+13
SMY02	GPIB	9 kHz	2.08 GHz	-140	+13
HP8340A	GPIB	10 MHz	26.5 GHz	-110	10
HP ESG-A Series 1000A, 2000A, 3000A, 4000A	GPIB	250 kHz	4 GHz	-136	20
HP ESG-D SERIES E4432B	GPIB	250 kHz	3 GHz	-136	+10

[1] Requires the option SMR-B11 to be fitted.
[2] Maximum/minimum power depends on presence of Option SMR-B15/-B17 and set frequency range. For more details see SMR data sheet.
[3] Maximum/minimum power depends on presence of Option SMP-B15/-B17 and set frequency range. For more details see SMP data sheet.

FREQUENCY SWEEP

The *FREQUENCY SWEEP* softkey opens a table for setting the generator level as well as the multiplier and the offset used to derive the generator frequency from the analyzer frequency.

This table also permits configuration of two generators so that switching between two different configurations is easily possible.

FREQUENCY SWEEP						
SOURCE FREQ = REC FREQ * NUM/DEN + OFFSET						
SRC	STATE	POWER[dBm]	NUM	DEN	OFFSET	RESULT
1	✓	-30dBm	1	1	0Hz	0Hz..3GHz *
2		-30dBm	1	1	0Hz	0Hz..3.2GHz

SRC — Index of selected generator

STATE — Selects the active generator. Only one generator can be active at a time. The operating mode of the active generator is set to remote control in the SELECT GENERATOR table.

POWER — Permits to enter the generator level within the limits P MIN to P MAX of the *SELECT GENERATOR* table.

NUM — Numerator,

DEN — Denominator,

OFFSET — Offset, used to derive the generator frequency from the current frequency of the FSU according to the following formula:

$$F_{Generator} = F_{Analyzer} * \frac{Numerator}{Denominator} + F_{Offset}$$

Note that the frequencies resulting from start and stop frequency of the FSU do not exceed the allowed generator range:

- If the start frequency lies below F MIN, the generator is only switched on when F MIN is reached.
- If the stop frequency lies above F MAX, the generator is switched off. When the generator is subsequently switched on using the *EXT SRC ON/OFF* softkey, the stop frequency is limited to F MAX.
- If the stop frequency lies below F MIN, the generator is switched off and the following error message output:

  ERROR
  GENERATOR RANGES EXEEDED; EXT GEN SWITCHED OFF.

- In the time domain (Span = 0 Hz) the generator frequency is derived from the set receive frequency of the FSU using the calculation formula.

For the sake of clarity, the formula is also displayed in the table.

RESULT The frequency range of the generator resulting from the calculation formula. An asterisk (*) after the upper limit indicates that the stop frequency of the FSU must be adapted when the generator is switched on in order not to exceed its maximum frequency. In the following illustration, this is true for the upper generator at a stop frequency of 3.2 GHz of the FSU, whereas the lower generator does not yet require an adaptation:

SOURCE FREQ = REC FREQ * NUM/DEN + OFFSET

NUM	DEN	OFFSET	RESULT
1	1	0Hz	0Hz..3GHz *
1	1	0Hz	0Hz..3.2GHz

IEC-bus commands

```
SOUR:EXT:POW -30dBm
SOUR:EXT:FREQ:NUM 4
SOUR:EXT:FREQ:DEN 3
SOUR:EXT:FREQ:OFFS 100MHZ
```

Option LAN Interface – FSU-B16

Using the option FSU-B16 LAN Interface, the instrument can be connected to an Ethernet LAN (Local Area Network). Thus it is possible to transfer data via the network and use network printers. The network card allows both for a 10-MHz Ethernet IEEE 802.3 and a 100-MHz Ethernet IEEE 802.3u. The selection between 10 Mbit/s and 100Mbit/s can take place either automatically or via manual setting.

Connecting the Instrument to the Network

Caution:
Before connecting the instrument to the network it is recommended to contact the network administrator, in particular larger LAN installations are affected. Faults in the connection may have a negative effect on the entire network.

The instrument is connected to a network hub of the desired LAN segment via a commercially-available RJ45 cable (not supplied with the instrument) at the instrument rear panel. Since RJ45 provides no bus but a star network topology, no other precautions need to be taken for the connection.

The connection procedure does not produce any disturbances in the network traffic. Disconnection from the network is easily possible provided that there is no more data traffic from and to the instrument.

Installing the Software

The data transfer in the network takes place in data blocks, the so-called packets. In addition to the useful data, further information on the operation, ie the so-called protocol data (transmitter, receiver, type of data, sequence), is transferred in the packets. For processing the protocol information, suitable drivers must be installed. For the network services (file transfer, directory services, printing in the network) a network operating system needs to be installed.

Installation and Configuration of the Driver for the Network Card

Notes:

- *The WINDOWS NT files required for the installation of network drivers, protocols or services are included in the directory "C:\I386".*
- *For the installation, a PC keyboard with trackball (or an additional mouse instead) is required.*

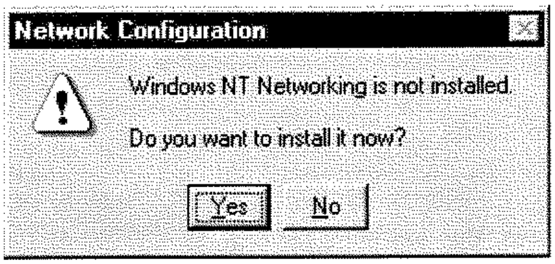
➢ Press the *SETUP* key.

The *SETUP* menu opens.

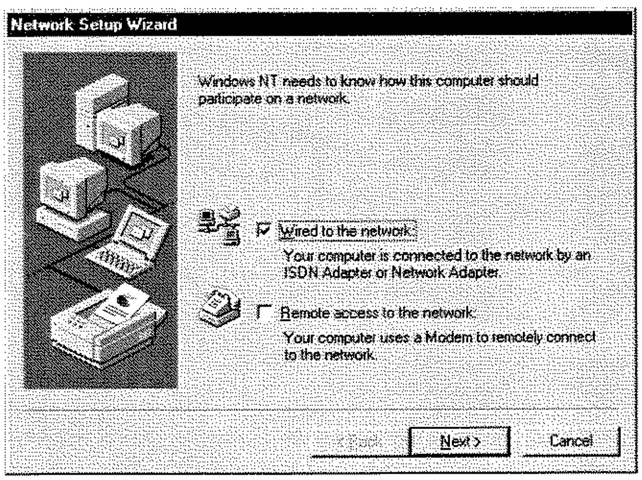
➢ Press the *GENERAL SETUP* key.

The *GENERAL SETUP* menu opens.

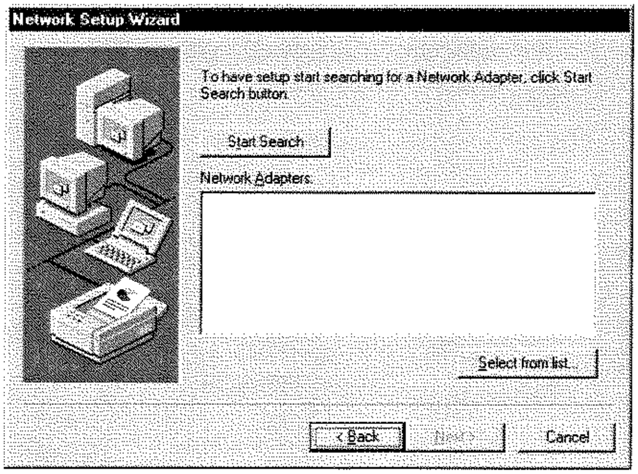
➢ Press the CONFIGURE NETWORK softkey.



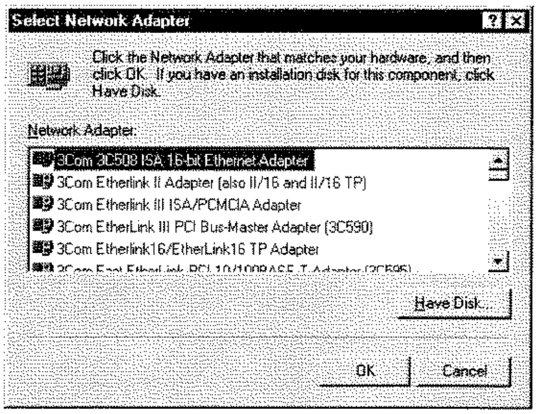
➢ Answer the prompt "Do you want to install it now?" with "Yes".



➢ Leave the default setting "Wired to the network" unchanged and confirm by means of "NEXT".



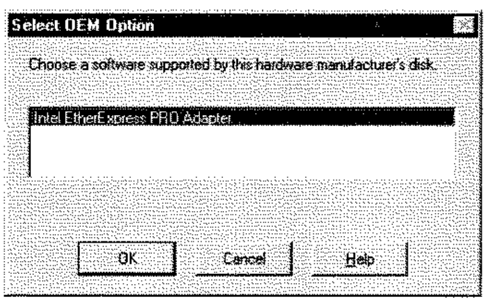
➢ To select the appropriate network card click on "Select from list".



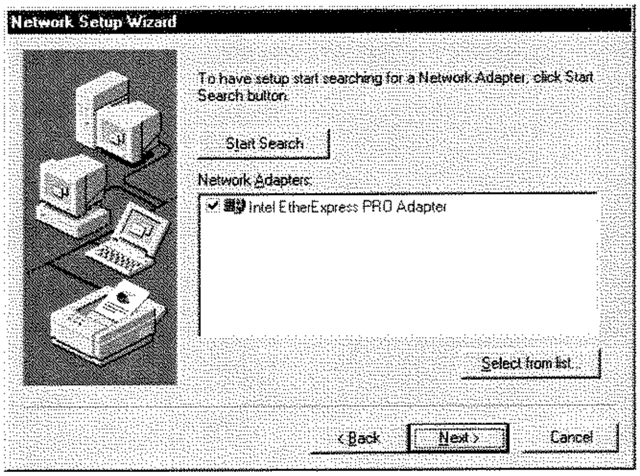
➢ Click on "Have Disk".

A prompt to insert the disk into the floppy drive will appear.

➢ Insert the driver disk and click on "OK".



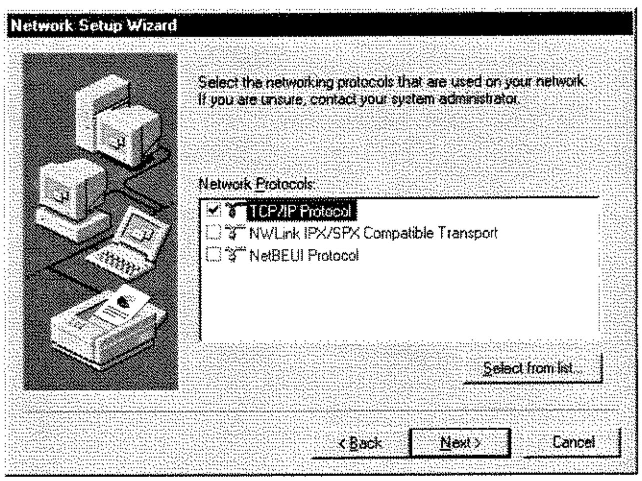
➢ Confirm "Intel EtherExpress PRO Adapter" with "OK".



➢ Close the dialog by means of "NEXT" after selecting "Intel EtherExpress PRO Adapter" once again.

Selection of the Network Protocols

Note: *The network administrator knows the protocols to be used. For the RSIB interface, the TCP/IP protocol must be installed in any case.*

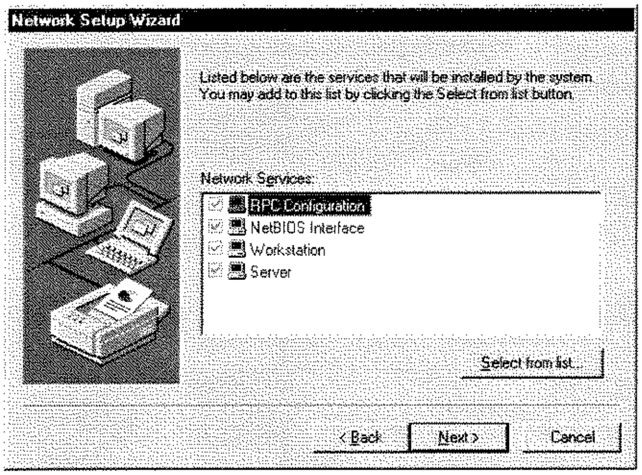


➢ Select the desired protocols and confirm using "NEXT".

Selection of the Network Services

To be able to utilize the resources in the network, it is necessary to install the respective services.

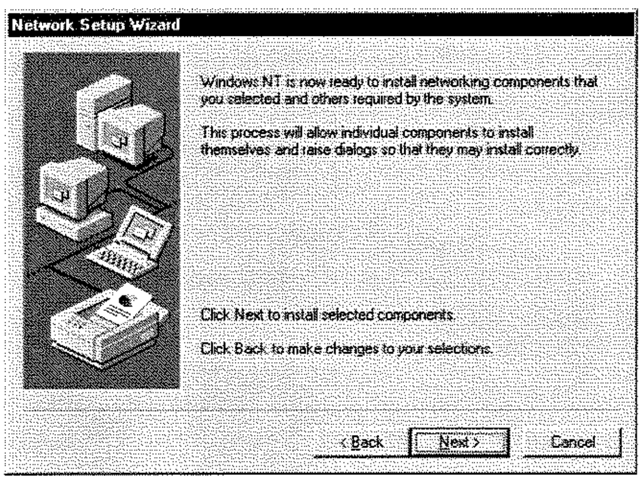
Note: *The network administrator knows the services to be used.*



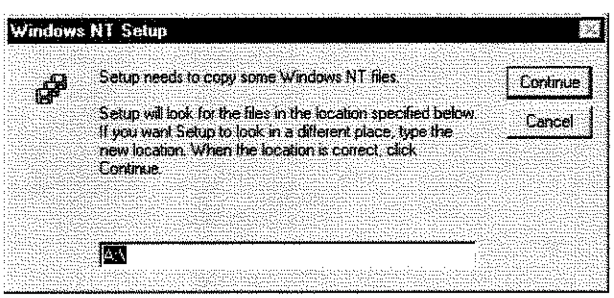
- During the first installation, the selected services cannot be changed.

  Further services can be added after completion of the installation.

Completion of the Installation

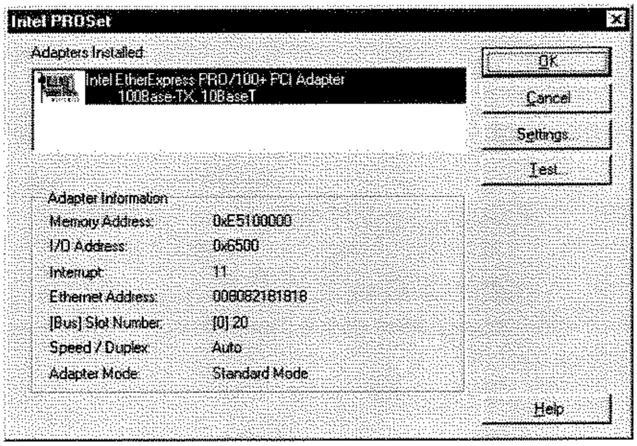


- Start the installation by clicking on "NEXT" .



- Enter drive "C:\I386" and click on "Continue".

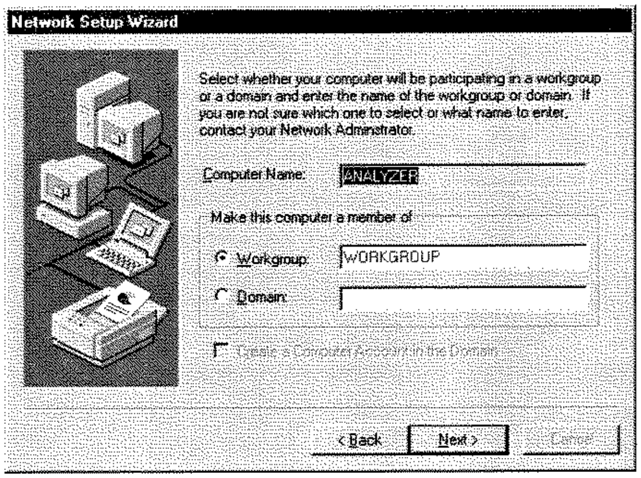
  After a couple of files have been copied, there is a message indicating that the driver for the network card has been installed.



➢ If required, the network speed and the duplex mode can be set manually using the "Settings" button.

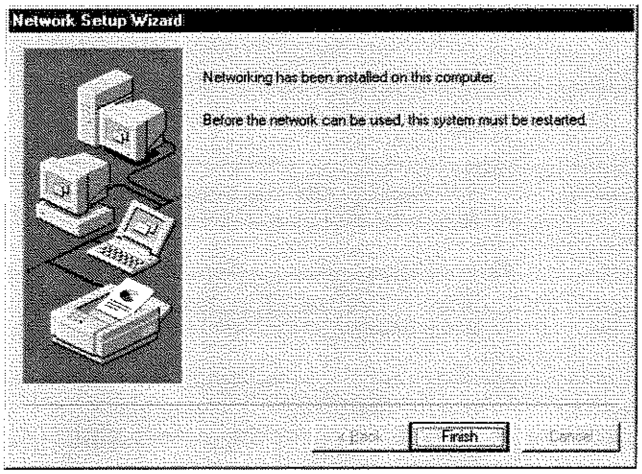
➢ Click on "OK".

The settings are checked and processed. Missing information on the installed network protocols (e.g. the TCP/IP address) is queried.

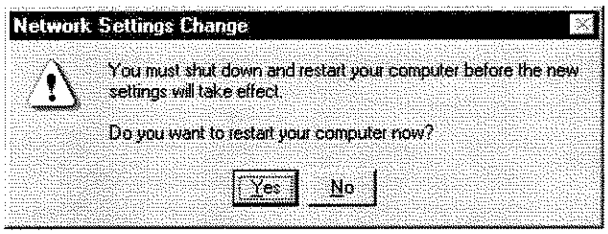


➢ The preselected computer and workgroup names "ANALYZER" and "WORKGROUP" can be confirmed using "NEXT".

Note:
In Windows networks, the computer name must be unique.



➢ Terminate the installation by clicking on "Finish".

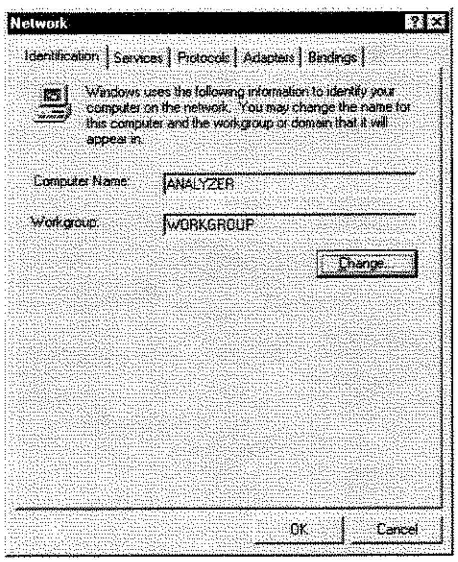


➢ Answer the prompt "You must shutdown..." with "No", since the "Service Pack 5" of Windows NT must be reinstalled after the installation of the driver software. (see chapter 1, section "Computer Function - "Installing the Windows NT Software ")

Examples of Configurations

Network	Protocols	Services	Notes
NOVELL Netware	NWLink IPX/SPX Compatible Transport	Client Service for NetWare	In folder "Protocols - Properties", the frame type used in the network is to be set.
IP Networks (FTP, TELNET, WWW, GOPHER, etc.)	TCP/IP Protocol	Simple TCP/IP Services	In folder "Protocols - Properties", an IP address that is unique in the network is to be set.
MICROSOFT Network	NetBEUI Protocol or TCP/IP Protocol	Workstation Server	In folder "Identification - Computer Name", a name that is unique in the network is to be entered.

Subsequent Changing of the Network Configuration (Computer Name etc.)



After completion of the installation, the computer name can be adapted as follows:

➢ Press the *SETUP* key.

The *SETUP* menu opens.

➢ Press softkey *GENERAL SETUP*.

The *GENERAL SETUP* menu opens.

➢ Press softkey *CONFIGURE NETWORK*.

The configuration menu "Network" for the network settings opens.

➢ Select folder "Identification".

Both entries can be changed in the submenu "Change".

The other settings can be changed after selecting the other folders. However, it is recommended to contact the network administrator before any changes.

Operating the Instrument on the Network

After the network support has been installed, it is possible to exchange data between the instrument and other computers and to use printers in the network.
A prerequisite to the network operation is the appropriate access rights for the required network resources. Resources may be file directories of other computers or also central printers.
Access rights can be obtained from the network or server administrator. In that respect it is necessary to obtain the network name of the resource as well as the corresponding access rights.
In order to avoid misuse, the resources are protected by passwords. Normally, every entitled user of the resources is assigned a user name that is also protected by a password. Resources can then be assigned to this user. It is possible to determine the type of data access, ie whether data can only be read or also written, as well as shared data access. Depending on the network operating system, different types of usage are possible.

NOVELL Networks

The operating system NETWARE from NOVELL is a server based system. Data cannot be exchanged between individual workstations; the data transfer takes place between the PC and a server. This server provides memory space and the connection to network printers. On a server, data are organized in directories as under DOS and mapped to the workstation as virtual drives. A virtual drive behaves like an additional hard disk on the workstation, and the data can be edited accordingly. Network printers can also be addressed like normal printers.

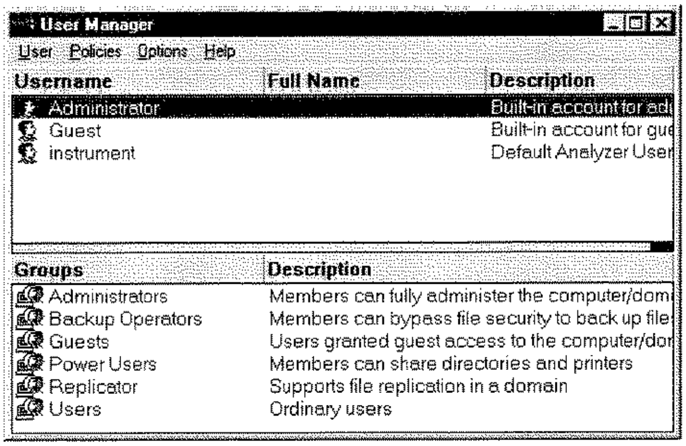
There are two versions of the NOVELL network operating system: NETWARE 3 and NETWARE 4 NDS. In the case of the older version, NETWARE 3, each server manages its resources on its own and is independent. A user must be managed on each server separately. In the case of NOVELL 4 NDS, all resources in the network are managed together in the NDS (NOVELL DIRECTORY SERVICE). The user must log into the network only once and is given access to the resources according to his access rights. The individual resources and users are managed as objects in a hierarchical tree (NDS TREE). The position of the object in the tree is referred to as "CONTEXT" with NETWARE and must be known for access to the resources.

MICROSOFT Network

In case of a MICROSOFT network, data can be exchanged both between workstations (peer to peer) and between workstations and servers. The latter can supply access to files and connection to the printers. On a server, data are organized in directories as under DOS and mapped to the workstation as virtual drives. A virtual drive behaves like an additional hard disk on the workstation, and the data can be edited accordingly. Network printers can also be addressed like normal printers. A connection is possible to DOS, WINDOWS FOR WORKGROUPS, WINDOWS95, WINDOWS NT.

Defining Users

After the network driver software has been installed, the instrument will output an error message on the next power-on, as there is no user called "Instrument" (= user name for NT autologin) in the network. It is therefore necessary to define a common user for Windows NT and the network.
The definition of new users in the network is done by the network administrator. For definition of a new user on the instrument, the User Manager is required:



➢ Use the key combination <CTRL> <ESC> to call the Windows-NT start menu.

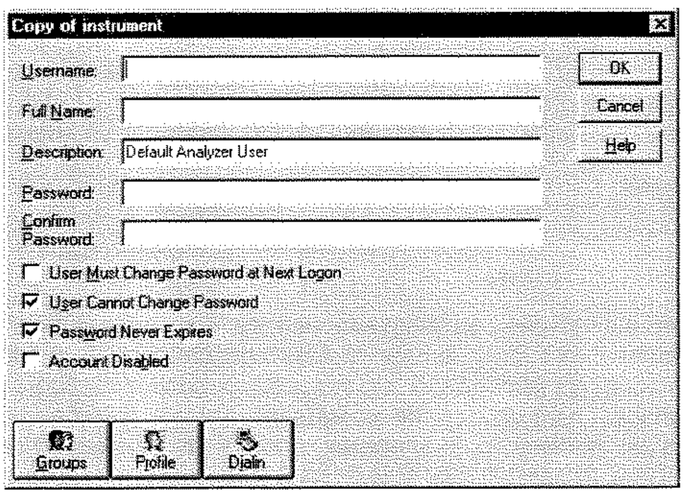
➢ Click on "Programs", "Administrative Tools (Common)" and "User Manager" one after the other.

The "User Manager" menu opens.

➢ Select User "instrument".

➢ Click on the "User" menu and select "Copy...".

The menu for entering the user data will appear.



➢ Fill in the lines
- "Username"
- "Password and
- "Confirm Password"

and terminate the data entry with "OK".

The user data must comply with the settings on the network.

Only NOVELL network:
Configure NOVELL Client

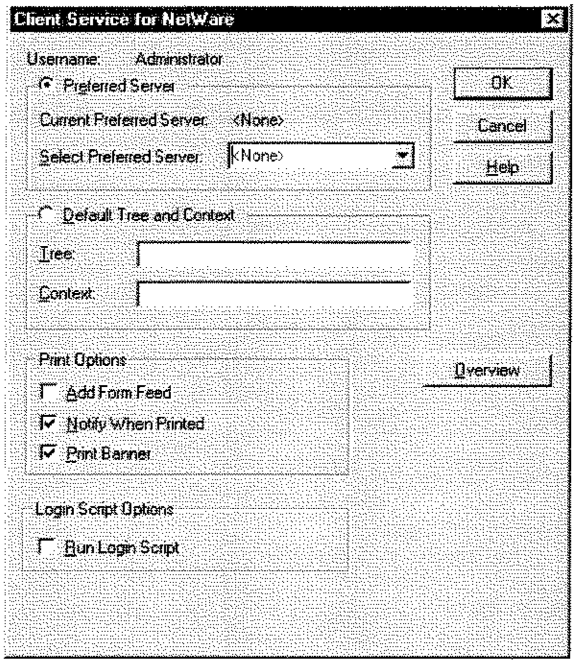
➢ Use the key combination <CTRL> <ESC> to call the Windows NT start menu.

➢ Click on "Settings", "Control Panel" and "CSNW" one after the other.

NOVELL 3.x

➢ Click on "Preferred Server".

➢ Select the NOVELL server where the user is configured using "Select Preferred Server".



NOVELL 4.x

➢ Click on "Default Tree and Context".

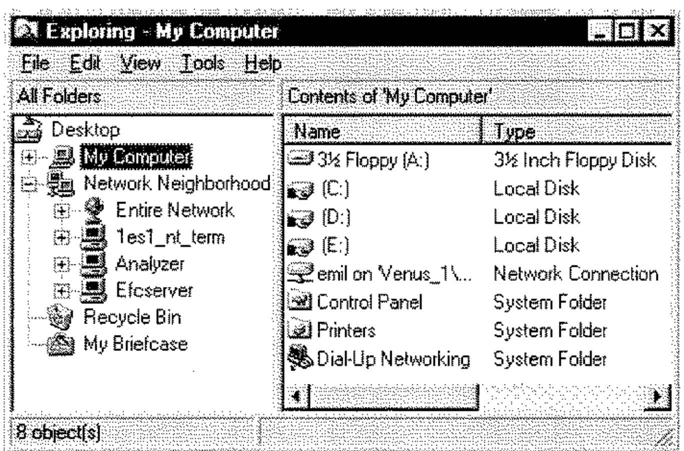
➢ Enter the NDS Tree under "Tree" and the hierarchical path where the user is defined under "Context".

Note: *This data can be obtained from the network administrator.*

Login in the Network

The user automatically logs into the network with the registration in the operating system. As a prerequisite, the user name and the password must be identical under Windows NT and on the network.

Using Network Drives



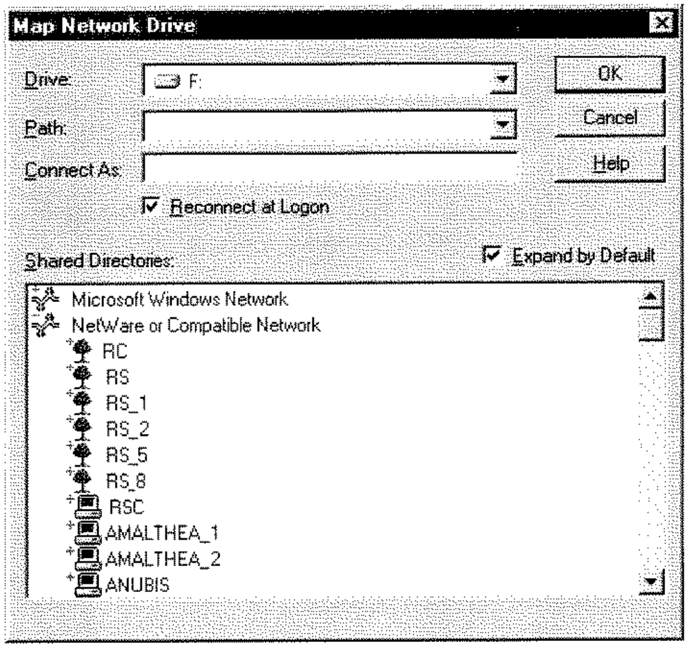
Mapping a network drive:

➢ Use the key combination <CTRL> <ESC> to call the Windows NT start menu.

➢ Click on "Programs", "Windows NT Explorer" one after the other.

➢ Click on the line "Network Neighborhood" in the overview "All Directories".

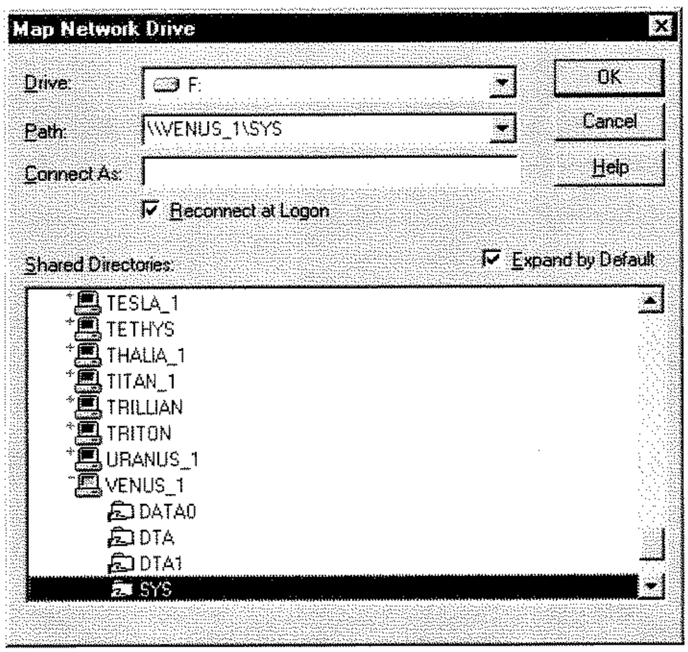
An overview of the available network drives is displayed.



➤ Click on "Tools" and then "Map Network Drive".

The network paths available in the network are displayed in the overview "Shared Directories:".

➤ Mark the desired network path.



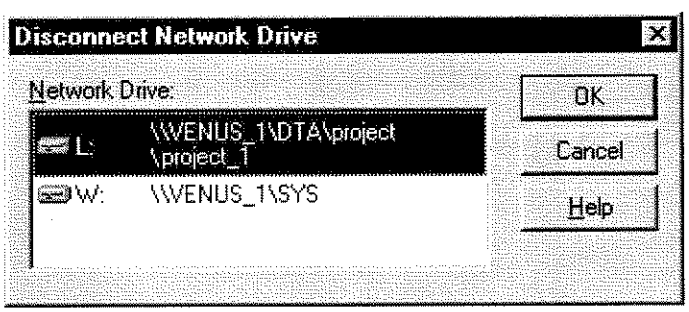
➤ Select the appropriate drive under "Drive:".

➤ Activate "Reconnect at Logon:" if the connection is to be set up automatically each time the instrument is started.

➤ Use "OK" to connect the network path with the selected drive.

The user name and the password are queried. Then the drive will appear in the overview "All Directories" of the explorer.

Note: *Only drives in the network can be connected that the user has the appropriate access rights for.*



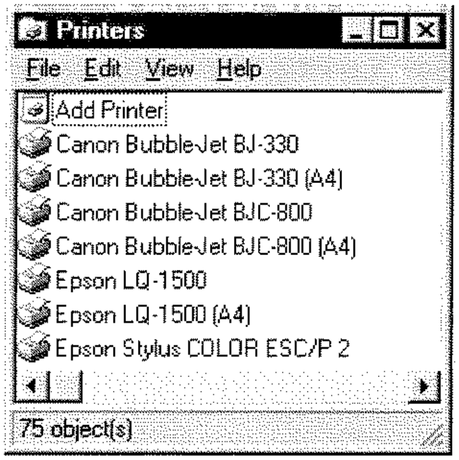
Disconnecting a network drive:

➤ Click on "Tools" in the Explorer and then "Disconnect Network Drive".

➤ Select the drive to be disconnected under "Network Drive:".

➤ Disconnect the drive using "OK". The security prompt must be answered with "Yes".

Printing on a Network Printer



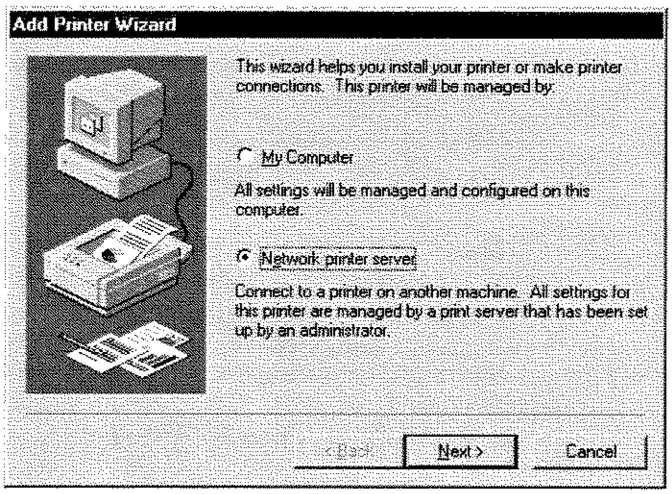
- Press the *HCOPY* key.

  The *HCOPY* menu opens.
- Press the *NEXT* key.

  The *HCOPY* submenu opens.
- Press the *INSTALL PRINTER* softkey.

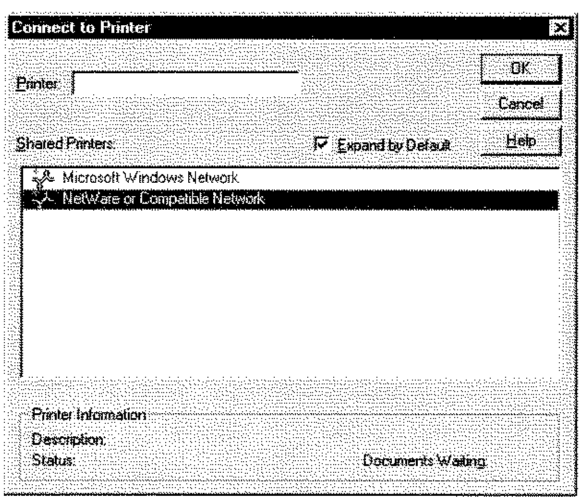
  The printer window opens.
- Double-click on the line "Add Printer".

  The "Add Printer Wizard" window opens. It guides through the following printer driver installation.



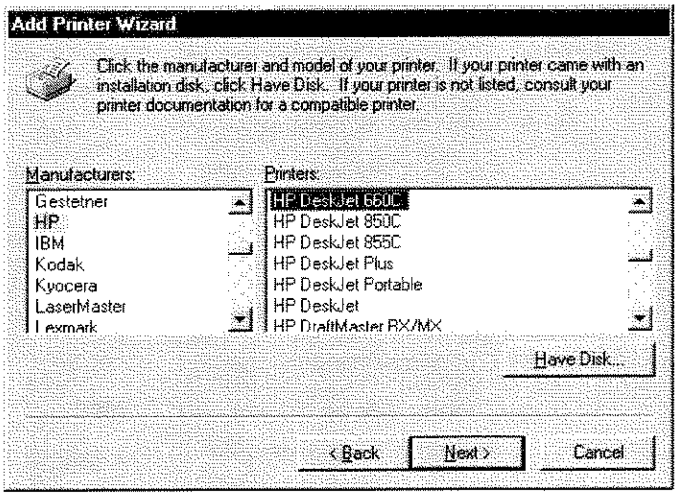
- Click on "Network Printer server" first and then on "Next".

  The choice of enabled printers appears.



- Mark the printer and select using "OK".
- Confirm the following prompt to install a suitable printer driver using "OK".

  The choice of printer drivers appears. The left table shows the manufacturers, the right one the available printer drivers.

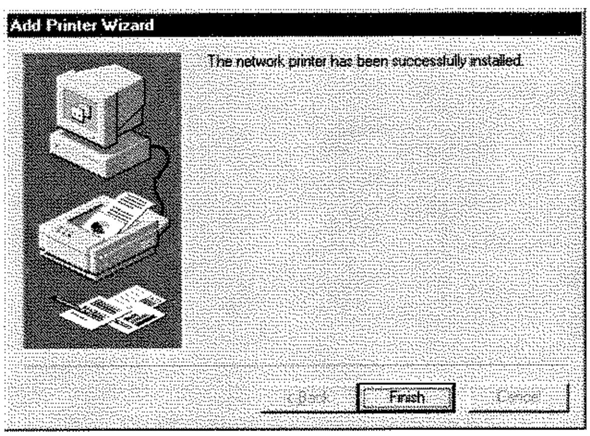


➢ Mark the manufacturer in the "Manufacturers" table and then the printer driver in the "Printers" table.

Note:
If the desired type of the output device does not appear in the list, the driver has not yet been installed on the instrument. In this case, click on the "HAVE DISK" button. A prompt appears, requesting the user to insert a disk with the respective printer driver. Then press "OK" and select the desired printer driver. After the installation, "Service Pack 5" must be reinstalled (see section "Installing the Windows NT Software")

➢ Click on "Next".

If one or more printers are already installed, this window will ask whether the just installed printer is to be selected as standard printer for the Windows NT applications (Do you want your Windows-based programs to use this printer as default printer?). "No" is set as default.



➢ Complete the installation of the printer driver by means of "Finish".

Note:
If the prompt to specify the path to the printer driver appears after clicking on "Finish", the Service Pack must be reinstalled after this printer installation (see Chapter 1, section "Computer Function - Installing the Windows NT Software").

Finally the instrument needs to be configured for use of the installed network printer using softkeys DEVICE 1 and DEVICE 2 in the Hardcopy Main Menu.

Remote Data Transfer with TCP/IP Services

The protocol TCP/IP allows the transfer of files between different computer systems. This requires a program running on the two computers that controls this data transfer. It is not necessary that the same operating or file system is used by both computers. For example, a file transfer between DOS/WINDOWS and UNIX is possible. One of the two partners must be configured as Host and the other one as Client. However, they may as well change their roles. Usually, the system which is able to perform several processes at the same time will play the host role. The file transfer program usually used under TCP/IP is FTP (File Transfer Protocol). An FTP host is installed as standard on the majority of UNIX systems.

If the TCP/IP services are installed, a terminal connection is possible using "Start" - "Programs" - "Accessories" - "Telnet" or a data transfer via FTP by means of "Start" - "Run" "ftp" - "OK". Thus all computer systems supporting these universal protocols can be addressed (UNIX, VMS, ...).

For further information please refer to the corresponding NT literature.

File Transfer via FTP

The total scope of functions and commands is described in the FTP literature. The following table therefore only contains the major functions:

Setting up the connection

Click on "Start" and then "Run" in the task bar

The DOS command
`FTP`
starts the program.

The command
`OPEN <xx.xx.xx.xx>`
sets up the connection.

xx.xx.xx.xx = IP address e.g. 89.0.0.13

Data transfer

The command
`PUT <dateiname>`
transfers the data to the target system.

The command
`GET <dateiname>`
transfers the data from the target system.

The command
`TYPE B`
transfers the data in BINARY format, no conversion takes place.

The command
`TYPE A`
transfers the data in ASCII format, converting control characters so that text files can also be read on the target system.

Examples:
`PUT C:\AUTOEXEC.BAT`
sends the file `AUTOEXEC.BAT` to the target system.
`LCD DATA`
changes the current directory on the local machine to subdirectory `DATA`
`CD SETTING`

changes to the subdirectory `SETTING` on the target system

dateiname= File name e.g. DATA.TXT

Changing the directories

The command
`LCD <path>`
changes the directory on the local machine as with `DOS`.

The command
`LDIR`
shows the directory contents on the local machine.

These commands refer to the file system of the FSU. If the `L` is omitted ahead of the commands, they apply to the target system.

RSIB Interface

The instrument is equipped with an RSIB interface as standard, which enables controlling of the instrument by means of Visual C++ and Visual Basic programs, but also by using the Windows applications WinWord and Excel. The control applications run on an external computer in the network.

Remote Control via RSIB Interface

In order to be able to access the measuring instruments via the RSIB interface, the file `RSIB32.DLL` must be copied into the Windows `system32` directory or into the directory of the control applications. For 16-bit applications, the file `RSIB.DLL` must be additionally copied into the directories mentioned. The files RSIB.DLL and RSIB32.DLL are included on the instrument in directory D:\R_S\Instr\RSIB.

For the different programming languages there are files available that contain the declarations of the DLL functions and the definition of the error codes.

Visual Basic (16 bit):	`'RSIB.BAS'`	`(D:\R_S\Instr\RSIB)`
Visual Basic (32 bit):	`'RSIB32.BAS'`	`(D:\R_S\Instr\RSIB)`
C:	`'RSIB.H'`	`(D:\R_S\Instr\RSIB)`

For C programs, import libraries are additionally available.

Import library for RSIB.DLL:	`RSIB.LIB'`	`(D:\R_S\Instr\RSIB)`
Import library for RSIB32.DLL:	`RSIB32.LIB'`	`(D:\R_S\Instr\RSIB)`

The control is performed using the Visual C++ or Visual Basic programs or one of the Windows applications WinWord or Excel. The programs use the IP address of the instrument to set up the connection.

Via VisualBasic: ud = RSDLLibfind ("82.1.1.200", ibsta, iberr, ibcntl)

Return to manual operation is possible via the front panel (*LOCAL* key) or via the RSIB interface:

Via RSIB: ud = RSDLLibloc (ud, ibsta, iberr, ibcntl);
or
ud = RSDLLibonl (ud, 0, ibsta, iberr, ibcntl);

RSIB Interface Functions

This chapter lists all functions of the DLL "RSIB.DLL" or "RSIB32.DLL", which allow to produce control applications.

Overview of Interface Functions

The DLL functions are adapted to the interface functions of National Instruments for GPIB programming. The functions supported by the DLL are listed in the following table.

Function	Description
RSDLLibfind()	Provides a handle for access to a device.
RSDLLibwrt()	Sends a zero-terminated string to a device.
RSDLLilwrt()	Sends a certain number of bytes to a device.
RSDLLibwrtf()	Sends the contents of a file to a device.
RSDLLibrd()	Reads data from a device into a string.
RSDLLilrd()	Reads a certain number of bytes from a device.
RSDLLibrdf()	Reads data from a device into a file.
RSDLLibtmo()	Sets timeout for RSIB functions
RSDLLibsre()	Switches a device into the local or remote state
RSDLLibloc()	Temporarily switches a device into the local state
RSDLLibeot()	Enables/disables the END message for write operations.
RSDLLibrsp()	Performs a serial poll and provides the status byte.
RSDLLibonl()	Sets the device On/Offline.
RSDLLTestSrq()	Checks whether a device has generated an SRQ.
RSDLLWaitSrq()	Waits until a device generates an SRQ.

Variables ibsta, iberr, ibcntl

As with the National Instrument interface, the successful execution of a command can be checked by means of the variables ibsta, iberr and ibcntl. For this purpose, all RSIB functions are assigned references to these three variables.

Status word - ibsta

The status word ibsta provides information on the status of the RSIB interface. The following bits are defined:

Bit designation	Bit	Hex code	Description
ERR	15	8000	Is set when an error has occurred on calling a function. If this bit is set, iberr contains an error code which specifies the error in greater detail.
TIMO	14	4000	Is set when a timeout has occurred on calling a function.
CMPL	8	0100	Is set if the response of the GPIB parser has been read out completely. If a parser response is read out with the function RSDLLilrd() and the length of the buffer is insufficient for the answer, the bit will be cleared.

Error variable - iberr

If the ERR bit (8000h) is set in the status word, iberr contains an error code which allows to specify the error in greater detail. Extra error codes are defined for the RSIB interface, independent of the National Instruments interface.

Error	Error code	Description
IBERR_CONNECT	2	Setup of the connection to the measuring instrument has failed.
IBERR_NO_DEVICE	3	A function of the interface has been called with an illegal device handle.
IBERR_MEM	4	No empty memory available
IBERR_TIMEOUT	5	Timeout has occurred.
IBERR_BUSY	6	The RSIB interface is blocked by a still running function.
IBERR_FILE	7	Error when reading or writing to a file.

Count variable - ibcntl

The variable ibcntl is updated with the number of transferred bytes each time a read or write function is called.

Description of Interface Functions

RSDLLibfind()

The function provides a handle for access to the device with the name `udName`.

VB format: `Function RSDLLibfind (ByVal udName$, ibsta%, iberr%, ibcntl&) As Integer`

C-format: `short FAR PASCAL RSDLLibfind( char far *udName, short far *ibsta, short far *iberr, unsigned long far *ibcntl)`

Parameter: `udName` IP address of device

Example: `ud = RSDLLibfind ("89.10.38.97", ibsta, iberr, ibcntl)`

The function must be called prior to all other functions of the interface.

As return value, the function provides a handle that must be indicated in all functions for access to the device. If the device with the name `udName` is not found, the handle has a negative value.

RSDLLibwrt

This function sends data to the device with the handle `ud`.

VB format: `Function RSDLLibwrt (ByVal ud%, ByVal Wrt$, ibsta%, iberr%, ibcntl&) As Integer`

C format: `short FAR PASCAL RSDLLibwrt( short ud, char far *Wrt, short far *ibsta, short far *iberr, unsigned long far *ibcntl )`

Parameter:

`ud`	Device handle
`Wrt`	String sent to the device.

Example: `RSDLLibwrt(ud, "SENS:FREQ:STAR?", ibsta, iberr, ibcntl)`

This function allows to send setting and query commands to the measuring instruments. Whether the data is interpreted as a complete command can be set using the function `RSDLLibeot()`.

RSDLLilwrt

This function sends `Cnt` bytes to a device with the handle `ud`.

VB format: `Function RSDLLilwrt (ByVal ud%, ByVal Wrt$, ByVal Cnt&, ibsta%, iberr%, ibcntl&) As Integer`

C format: `short FAR PASCAL RSDLLilwrt( short ud, char far *Wrt, unsigned long Cnt, short far *ibsta, short far *iberr, unsigned long far *ibcntl)`

Parameter:

`ud`	Device handle
`Wrt`	String sent to the GPIB parser.
`Cnt`	Number of bytes sent to the device.

Example: `RSDLLilwrt (ud, '......', 100, ibsta, iberr, ibcntl)`

Like `RSDLLibwrt()` this function sends data to a device. The only difference is that binary data can be sent as well. The length of the data is not determined by a zero-terminated string, but by the indication of `Cnt` bytes. If the data is to be terminated with EOS (0Ah), the EOS byte must be appended to the string.

RSDLLibwrtf

This function sends the contents of a file `file$` to the device with the handle `ud`.

VB format: `Function RSDLLibwrtf (ByVal ud%, ByVal file$, ibsta%, iberr%, ibcntl&) As Integer`

C format: `short FAR PASCAL RSDLLibwrt( short ud, char far *Wrt, short far *ibsta, short far *iberr, unsigned long far *ibcntl )`

Parameter:

ud	Device handle
file	File the contents of which are sent to the device.

Example: `RSDLLibwrtf(ud, "C:\db.sav", ibsta, iberr, ibcntl)`

This function allows to send setting and query commands to the measuring instruments. Whether the data is interpreted as complete command can be set using the function `RSDLLibeot()`.

RSDLLibrd()

The function reads data from the device with the handle `ud` into the string `Rd`.

VB format: `Function RSDLLibrd (ByVal ud%, ByVal Rd$, ibsta%, iberr%, ibcntl&) As Integer`

C format: `short FAR PASCAL RSDLLibrd( short ud, char far *Rd, short far *ibsta, short far *iberr, unsigned long far *ibcntl )`

Parameter:

ud	Device handle
Rd	String into which the read data is copied.

Example: `RSDLLibrd (ud, Rd, ibsta, iberr, ibcntl)`

This function fetches the responses of the GPIB parser to a query.

In the case of Visual Basic programming, a string of sufficient length must be generated before. This can be done during the definition of the string or using the command `Space$()`.

Generation of a string of the length 100:

- `Dim Rd as String * 100`
- `Dim Rd as String`
  `Rd = Space$(100)`

RSDLLilrd

This function reads `Cnt` bytes from the device with the handle `ud`.

VB format: `Function RSDLLilrd (ByVal ud%, ByVal Rd$, ByVal Cnt&, ibsta%, iberr%, ibcntl&) As Integer`

C format: `short FAR PASCAL RSDLLilrd( short ud, char far *Rd, unsigned long Cnt, short far *ibsta, short far *iberr, unsigned long far *ibcntl )`

Parameter:

ud	Device handle
cnt	Maximum number of bytes copied from the DLL into the target string `Rd`.

Example: `RSDLLilrd (ud, RD, 100, ibsta, iberr, ibcntl)`

Like the function `RSDLLibrd()`, this function reads data from a device. The only difference is that in this case the maximum number of bytes to be copied into the target string `Rd` can be indicated by means of `Cnt`. This function prevents writing beyond the end of the string.

RSDLLibrdf()

Reads data from the device with the handle `ud` into the file `file`.

VB format: `Function RSDLLibrdf (ByVal ud%, ByVal file$, ibsta%, iberr%, ibcntl&) As Integer`

C format: `short FAR PASCAL RSDLLibrd( short ud, char far *file, short far *ibsta, short far *iberr, unsigned long far *ibcntl )`

Parameter:

ud	Device handle
file	File into which the read data is written.

Example: `RSDLLibrdf (ud, "c:\db.sav", ibsta, iberr, ibcntl)`

The file name may as well include a drive or path specification.

RSDLLibtmo

This function defines the timeout for a device. The default value for the timeout is set to 5 seconds.

VB format: `Function RSDLLibtmo (ByVal ud%, ByVal tmo%, ibsta%, iberr%, ibcntl&) As Integer`

C format: `void FAR PASCAL RSDLLibtmo( short ud, short tmo, short far *ibsta, short far *iberr, unsigned long far *ibcntl )`

Parameter:

ud	Device handle
tmo	Timeout in seconds

Example: `RSDLLibtmo (ud, 10, ibsta, iberr, ibcntl)`

RSDLLibsre

This function sets the device to the 'LOCAL' or 'REMOTE' state.

VB format: `Function RSDLLibsre (ByVal ud%, ByVal v%, ibsta%, iberr%, ibcntl&) As Integer`

C format: `void FAR PASCAL RSDLLibsre( short ud, short v, short far *ibsta, short far *iberr, unsigned long far *ibcntl)`

Parameter:

ud	Device handle
v	State of device 0 - local 1 - remote

Example: `RSDLLibsre (ud, 0, ibsta, iberr, ibcntl)`

RSDLLibloc

This function temporarily switches the device to the 'LOCAL' state.

VB format: `Function RSDLLibloc (ByVal ud%, ibsta%, iberr%, ibcntl&) As Integer`

C format: `void FAR PASCAL RSDLLibloc( short ud, short far *ibsta, short far *iberr, unsigned long far *ibcntl)`

Parameter: `ud` Device handle

Example: `RSDLLibloc (ud, ibsta, iberr, ibcntl)`

Having reached LOCAl state, the device can be manually operated via the front panel. With the next access to the device with one of the functions of the RSIB.DLL, the device is set back to the 'REMOTE' state again.

RSDLLibeot

This function enables or disables the END message after write operations.

VB format: `Function RSDLLibeot (ByVal ud%, ByVal v%, ibsta%, iberr%, ibcntl&) As Integer`

C format: `void FAR PASCAL RSDLLibsre( short ud, short v, short far *ibsta, short far *iberr, unsigned long far *ibcntl)`

Parameter:
`ud` Device handle.
`v` 0 - no END message
1 – send END message

Example: `RSDLLibeot (ud, 1, ibsta, iberr, ibcntl)`

If the END message is disabled, the data of a command can be sent with several successive calls of write functions. The END message must be enabled again before sending the last data block.

RSDLLibrsp

This function performs a serial poll and provides the status byte of the device.

VB format: `Function RSDLLibrsp(ByVal ud%, spr%, ibsta%, iberr%, ibcntl&) As Integer`

C format: `void FAR PASCAL RSDLLibrsp( short ud, char far* spr, short far *ibsta, short far *iberr, unsigned long far *ibcntl)`

Parameter:
`ud` Device handle
`spr` Pointer to status byte

Example: `RSDLLibrsp(ud, spr, ibsta, iberr, ibcntl)`

RSDLLibonl

This function switches the device to 'online' or 'offline' mode. When it is switched to 'offline' mode, the interface is released and the device handle becomes invalid. By calling RSDLLibfind again, the communication is set up again.

VB format: `Function RSDLLibonl (ByVal ud%, ByVal v%, ibsta%, iberr%, ibcntl&) As Integer`

C format: `void FAR PASCAL RSDLLibonl( short ud, short v, short far *ibsta, short far *iberr, unsigned long far *ibcntl)`

Parameter:

`ud`	Device handle
`v`	Device state 0 - local 1 - remote

Example: `RSDLLibonl(ud, 0, ibsta, iberr, ibcntl)`

RSDLLTestSRQ

This function checks the status of the SRQ bit.

VB format: `Function RSDLLTestSrq (ByVal ud%, Result%, ibsta%, iberr%, ibcntl&) As Integer`

C format: `void FAR PASCAL RSDLLTestSrq( short ud, short far *result, short far *ibsta, short far *iberr, unsigned long far *ibcntl)`

Parameter:

`ud`	Device handle
`result`	Reference to an integer value in which the library returns the status of the SRQ bit. 0 - no SRQ 1 - SRQ active, device requests service

Example: `RSDLLTestSrq (ud, result%, ibsta, iberr, ibcntl)`

This function corresponds to the function `RSDLLWaitSrq`. The only difference is that `RSDLLTestSRQ` immediately returns the current status of the SRQ bit, whereas `RSDLLWaitSrq` waits for an SRQ to occur.

RSDLLWaitSrq

This function waits until the device triggers an SRQ with the handle `ud`.

VB format: `Function RSDLLWaitSrq (ByVal ud%, Result%, ibsta%, iberr%, ibcntl&) As Integer`

C format: `void FAR PASCAL RSDLLWaitSrq( short ud, short far *result, short far *ibsta, short far *iberr, unsigned long far *ibcntl)`

Parameter:

`ud`	Device handle
`result`	Reference to an integer value in which the library returns the status of the SRQ bit. 0 - No SRQ has occurred during the timeout 1 - SRQ has occurred during the timeout

Parameter: `RSDLLWaitSrq( ud, result, ibsta, iberr, ibcntl );`

The function waits until one of the following two events occurs.

- The measuring instrument triggers an SRQ
- No SRQ occurs during the timeout defined with `RSDLLibtmo()`

Programming via the RSIB Interface

Visual Basic

Programming hints:

- Access to the functions of the RSIB.DLL

  To create Visual Basic control applications, the file RSIB.BAS must be added to a project for 16-bit Basic programs and the file RSIB32.BAS for 32-bit Basic programs (D:\R_S\INSTR\RSIB) so that the functions of the RSIB.DLL or RSIB32.DLL can be accessed.

- Generating a response buffer

  Prior to calling the functions `RSDLLibrd()` and `RSDLLilrd()`, a string of sufficient length must be generated. This is possible either by defining the string or using the command `Space$()`.
  Generating a string of the length 100:
  - `Dim Response as String * 100`
  - `Dim Response as String`
    `Response = Space$(100)`

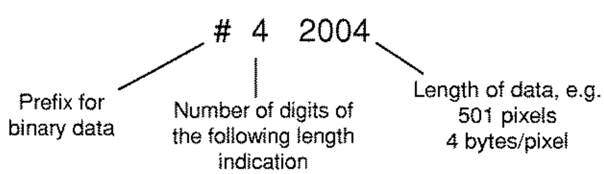
  If a response is to be output as a string from the measuring instrument, the appended blanks can be removed using the Visual Basic Function RTrim().

  Example:
  ```
  Response = Space$(100)
  Call RSDLLibrd(ud, Response, ibsta, iberr, ibcntl)
  Response = RTrim(Response)
  ' Output of Response
  ```

- Reading out trace data in real format

  Using the function declarations in the file RSIB.BAS or RSIB32.BAS the responses of the device can be assigned to one string only. If the data are to be read into an array with float values, the header and the useful data must be read out with separate function calls.

  Example of a header



  In order to enable the trace data to be directly read into a float array, a special function declaration must be created.

```
Declare Function RSDLLilrdTraceReal Lib "rsib32.dll" Alias "RSDLLilrd"
(ByVal ud%, Rd As Single, ByVal Cnt&, ibsta%, iberr%, ibcntl&) As Integer
```

Example:

```
Dim ibsta As Integer            ' Status variable
Dim iberr As Integer            ' Error variable
Dim ibcntl As Long              ' Count variable
Dim ud As Integer               ' Handle for measuring instrument
Dim Result As String            ' Buffer for simple results
Dim Digits As Byte              ' Number of digits of length indication
Dim TraceBytes As Long          ' Length of trace data in bytes
Dim TraceData(625) As Single    ' Buffer for floating point
                                ' Binary data

' Set up connection to instrument
ud = RSDLLibfind("89.10.38.97", ibsta, iberr, ibcntl)

' Query trace data in real format
Call RSDLLibwrt(ud, "FORM:DATA REAL,32", ibsta, iberr, ibcntl)
Call RSDLLibwrt(ud, "TRACE? TRACE1", ibsta, iberr, ibcntl)

'Read number of digits of length indication
Result = Space$(20)
Call RSDLLilrd(ud, Result, 2, ibsta, iberr, ibcntl)
Digits = Val(Mid$(Result, 2, 1))

'Read length indication
Result = Space$(20)
Call RSDLLilrd(ud, Result, Digits, ibsta, iberr, ibcntl)
TraceBytes = Val(Left$(Result, Digits))    'and store

' Read out trace data
Call RSDLLilrdTraceReal(ud, TraceData(0), TraceBytes, ibsta, iberr,ibcntl)
```

Programming examples:

- In this example, the start frequency of the instrument is queried.

```
Dim ibsta As Integer      ' Status variable
Dim iberr As Integer      ' Error variable
Dim ibcntl As Long        ' Count variable
Dim ud As Integer         ' Handle for measuring instrument
Dim Response As String    ' Response string

' Set up connection to measuring instrument
ud = RSDLLibfind("89.10.38.97", ibsta, iberr, ibcntl)
If (ud < 0) Then
   ' Error treatment
End If

' Send query command
Call RSDLLibwrt(ud, "FREQ:START?", ibsta, iberr, ibcntl)

' Provide space for response
Response = Space$(100)

' Read response from measuring instrument
Call RSDLLibrd(ud, Response, ibsta, iberr, ibcntl)
```

- In this example, a Save/Recall of the instrument setups is performed.

```
Dim ibsta As Integer    ' Status variable
Dim iberr As Integer    ' Error variable
Dim ibcntl As Long      ' Count variable
Dim ud As Integer       ' Handle for measuring instrument
Dim Cmd As String       ' Command string

' Set up connection to measuring instrument
ud = RSDLLibfind("89.10.38.97", ibsta, iberr, ibcntl)
If (ud < 0) Then
   ' Error treatment
End If

' Request instrument settings
Cmd = "SYST:SET?"
Call RSDLLibwrt(ud, Cmd, ibsta, iberr, ibcntl)

' Store instrument response in file
Call RSDLLibrdf(ud, "C:\db.sav", ibsta, iberr, ibcntl)

' Reset instrument
Call RSDLLibwrt(ud, "*RST", ibsta, iberr, ibcntl)

' and restore the previous settings
' to this end disable the END message
Call RSDLLibeot(ud, 0, ibsta, iberr, ibcntl)
' first send off command
Call RSDLLibwrt(ud, "SYST:SET ", ibsta, iberr, ibcntl)
' enable the END message again
Call RSDLLibeot(ud, 1, ibsta, iberr, ibcntl)
' and send the data
Call RSDLLibwrtf(ud, "C:\db.sav", ibsta, iberr, ibcntl)
```

Visual Basic for Applications (Winword and Excel)

Programming hints:

The programming language Visual Basic for Applications (VBA) is supported as a macro language by various manufacturers. The programs Winword and Excel use this language for the versions Winword 97 or Excel 5.0 and higher.
For macros created with Visual Basic for Applications, the same hints are valid as for Visual Basic Applications.

Programming example:

- Using the macro `QueryMaxPeak` a single sweep with subsequent query of the maximum peak is performed. The result is entered in a Winword or Excel document.

```
Sub QueryMaxPeak()

    Dim ibsta As Integer      ' Status variable
    Dim iberr As Integer      ' Error variable
    Dim ibcntl As Long        ' transferred characters
    Dim ud As Integer         ' Unit Descriptor (handle)for instrument
    Dim Response As String    ' Response string

    ' Set up connection to measuring instrument
    ud = RSDLLibfind("89.10.38.97", ibsta, iberr, ibcntl)
    If (ud < 0) Then
      Call MsgBox("Device with address 89.10.38.97 could" & _
                  "not be found", vbExclamation)
      End
    End If

    ' Determine maximum peak in the range 1-2MHZ
    Call RSDLLibwrt(ud, "*RST", ibsta, iberr, ibcntl)
    Call RSDLLibwrt(ud, "INIT:CONT OFF", ibsta, iberr, ibcntl)
    Call RSDLLibwrt(ud, "FREQ:START 1MHZ", ibsta, iberr, ibcntl)
    Call RSDLLibwrt(ud, "FREQ:STOP 2MHZ", ibsta, iberr, ibcntl)
    Call RSDLLibwrt(ud, "INIT:IMM;*WAI", ibsta, iberr, ibcntl)
    Call RSDLLibwrt(ud, "CALC:MARK:MAX;Y?", ibsta, iberr, ibcntl)
    Response = Space$(100)
    Call RSDLLibrd(ud, Response, ibsta, iberr, ibcntl)
    Response = RTrim(Response) ' Cut off space

    ' Insert value in current document (Winword)
    Selection.InsertBefore (Response)
    Selection.Collapse (wdCollapseEnd)

    ' Terminate connection to measuring instrument
    Call RSDLLibonl(ud, 0, ibsta, iberr, ibcntl)

End Sub
```

The entry of the peak value in the Winword document can be replaced as follows for Excel:

```
    ' Insert value in current document (Excel)
    ActiveCell.FormulaR1C1 = Response
```

C / C++

Programming hints:

- Access to the functions of the RSIB32.DLL

  The functions of the `RSIB32.DLL` are declared in the header file `RSIB.H`. The DLL functions can be linked to a C/C++ program in different ways.

  1. Enter one of the supplied import libraries (`RSIB.LIB or RSIB32.LIB`) into the linker options.
  2. Load the library using the function `LoadLibrary()` during runtime and determine the function pointers of the DLL functions using `GetProcAddress()`. Before the end of the program, the `RSIB.DLL` must be unloaded again using the function `FreeLibrary()`.

  When import libraries are used, the DLL is automatically loaded immediately before the application is started. At the end of the program, the DLL is unloaded again unless it is still used by other applications.

- Query of strings

  If instrument responses are to be further processed as strings, a zero termination must be appended.

  Example:

```
char buffer[100];
...
RSDLLibrd( ud, buffer, &ibsta, &iberr, &ibcntl );
buffer[ibcntl] = 0;
```

Programming example:

In the following C program example, a single sweep is started on the device with the IP address 89.10.38.97 and subsequently a marker is set to maximum level. Prior to the search for maximum, a synchronization to the end of the sweep is performed. For this purpose the command "*OPC" (Operation complete) is used to create a service request at the end of the sweep, for which the control program waits with the function RSDLLWaitSrq(). Then the maximum is determined ("CALC:MARK:MAX") and the level read out ("Y?").

```
#define MAX_RESP_LEN 100

short           ibsta, iberr;
unsigned long   ibcntl;
short           ud;
short           srq;
char            MaxPegel[MAX_RESP_LEN];
char            spr;

// Determine handle for instrument
ud = RSDLLibfind( "89.10.38.97", &ibsta, &iberr, &ibcntl );

// if instrument exists
if ( ud >= 0 )
{
  // Set timeout for RSDLLWaitSrq() to 10 seconds
  RSDLLibtmo( ud, 10, &ibsta, &iberr, &ibcntl );

  // Activate SRQ generation via event status register (ESR)
  // and enable ESB bit in SRE register
  RSDLLibwrt( ud, "*ESE 1;*SRE 32", &ibsta, &iberr, &ibcntl );

  // Set single sweep, trigger sweep and use "*OPC" to cause
  // the generation of a service request at the end of the sweep
  RSDLLibwrt( ud, "INIT:CONT off;INIT;*OPC", &ibsta, &iberr, &ibcntl );

  // Wait for SRQ (end of sweep)
  RSDLLWaitSrq( ud, &srq, &ibsta, &iberr, &ibcntl );

  // Clear RQS/MSS bit
  RSDLLibrsp( ud, &spr, &ibsta, &iberr, &ibcntl );

  // if sweep is terminated
  if (srq)
  {
    // then set marker to first maximum and query the level
    RSDLLibwrt( ud, "CALC:MARK:MAX;Y?", &ibsta, &iberr, &ibcntl );
    RSDLLilrd( ud, MaxPegel, MAX_RESP_LEN, &ibsta, &iberr, &ibcntl );
    MaxPegel[ibcntl] = 0;
  }
  // End connection to instrument
  RSDLLibonl (ud, 0, &ibsta, &iberr, &ibcntl ) ;
}
else
{
  ; // Error Instrument not found
}
```

Contents - Chapter 5 "Remote Control - "Basics"

5 Remote Control - Basics

In this chapter you'll find:

- instructions on how to put the FSU into operation via remote control,
- 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,
- diagrams and tables describing the status registers used in the FSU.

In chapter 6, all remote control functions are described in detail. The subsystems are listed by alphabetical order according to SCPI. All commands and their parameters are listed by alphabetical order in the command list at the end of chapter 6.

Program examples for the FSU can be found in chapter 7.

The remote control interfaces and their interface functions are described in Chapter 8.

Introduction

The instrument is equipped with an IEC-bus interface according to standard IEC 625.1/IEEE 488.2 and a RS-232 interface. The connectors are located at the rear of the instrument and permits to connect a controller for remote control.

The instrument supports the SCPI:version 1997.0 (Standard Commands for Programmable Instruments). 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 tutorial "Automatic Measurement Control – A tutorial on SCPI and IEEE 488.2" from John M. Pieper (R&S order number 0002.3536.00) offers detailed information on concepts and definitions of SCPI.

This section assumes basic knowledge of IEC/IEEE bus programming and operation of the controller. A description of the interface commands can be obtained from the relevant manuals.

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.

The program examples for IEC-bus programming are all written in VISUAL BASIC.

Getting Started

The short and simple operating sequence given below permits fast putting into operation of the instrument and setting of its basic functions. As a prerequisite, the IEC/IEEE-bus address, which is factory-set to 20, must not have been changed.

1. Connect instrument and controller using IEC/IEEE-bus cable.
2. Write and start the following program on the controller:

```
CALL IBFIND("DEV1", analyzer%)                    'Open port to the instrument
CALL IBPAD(analyzer%, 20)                         'Inform controller about instrument address
CALL IBWRT(analyzer%, '*RST;*CLS')                "Reset instrument

CALL IBWRT(analyzer%, 'FREQ:CENT 100MHz')         ' Set center frequency to 100 MHz
CALL IBWRT(analyzer%, 'FREQ:SPAN 10MHz')          ' Set span to 10 MHz
CALL IBWRT(analyzer%, 'DISP:TRAC:Y:RLEV -10dBm')
                                                  ' Set reference level to -10 dBm
```

The instrument now performs a sweep in the frequency range of 95 MHz to 105 MHz.

3. To return to manual control, press the *LOCAL* key at the front panel

Starting Remote Control Operation

On power-on, the instrument is always in the manual operating state ("LOCAL" state) and can be operated via the front panel.
It is switched to remote control ("REMOTE" state)

IEC/IEEE-bus	as soon as it receives an addressed command from a controller.
RS-232	as soon as it receives the command "@REM" from a controller.

During remote control, 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 remote control interfaces. Switching from manual operation to remote control and vice versa does not affect the remaining instrument settings.

Display Contents during Remote Control

During remote control, only the LOCAL softkey appears, with which it is possible to return to manual operation.

In addition, the display of diagrams and results can be blanked out with the command "`SYSTem:DISPlay:UPDate OFF`" (default in remote control) to obtain optimum performance during remote control operation.

During program execution it is recommended to activate the display of results by means of "`SYSTem:DISPlay:UPDate ON`" so that it is possible to follow the changes in the device settings and the recorded measurement curves on the screen.

Note: *If the instrument is exclusively operated in remote control, it is recommended to switch on the power-save mode (POWER SAVE). In this mode, the required display is completely switched off after a preset time.*

Remote Control via IEC/IEEE Bus

Setting the Device Address

In order to operate the instrument via the IEC-bus, it must be addressed using the set IEC/IEEE bus address. The IEC/IEEE bus address of the instrument is factory-set to 20. It can be changed manually in the *SETUP - GENERAL SETUP* menu or via IEC bus. Addresses 0 to 30 are permissible.

Manually:

➢ Call *SETUP - GENERAL SETUP* menu

➢ Enter desired address in table *GPIB-ADDRESS*

➢ Terminate input using the *ENTER* key

Via IEC/IEEE bus:

```
CALL IBFIND("DEV1", analyzer%)                    'Open port to the instrument
CALL IBPAD(analyzer%, 20)                         'Inform controller about old address
CALL IBWRT(analyzer%, "SYST:COMM:GPIB:ADDR 18")   'Set instrument to new address
CALL IBPAD(analyzer%, 18)                         'Inform controller about new address
```

Return to Manual Operation

Return to manual operation is possible via the front panel or the IEC/IEEE bus.

Manually: ➢ Press the *LOCAL* softkey or the *PRESET* key

Notes:
- *Before the transition, command processing must be completed as otherwise transition to remote control is performed immediately.*
- *The keys can be disabled by the universal command LLO (see Chapter 8) in order to prevent unintentional transition. In this case, transition to manual mode is only possible via the IEC/IEEE bus.*
- *The keys can be enabled again by deactivating the REN line of the IEC/IEEE bus (see Chapter 8).*

Via IEC bus:

```
...
CALL IBLOC(analyzer%)          'Set instrument to manual operation
...
```

Remote Control via RS-232-Interface

Setting the Transmission Parameters

To enable an error-free and correct data transmission, the parameters of the unit and the controller should have the same setting.
Parameters can be manually changed in menu *SETUP-GENERAL SETUP* in table *COM PORT* or via remote control using the command `SYSTem:COMMunicate:SERial:....`

The transmission parameters of the COM interface are factory-set to the following values:
baudrate = 9600, data bits = 8, stop bits = 1, parity = NONE and owner = INSTRUMENT.
For remote control operation, the interface should be allocated to the operating system (owner = OS) so that the control characters including @ can be recognized by the interface.

Manually: Setting the COM interface

- ➢ Call *SETUP-GENERAL SETUP* menu
- ➢ Select desired baudrate, bits, stopbit, parity in table *COM PORT.*
- ➢ Set owner to OS in table *COM PORT.*
- ➢ Terminate input using the *ENTER* key.

Return to Manual Operation

Return to manual operation is possible via the front panel or via RS-232 interface.

Manually:

- ➢ Press the *LOCAL* softkey or the *PRESET* key.

Notes:

- *Before the transition, command processing must be completed as otherwise transition to remote control is performed immediately*
- *The keys can be enabled again by sending the control string "@LOC" via RS-232 (see Chapter 8).*

Via RS-232:

```
...
v24puts(port,"@LOC");
...
```

Set instrument to manual operation..

Limitations

The following limitations apply if the unit is remote-controlled via the RS-232-C interface:

- No interface messages, only control strings.
- Only the Common Commands *OPC? can be used for command synchronization, *WAI and *OPC are not available.
- Block data cannot be transmitted.

Messages

The messages transferred via the data lines of the IEC bus can be divided into two groups:

- **interface messages and**
- **device messages.**

IEC/IEEE-Bus Interface Messages

Interface messages are transferred on the data lines of the IEC bus, the "ATN" control line being active. They are used for communication between controller and instrument and can only be sent by a controller which has the IEC/IEEE bus control. Interface commands can be subdivided into

- **universal commands and**
- **addressed commands.**

Universal commands act on all devices connected to the IEC/IEEE 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.

Device Messages (Commands and Device Responses)

Device messages are transferred on the data lines of the IEC bus, the "ATN" control line not being active. ASCII code is used.
A distinction is made according to the direction in which they are sent on the IEC/IEEE bus:

- **Commands** are messages the controller sends to the instrument. They operate the device functions and request informations.
  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 reset of the instrument or setting the center frequency.
     Queries cause data to be provided for output on the IEC/IEEE bus, e.g. for identification of the device or polling the marker.
  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 standar-dized 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 "Responses to Queries").

Structure and syntax of the device messages are described in the following Section.

Structure and Syntax of the Device Messages

SCPI Introduction

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. 5-1 illustrates this tree structure using a section of command system SENSe, which controls the device-specific settings, that do not refer to the signal characteristics of the measurement signal.
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").

Structure of a Command

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.

Note: *The commands used in the following examples are not in every case implemented in the instrument.*

Common commands

Common commands consist of a header preceded by an asterisk "*" and one or several parameters, if any.

Examples:	`*RST`	RESET, resets the device
	`*ESE 253`	EVENT STATUS ENABLE, sets the bits of the event status enable register
	`*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. 5-1). 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: `SENSe` This key word denotes the command system `SENSe`.

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: `SENSe:FREQuency:SPAN 10MHZ`

This command lies in the third level of the SENSe system. It set the frequency span.

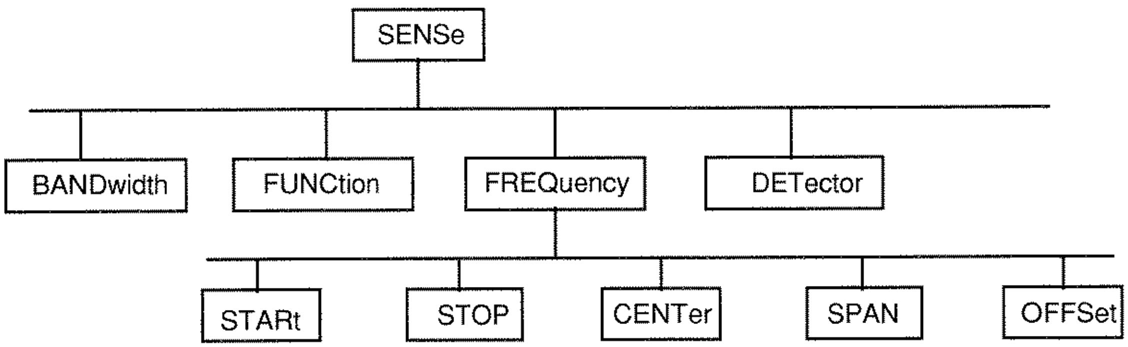


Fig. 5-1 Tree structure the SCPI command systems using the SENSe system by way of example

Some key words occur in several levels within one command system. Their effect depends on the structure of the command, that is to say, at which position in the header of a command they are inserted.

Example: `SOURce:FM:POLarity NORMal`
This command contains key word POLarity in the third command level. It defines the polarity between modulator and modulation signal.

`SOURce:FM:EXTernal:POLarity NORMal`
This command contains key word POLarity in the fourth command level. It defines the polarity between modulation voltage and the resulting direction of the modulation only for the external signal source indicated.

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 the description. The full command length must be recognized by the instrument for reasons of compatibility with the SCPI standard. Some commands are considerably shortened by these optional key words.

Example: `[SENSe]:BANDwidth[:RESolution]:AUTO`
This command couples the resolution bandwidth of the instrument to other parameters. The following command has the same effect:
BANDwidth`:AUTO`

Note: *An optional key word must not be omitted if its effect is specified in detail 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.

Beispiel: `STATus:QUEStionable:ENABle 1= STAT:QUES:ENAB 1`

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 serve the above purpose, the instrument itself does not make any difference between upper-case and lower-case letters.*

Parameter: The parameter must be separated from the header by a "white space". If several parameters are specified in a command, they are separated by a comma ",". A few queries permit the parameters MINimum, MAXimum and DEFault to be entered. For a description of the types of parameter, refer to Section "Parameters".

Example: `SENSe:FREQuency:STOP? MAXimum` Response: 3.5E9
This query requests the maximal value for the stop frequency.

Numeric suffix: If a device features several functions or features of the same kind, e.g. 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:. `SYSTem:COMMunicate:SERial2:BAUD 9600`
This command sets the baudrate of a second serial interface.

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. The IEC/IEEE driver of the controller usually produces automatically an EOI together with the last data byte.

Several commands in a command line are separated by a semicolon ";". If the next command belongs to a different command system, the semicolon is followed by a colon.

Example:
`CALL IBWRT(analyzer%,"SENSe:FREQuency:CENTer 100MHz;:INPut:ATTenuation 10")`

This command line contains two commands. The first one is part of the SENSe command system and is used to determine the center frequency of the analyzer. The second one is part of the INPut command system and sets the input signal attenuation.

If the successive commands belong to the same system, having one or several levels in common, the command line can be abbreviated. For that purpose, 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(analyzer%, "SENSe:FREQuency:STARt 1E6;:SENSe:FREQuency:STOP 1E9")`

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 SENSe command system, subsystem FREQuency, i.e. they have two common levels.
When abbreviating the command line, the second command begins with the level below SENSe:FREQuency. The colon after the semicolon is omitted.

The abbreviated form of the command line reads as follows:

`CALL IBWRT(analyzer%, "SENSe:FREQuency:STARt 1E6;STOP 1E9")`

However, a new command line always begins with the complete path.

Example:
```
CALL IBWRT(analyzer, "SENSe:FREQuency:STARt 1E6")
CALL IBWRT(analyzer%, "SENSe:FREQuency:STOP 1E9")
```

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: `INPut:COUPling?` Response: `DC`

2. Maximum values, minimum values and all further quantities, which are requested via a special text parameter are returned as numerical values.
   Example: `SENSe:FREQuency:STOP? MAX` Response: `3.5E9`

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:FREQuency:CENTer?` Response: `1E6` for 1 MHz

4. Truth values <Boolean values> are returned as 0 (for OFF) and 1 (for ON).
   Example: `SENSe:BANDwidth:AUTO?` Response: `1` for ON

5. Text (character data) is returned in a short form (see also Section 3.5.5).
   Example: `SYSTem:COMMunicate:SERial:CONTrol:RTS?` Response(for standard): `STAN`

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 exponent must lie inside the value range -32000 to 32000. The exponent is introduced by an "E" or "e". Entry of the exponent alone is not permissible. 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). It the unit is missing, the basic unit is used.

Example:
`SENSe:FREQuency:STOP 1.5GHz = SENSe:FREQuency:STOP 1.5E9`

Special numerical

The texts MINimum, MAXimum, DEFault, UP and DOWN are interpreted as valuesspecial numerical values.

In the case of a query, the numerical value is provided.

Example: Setting command: `SENSe:FREQuency:STOP MAXimum`
Query: `SENSe:FREQuency:STOP?` Response: `3.5E9`

MIN/MAX — MINimum and MAXimum denote the minimum and maximum value.

DEF — DEFault denotes a preset value which has been stored in the EPROM. This value conforms to the default setting, as it is called by the *RST command

UP/DOWN — UP, DOWN increases or reduces the numerical value by one step. The step width can be specified via an allocated step command (see annex C, List of Commands) for each parameter which can be set via UP, DOWN.

INF/NINF — INFinity, Negative INFinity (NINF) Negative INFinity (NINF) represent the numerical values -9.9E37 or 9.9E37, respectively. INF and NINF are only sent as device reponses.

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 the division of zero by zero, the subtraction of infinite from 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. 0 or 1 is provided in a query.

Example: Setting command: `DISPlay:WINDow:STATe ON`
Query: `DISPlay:WINDow:STATe?` Response: `1`

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: `INPut:COUPling GROund`
Query: `INPut:COUPling?` Response `GRO`

Strings

Strings must always be entered in quotation marks (' or ").

Example: `SYSTem:LANGuage "SCPI"` or
`SYSTem:LANGuage 'SCPI'`

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 has the following structure:

Example: `HEADer:HEADer #45168xxxxxxxx`

ASCII character # introduces the data block. The next number indicates how many of the following digits describe the length of the data block. In the example the 4 following digits indicate the length to be 5168 bytes. The data bytes follow. During the transmission of these data bytes all End or other control signs are ignored until all bytes are transmitted.

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 colon after 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 asterix marks a common command.
"	Quotation marks introduce a string and terminate it.
#	The double dagger (#) introduces block data
	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 instrument model shown in Fig. 5-2 has been made viewed from the standpoint of the servicing of IEC-bus commands. The individual components work independently of each other and simultaneously. They communicate by means of so-called "messages".

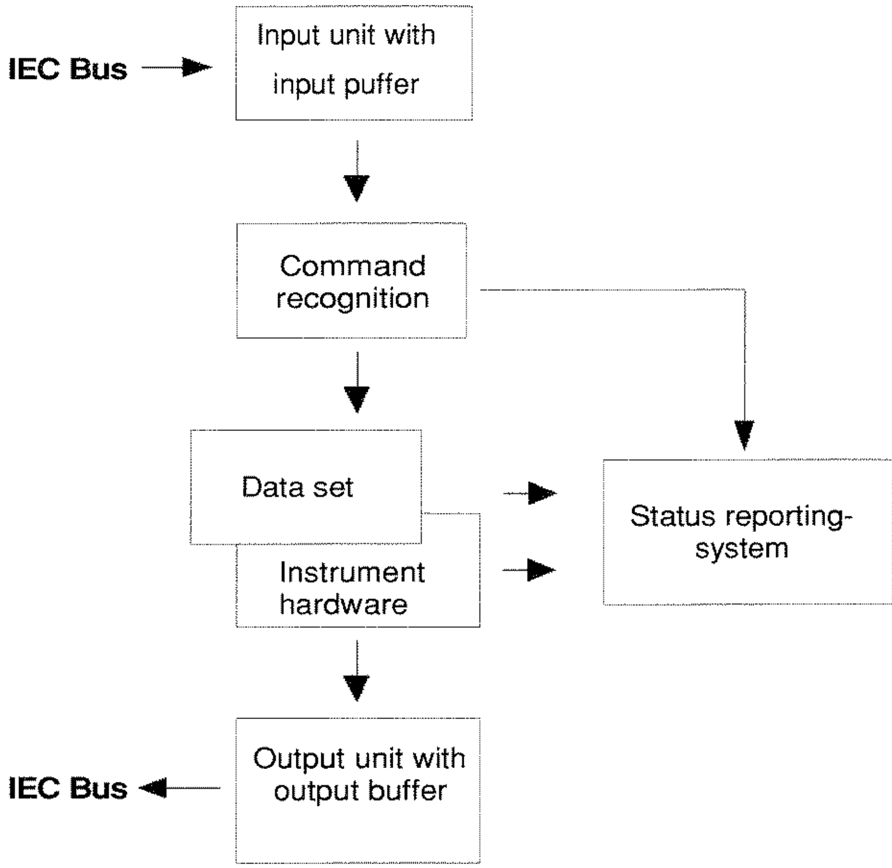


Fig. 5-2 Instrument model in the case of remote control by means of the IEC bus

Input Unit

The input unit receives commands character by character from the IEC 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 IEC-bus traffic is stopped and the data received up to then are processed. Subsequently the IEC-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 as well. Each recognized command is immediately transferred to the instrument data base but without being executed there at once.
Syntactical errors in the command are recognized in the command recognition and supplied to the status reporting system. The rest of a command line after a syntax error is analysed further if possible and serviced.
If the command recognition recognizes a delimiter (<PROGRAM MESSAGE SEPARATOR> or <PROGRAM MESSAGE TERMINATOR>) or a DCL, it requests the instrument data base to set the commands in the instrument hardware as well now. 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").

Instrument Data Base and Instrument Hardware

Here 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 instrument data base is a detailed reproduction of the instrument hardware in the software.

IEC-bus setting commands lead to an alteration in the data set. The data base management enters the new values (e.g. frequency) into the data base, however, only passes them on to the hardware when requested by the command recognition.

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 an execution is not possible, an "execution error" is signalled to the status reporting system. The alteration of the data base are cancelled, the instrument hardware is not reset.

IEC-bus queries induce the data base 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 3.8

Output Unit

The output unit collects the information requested by the controller, which it receives from the data base management. It processes it according to the SCPI rules and makes it available in the output buffer.
If the instrument is addressed as a talker without the output buffer containing data or awaiting data from the data base management, the output unit sends error message "Query UNTERMINATED" to the status reporting system. No data are sent on the IEC bus, the controller waits until it has reached its time limit. This behaviour is specified by SCPI.

Command Sequence and Command Synchronization

What has been said above makes clear that all commands can potentially be carried out overlapping.

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 Synchronisation using *OPC, *OPC? and *WAI

Command	Action after the hardware has settled	Programming the controller
*OPC	Setting the opteration-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	Continuing the IEC-bus handshake	Sending the next command

An example as to command synchronization can be found in Chapter "Program Examples".

For a couple of commands the synchronization to the end of command execution is mandatory in order to obtain the desired result. The affected commands require either more than one measurement in order to accomplish the desired instrument setting (eg autorange functions), or they require a longer period of time for execution. If a new command is received during execution of the corresponding function this may either lead to either to an aborted measurement or to invalid measurement data.

The following list includes the commands, for which a synchronization via *OPC, *OPC? or *WAI is mandatory:

Table 5-1 Commands with mandatory synchronization (Overlapping Commands)

Command	Purpose
INIT	start measurement
INIT:CONM	continue measurement
CALC:MARK:FUNC:ZOOM	zoom frequency range around marker 1
CALC:STAT:SCAL:AUTO ONCE	optimize level settings for signal statistic measurement functions
[SENS:]POW:ACH:PRES:RLEV	optimize level settings for adjacent channel power measurements

Status Reporting System

The status reporting system (cf. Fig. 5-4) stores all information on the present operating state of the instrument, e.g. that the instrument presently carries out a calibration 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 IEC 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 the same 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. 5-4.

Structure of an SCPI Status Register

Each SCPI register consists of 5 parts which each have a width of 16 bits and have different functions (cf. Fig. 5-3). 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. For example, bit 3 of the STATus:OPERation register is assigned to the hardware status "wait for trigger" in 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.

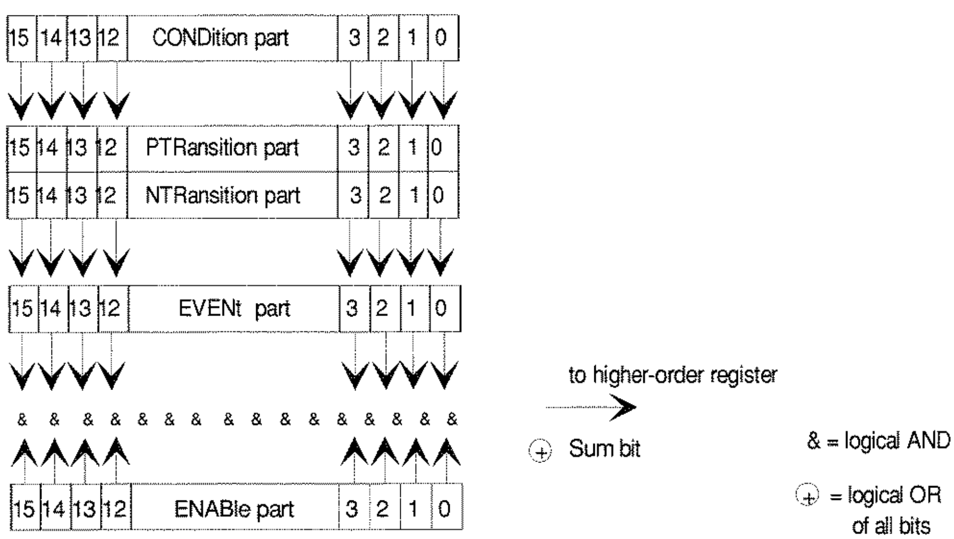


Fig. 5-3 The status-register model

CONDition part

The CONDition part is directly written into by the hardware or the sum bit of the next lower register. Its contents reflects the current instrument status. This register part can only be read, but not written into or cleared. Its contents is not affected by reading.

PTRansition part

The Positive-TRansition part acts as an edge detector. 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 part can be written into and read at will. Its contents is not affected by reading.

NTRansition part

The Negative-TRansition part also acts as an edge detector. 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 written into and read at will. Its contents is not affected by reading.

With these two edge 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 edge filters. It is permanently updated by the instrument. This part can only be read by the user. During reading, its contents is set to zero. In linguistic usage this part is often equated with the entire register.

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 '+').
ENABle-Bit = 0: the associated EVENt bit does not contribute to the sum bit
ENABle-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

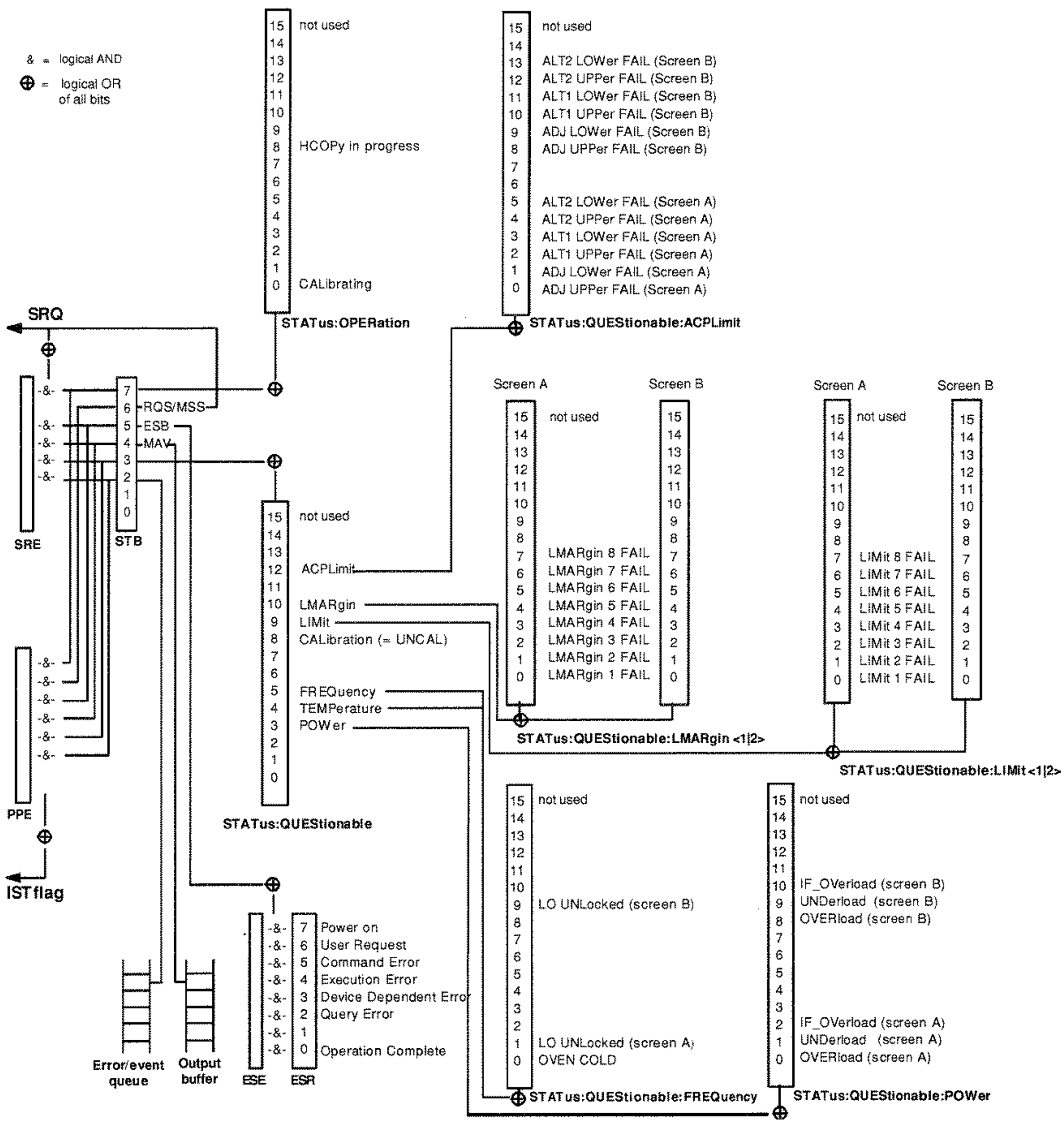


Fig. 5-4 Overview of the status registers

Description of 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 implies the SRE. It corresponds to the ENABle part of the SCPI registers as to 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 IEC 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 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 IEC-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 implies an error or an event 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 registers 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 determined 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 3.8.4.3) or using 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 already 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 command "*ESE" and read using command "*ESE?".

Table 5-3 Meaning of the bits 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.
1	This bit is not used
2	**Query Error** This bit is set if either the controller wants to read data from the instrument without having send 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, however, 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. Section "Error Messages").
6	**User Request** This bit is set on pressing the *LOCAL* key.
7	**Power On** (supply voltage on) This bit is set on switching on the instrument.

STATus:OPERation Register

In the CONDition part, this register contains information on which actions the instrument is being executing or, in the EVENt part, information on which actions the instrument has executed since the last reading. It can be read using commands `"STATus:OPERation:CONDition?"` or `"STATus:OPERation[:EVENt]?"`.

Table 5-4 Meaning of the bits in the STATus.OPERation register

Bit No.	Meaning
0	**CALibrating** This bit is set as long as the instrument is performing a calibration.
1 to 7	These bits are not used
8	**HardCOPy in progress** This bit is set while the instrument is printing a hardcopy.
9 to 14	These bits are not used
15	This bit is always 0

STATus:QUEStionable Register

This register comprises information about indefinite states which may occur if the unit is operated without meeting the specifications. It can be queried by commands `STATus:QUEStionable:CONDition?` and `STATus:QUEStionable[:EVENt]?`.

Table 5-5 Meaning of bits in STATus:QUEStionable register

Bit No.	Meaning
0 to 2	These bits are not used
3	**POWer** This bit is set if a questionable power occurs (cf. also section "STATus:QUEStionable:POWer Register")
4	**TEMPerature** This bit is set if a questionable temperature occurs.
5	**FREQuency** The bit is set if a frequency is questionable (cf. section "STATus:QUEStionable:FREQuency Register")
6 to 7	These bits are not used
8	**CALibration** The bit is set if a measurement is performed uncalibrated (≙ label "UNCAL")
9	**LIMit** (device-specific) This bit is set if a limit value is violated (see also section STATus:QUEStionable:LIMit Register)
10	**LMARgin** (device-specific) This bit is set if a margin is violated (see also section STATus:QUEStionable:LMARgin Register)
11	Device specific- not used
12	**ACPLimit** (device-specific) This bit is set if a limit for the adjacent channel power measurement is violated (see also section "STATus:QUEStionable:ACPLimit Register")
13 to 14	These bits are not used
15	This bit is always 0.

STATus QUEStionable:ACPLimit Register

This register comprises information about the observance of limits during adjacent power measurements. It can be queried with commands 'STATus:QUEStionable:ACPLimit:CONDition?' and 'STATus:QUEStionable:ACPLimit[:EVENt]?'

Table 5-6 Meaning of bits in STATus:QUEStionable:ACPLimit register

Bit No.	Meaning
0	**ADJ UPPer FAIL(Screen A)** This bit is set if in screen A. the limit is exceeded in the upper adjacent channel
1	**ADJ LOWer FAIL (Screen A)** This bit is set if in screen A the limit is exceeded in the lower adjacent channel.
2	**ALT1 UPPer FAIL (Screen A)** This bit is set if in screen A the limit is exceeded in the upper 1st alternate channel.
3	**ALT1 LOWer FAIL (Screen A)** This bit is set if in screen A the limit is exceeded in the lower 1st alternate channel.
4	**ALT2 UPPer FAIL (Screen A)** This bit is set if in screen A the limit is exceeded in the upper 2nd alternate channel.
5	**ALT2 LOWer FAIL (Screen A)** This bit is set if in screen A the limit is exceeded in the lower 2nd alternate channel.
6 to 7	not used
8	**ADJ UPPer FAIL (Screen B)** This bit is set if in screen B the limit is exceeded in the upper adjacent channel.
9	**ADJ LOWer FAIL (Screen B)** This bit is set if in screen B the limit is exceeded in the lower adjacent channel.
10	**ALT1 UPPer FAIL (Screen B)** This bit is set if in screen B the limit is exceeded in the upper 1st alternate channel.
11	**ALT1 LOWer FAIL (Screen B)** This bit is set if in screen B the limit is exceeded in the lower 1st alternate channel.
12	**ALT2 UPPer FAIL (Screen B)** This bit is set if in screen B the limit is exceeded in the upper 2nd alternate channel.
13	**ALT2 LOWer FAIL (Screen B)** This bit is set if in screen B the limit is exceeded in the lower 2nd alternate channel.
14	not used
15	This bit is always set to 0.

STATus QUEStionable:FREQuency Register

This register comprises information aboutthe reference and local oscillator.
It can be queried with commands `STATus:QUEStionable:FREQuency:CONDition?` and "`STATus :QUEStionable:FREQuency[:EVENt]?`.

Table 5-7 Meaning of bits in STATus:QUEStionable:FREQuency register

Bit No.	Meaning
0	**OVEN COLD** This bit is set if'the reference oscillator has not yet attained its operating temperature. 'OCXO' will then be displayed.
1	**LO UNLocked** (Screen A) This bit is set if the local oscillator no longer locks. 'LOUNL will then be displayed.
2 to 8	not used
9	**LO UNLocked** (Screen B) This bit is set if the local oscillator no longer locks.' LOUNL' will then be displayed.
10 to 14	not used
15	This bit is always 0.

STATus QUEStionable:LIMit<1|2> Register

This register comprises information about the observance of limit lines in the corresponding measurement window (LIMit 1 corresponds to Screen A, LIMit 2 to Screen B). It can be queried with commands `STATus:QUEStionable:LIMit<1|2>:CONDition?` and `STATus:QUEStionable:LIMit<1|2>[:EVENt]?`.

Table 5-8 Meaning of bits in STATus:QUEStionable:LIMit<1|2> register

Bit No.	Meaning
0	**LIMit 1 FAIL** This bit is set if limit line 1 is violated.
1	**LIMit 2 FAIL** This bit is set if limit line 2 is violated.
2	**LIMit 3 FAIL** This bit is set if limit line 3 is violated.
3	**LIMit 4 FAIL** This bit is set if limit line 4 is violated.
4	**LIMit 5 FAIL** This bit is set if limit line 5 is violated.
5	**LIMit 6 FAIL** This bit is set if limit line 6 is violated.
6	**LIMit 7 FAIL** This bit is set if limit line 7 is violated.
7	**LIMit 8 FAIL** This bit is set if limit line 8 is violated.
8 to 14	not used
15	This bit is always 0.

STATus QUEStionable:LMARgin<1|2> Register

This register comprises information about the observance of limit margins in the corresponding measurement window (LMARgin1 corresponds to Screen A, LMARgin2 corresponds to Screen B). It can be queried with commands `STATus:QUEStionable:LMARgin<1|2>:CONDition?` and "`STATus :QUEStionable:LMARgin<1|2>[:EVENt]?`.

Table 5-9 Meaning of bits in STATus:QUEStionable:LMARgin<1|2> register

Bit No.	Meaning
0	**LMARgin 1 FAIL** This bit is set if limit margin 1 is violated.
1	**LMARgin 2 FAIL** This bit is set if limit margin 2 is violated.
2	**LMARgin 3 FAIL** This bit is set if limit margin 3 is violated.
3	**LMARgin 4 FAIL** This bit is set if limit margin 4 is violated.
4	**LMARgin 5 FAIL** This bit is set if limit margin 5 is violated.
5	**LMARgin 6 FAIL** This bit is set if limit margin 1 is violated.
6	**LMARgin 7 FAIL** This bit is set if limit margin 7 is violated.
7	**LMARgin 8 FAIL** This bit is set if limit margin 8 is violated.
8 to 14	not used
15	This bit is always 0.

STATus QUEStionable:POWer Register

This register comprises all information about possible overloads of the unit.
It can be queried with commands `STATus:QUEStionable:POWer:CONDition?` and "`STATus:QUEStionable:POWer[:EVENt]?`.

Table 5-10 Meaning of bits in STATus:QUEStionable:POWer register

Bit No.	Meaning
0	**OVERload** (Screen A) This bit is set if the RF input is overloaded. 'OVLD' will then be displayed.
1	**UNDerload** (Screen A) This bit is set if, during measurements in vector analyzer mode without capture buffer used, the lower level limit in the IF path is violated.
2	**IF_OVerload** (Screen A) This bit is set if the IF path is overloaded. 'IFOVL' will then be displayed.
3 to 7	not used
8	**OVERload** (Screen B) This bit is set if the RF input is overloaded. 'OVLD' will then be displayed.
9	**UNDerload** (Screen B) This bit is set if, during measurements without capture buffer used, the lower level limit in the IF path is violated.
10	**IF_OVerload** (Screen B) This bit is set if the IF path is overloaded. 'IFOVL' will then be displayed.
11 to 14	not used
15	This bit is always 0.

Application of the Status Reporting Systems

In order to be able 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 represented in the following. Detailed program examples are to be found in annex D, Program Examples.

Service Request, Making Use of the Hierarchy Structure

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 with corresponding actions. As evident from Fig. 5-4, 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 make use of the possibilities of the service request, all bits should be set to "1" in enable registers SRE and ESE.

Examples (cf. Fig. 5-4 and annex D, Program Examples, as well):

Use of command "*OPC" to generate an SRQ at the end of a sweep.

- `CALL IBWRT(analyzer%, "*ESE 1")` Set bit 0 in the ESE (Operation Complete)
- `CALL IBWRT(analyzer%, "*SRE 32")` Set bit 5 in the SRE (ESB)?

  After its settings have been completed, the instrument generates an SRQ.

The SRQ is the only possibility for the instrument to become active on its own. Each controller program should set the instrument in a way that a service request is initiated in the case of malfunction. The program should react appropriately to the service request. A detailed example for a service request routine is to be found in annex D, Program Examples.

Serial Poll

In a serial poll, just as with command "*STB", the status byte of an instrument is queried. However, the query is realized 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 with instruments which do not adhere to SCPI or IEEE 488.2.

The VISUAL BASIC command for executing a serial poll is "IBRSP()". Serial poll is mainly used to obtain a fast overview of the state of several instruments connected to the IEC 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 logically "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 as well considering bit 6. The results are ORed, the result is then sent (possibly inverted) as a response in the parallel poll of the controller. The result can also be queried without parallel poll by means of command "*IST".

The instrument first has to be set for the parallel poll using 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 IEC bus. To this effect, SRE and PPE must be set to the same value. A detailed example as to the parallel poll is to be found in annex D, Program Examples.

Query by Means of Commands

Each part of every status register can be read by means of queries. The individual commands are indicated in the detailed description of the registers in Section 3.8.3. What is returned is always a number which represents the bit pattern of the register queried. Evaluating this number is effected 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 IEC bus using command "SYSTem:ERRor?". Each call of "SYSTem:ERRor?" provides an 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.

Resetting Values of the Status Reporting System

Table 5-11 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 5-11 Resettting 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 EVENTt 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.

Contents - Chapter 6 "Remote Control - Description of Commands"

Contents - Chapter 6 "Remote Control - Description of Commands"

6 Remote Control - Description of Commands

Notation

In the following sections, all commands implemented in the instrument are first listed in tables and then described in detail, arranged according to the command subsystems. The notation is adapted to the SCPI standard. The SCPI conformity information is included in the individual description of the commands.

Table of Commands

Command: In the command column, the table provides an overview of the commands and their hierarchical arrangement (see indentations).

Parameter: The parameter column indicates the requested parameters together with their specified range.

Unit: The unit column indicates the basic unit of the physical parameters.

Comment: In the comment column an indication is made on:
- whether the command does not have a query form,
- whether the command has only one query form
- whether the command is implemented only with a certain option of the instrument

Indentations

The different levels of the SCPI command hierarchy are represented in the table by means of indentations to the right. The lower the level, the further the indentation to the right. Please note that the complete notation of the command always includes the higher levels as well.

Example: `SENSe:FREQuency:CENTer` is represented in the table as follows:

`SENSe`	first level
`  :FREQuency`	second level
`    :CENTer`	third level

Individual description The individual description contains the complete notation of the command. An example for each command, the *RST value and the SCPI information are included as well.
The operating modes for which a command can be used are indicated by the following abbreviations:

A	Spectrum analysis
A-F	Spectrum analysis - frequency domain only
A-T	Spectrum analysis - time domain only (zero span)
MS	GSM Mobile Station – analysis (FS-K5 option)

Upper/lower case notation Upper/lower case letters are used to mark the long or short form of the key words of a command in the description (see Section 3.5.2). The instrument itself does not distinguish between upper and lower case letters.

Special characters **|** A selection of key words with an identical effect exists for several commands. These keywords are indicated in the same line; they are separated by a vertical stroke. Only one of these keywords needs to be included in the header of the command. The effect of the command is independent of which of the keywords is used.

Example: `SENSe:FREQuency:CW|:FIXed`

The two following commands with identical meaning can be created. They set the frequency of the fixed frequency signal to 1 kHz:

`SENSe:FREQuency:CW 1E3` = `SENSe:FREQuency:FIXed 1E3`

A vertical stroke in parameter indications marks alternative possibilities in the sense of "or". The effect of the command is different, depending on which parameter is used.

Example: Selection of the parameters for the command

`DISPlay:FORMat FULL | SPLit`

If parameter FULL is selected, full screen is displayed, in the case of SPLit, split screen is displayed.

[ ] Key words in square brackets can be omitted when composing the header (cf. Section 3.5.2, Optional Keywords). The full command length must be accepted by the instrument for reasons of compatibility with the SCPI standards.
Parameters in square brackets can be incorporated optionally in the command or omitted as well.

{ } Parameters in braces can be incorporated optionally in the command, either not at all, once or several times.

Description of parameters Due to the standardization, the parameter section of SCPI commands consists always of the same syntactical elements. SCPI has therefore specified a series of definitions, which are used in the tables of commands. In the tables, these established definitions are indicated in angled brackets (<...>) and will be briefly explained in the following (see also Section 3.5.5, "Parameters").

<Boolean> This keyword refers to parameters which can adopt two states, "on" and "off". The "off" state may either be indicated by the keyword **OFF** or by the numeric value 0, the "on" state is indicated by **ON** or any numeric value other than zero. Parameter queries are always returned the numeric value 0 or 1.

<numeric_value>
<num>

These keywords mark parameters which may be entered as numeric values or be set using specific keywords (character data).

The following keywords given below are permitted:

MINimum	This keyword sets the parameter to the smallest possible value.
MAXimum	This keyword sets the parameter to the largest possible value.
DEFault	This keyword is used to reset the parameter to its default value.
UP	This keyword increments the parameter value.
DOWN	This keyword decrements the parameter value.

The numeric values associated to MAXimum/MINimum/DEFault can be queried by adding the corresponding keywords to the command. They must be entered following the quotation mark.

Example: `SENSe:FREQuency:CENTer? MAXimum`

returns the maximum possible numeric value of the center frequency as result.

<arbitrary block program data>

This keyword is provided for commands the parameters of which consist of a binary data block.

Common Commands

The common commands are taken from the IEEE 488.2 (IEC 625-2) standard. A particular command has the same effect on different devices. The headers of these commands consist of an asterisk "*" followed by three letters. Many common commands refer to the status reporting system which is described in detail in Section 3.8.

Command	Parameter	Function	Comment
*CAL?		Calibration Query	query only
*CLS		Clear Status	no query
*ESE	0 to 255	Event Status Enable	
*ESR?		Standard Event Status Query	query only
*IDN?		Identification Query	query only
*IST?		Individual Status Query	query only
*OPC		Operation Complete	
*OPT?		Option Identification Query	query only
*PCB	0 to 30	Pass Control Back	no query
*PRE	0 to 255	Parallel Poll Register Enable	
*PSC	0 | 1	Power On Status Clear	
*RST		Reset	no query
*SRE	0 to 255	Service Request Enable	
*STB?		Status Byte Query	query only
*TRG		Trigger	no query
*TST?		Self Test Query	query only
*WAI		Wait to continue	no query

***CAL?**

CALIBRATION QUERY initiates a calibration of the instrument and subsequently queries the calibration status. Any responses > 0 indicate errors.

***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. The query form *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.
Example: " Rohde&Schwarz, FSU-3, 123456/789, 1.03"
FSU-3 = Device name
123456/789 = Serial number of the instrument
1.03 = Firmware version number

***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 (cf. Section 3.8.3.2).

***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. Section 3.7).

***OPC?**

OPERATION COMPLETE QUERY writes message "1" into the output buffer as soon as all preceding commands have been executed (cf. Section 3.7).

*OPT?

OPTION IDENTIFICATION QUERY queries the options included in the instrument and returns a list of the options installed. The options are separated from each other by means of commas.

Position	Option	
1		reserved
2	FSU-B4	OCXO
3		reserved
4		reserved
5		reserved
6		reserved
7		reserved
8	FSP-B10	Ext. Generator Control
9...13		reserved
14	FSU-B16	LAN Interface
15...18		reserved
19		reserved
20...22		reserved
23	FSU-B25	Electronic Attenuator
24...29		reserved
30		reserved
31...40		reserved

Example:
B3,B4,0,0,0,0,0,B10,0,0,0,0,0,B16,0,0,0,0,0,0,0,0,B25,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0

*PCB 0 to 30

PASS CONTROL BACK indicates the controller address which the IEC-bus control is to be returned to after termination of the triggered action.

*PRE 0 to 255

PARALLEL POLL REGISTER ENABLE sets the parallel poll enable register to the indicated value. The query form *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 are preserved or reset during power-up.

*PSC = 0 causes the contents of the status registers to be preserved. Thus a service request can be generated when switching on the instrument, if the status registers ESE and SRE are suitably configured.

*PSC ≠ 0 resets the registers.

The query form *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 essentially corresponds to pressing the *PRESET* key. The default setting is indicated in the description of the commands.

*SRE 0 to 255

SERVICE REQUEST ENABLE sets the service request enable register to the indicated value. Bit 6 (MSS mask bit) remains 0. This command determines under which conditions a service request is generated. The query form *SRE? reads the contents of the service request enable register in decimal form. Bit 6 is always 0.

***STB?**

READ STATUS BYTE QUERY reads out the contents of the status byte in decimal form.

***TRG**

TRIGGER initiates all actions in the currently active test screen expecting a trigger event. This command corresponds to `INITiate:IMMediate` (cf. Section "TRIGger subsystem").

***TST?**

SELF TEST QUERY initiates the selftest of the instrument and outputs an error code in decimal form (0 = no error).

***WAI**

WAIT-to-CONTINUE permits servicing of subsequent commands only after all preceding commands have been executed and all signals have settled (cf. Section 3.7 and "*OPC" as well).

ABORt Subsystem

The ABORt subsystem contains the commands for aborting triggered actions. An action can be triggered again immediately after being aborted. All commands trigger events, and therefore they have no *RST value.

COMMAND	PARAMETERS	UNIT	COMMENT
ABORt		--	no query

ABORt

This command aborts a current measurement and resets the trigger system.

Example: `"ABOR;INIT:IMM"`

Characteristics: *RST value: 0
SCPI: conforming

Mode: A, MS

CALCulate Subsystem

The CALCulate subsystem contains commands for converting instrument data, transforming and carrying out corrections. These functions are carried out subsequent to data acquistion, ie following the SENSe subsystem.

The numeric suffix is used in CALCulate to make the distinction between the two measurement windows SCREEN A and SCREEN B:

CALCulate1 = Screen A
CALCulate2 = Screen B.

For commands without suffix, screen A is selected automatically.

Full Screen — The settings are valid for the measurement window selected with the numeric suffix. They become effective as soon as the corresponding measurement window has been selected as active measurement window using the command `DISPLay[:WINDow<1|2>]:SELect`. Triggering measurements and querying measured values is possible only in the active measurement window.

Split Screen — The settings are valid for the measurement window selected by means of the numeric suffix and become effective immediately.

Note: *The GSM option works always in Screen A. Therefore the commands must begin with numeric suffix 1 (like CALCulate1) or without numeric suffix (like CALCulate).*

CALCulate:DELTamarker Subsystem

The CALCulate:DELTamarker subsystem controls the delta-marker functions in the instrument. The measurement windows are selected via CALCulate1 (screen A) or 2 (screen B).

COMMAND	PARAMETERS	UNIT	COMMENT
CALCulate<1|2>			
:DELTamarker<1 to 4>			
[:STATe]	<Boolean>	--	
:MODE	ABSolute|RELative		
:AOFF			no query
:TRACe	<numeric_value>	--	
:X	<numeric_value>	HZ | S | DBM | DB	
:RELative?	--	--	query only
:Y?	--	--	query only
:MAXimum			
[:PEAK]	--	--	no query
:NEXT	--	--	no query
:RIGHt	--	--	no query
:LEFT	--	--	no query
:MINimum			
[:PEAK]	--	--	no query
:NEXT	--	--	no query
:RIGHt	--	--	no query
:LEFT	--	--	no query
:FUNCtion			
:FIXed			
[:STATe]	<Boolean>		
:RPOint			
:Y	<numeric_value>	DBM	
:OFFSet	<numeric_value>	DB	
:X	<numeric_value>	HZ | S	
:PNOise			
[:STATe]	<Boolean>		
:RESult?	--	--	query only

CALCulate<1|2>:DELTamarker<1 to 4>[:STATe] ON | OFF

This command switches on and off the delta marker when delta marker 1 is selected. The corresponding marker becomes the delta marker when delta marker 2 to 4 is selected. If the corresponding marker is not activated, it will be activated and positioned on the maximum of the measurement curve.
If no numeric suffix is indicated, delta marker 1 is selected automatically.

Example: `"CALC:DELT3 ON"` Switches marker 3 in screen A to delta marker mode.

Characteristics: *RST value: OFF
SCPI: device-specific

Mode: A, MS

CALCulate<1|2>:DELTamarker<1 to 4>:MODE ABSolute | RELative

This command switches between relative and absolute frequency input of the delta marker (or time with span = 0). It affects all delta markers independent of the measurement window.

Example:	"CALC:DELT:MODE ABS"	Switches the frequency/time indication for all delta markers to absolute values.
	"CALC:DELT:MODE REL"	Switches the frequency/time indication for all delta markers to relative to marker 1.

Characteristics: *RST value: REL
SCPI: device-specific

Mode: A, MS

CALCulate<1|2>:DELTamarker<1 to 4>:AOFF

This command switches off all active delta markers in the selected measurement window (screen A or screen B).

Example: "CALC2:DELT:AOFF" Switches off all delta markers in screen B.

Characteristics: *RST value: -
SCPI: device-specific

Mode: A, MS

This command is an event and therefore it has no *RST-value and no query form.

CALCulate<1|2>:DELTamarker<1 to 4>:TRACe 1 to 3

This command assigns the selected delta marker to the indicated measurement curve in the indicated measurement window. The selected measurement curve must be active, ie its state must be different from "BLANK".

Example:	"CALC:DELT3:TRAC 2"	Assigns deltamarker 3 to trace 2 in screen A.
	"CALC:DELT:TRAC 3"	Assigns deltamarker 1 to trace 3 in screen B.

Characteristics: *RST value: -
SCPI: device-specific

Mode: A, MS

CALCulate<1|2>:DELTamarker<1 to 4>:X 0 to MAX (frequency | sweep time)

This command positions the selected delta marker in the indicated measurement window to the indicated frequency (span > 0), time (span = 0) or level (APD measurement = ON or CCDFmeasurement = ON). The input is in absolute values or relative to marker 1 depending on the command `CALCulate:DELTamarker:MODE`. If Reference Fixed measurement (`CALCulate:DELTamarker:FUNCtion:FIXed:STATe ON`) is active, relative values refer to the reference position are entered. The query always returns absolute values.

Example:	"CALC:DELT:MOD REL"	Switches the input for all delta markers to relative to marker 1.
	"CALC:DELT2:X 10.7MHz"	Positions delta marker 2 in screen A 10.7 MHz to the right of marker 1.
	"CALC2:DELT:X?"	Outputs the absolute frequency/time of delta marker 1 in screen B
	"CALC2:DELT:X:REL?"	Outputs the relative frequency/time/level of delta marker 1 in screen B

Characteristics: *RST value: -
SCPI: device-specific

Mode: A, MS

CALCulate<1|2>:DELTamarker<1 to 4>:X:RELative?

This command queries the frequency (span > 0) or time (span = 0) of the selected delta marker relative to marker 1 or to the reference position (for `CALCulate:DELTamarker:FUNCtion:FIXed:STATe ON`). The command activates the corresponding delta marker, if necessary.

Example:	"CALC:DELT3:X:REL?"	Outputs the frequency of delta marker 3 in screen B relative to marker 1 or relative to the reference position.

Characteristics: *RST value: -
SCPI: device-specific

Mode: A, MS

CALCulate<1|2>:DELTamarker<1 to 4>:Y?

This command queries the measured value of the selected delta marker in the indicated measurement window. The corresponding delta marker will be activated, if necessary. The output is always a relative value referred to marker 1 or to the reference position (reference fixed active).

To obtain a valid query result, a complete sweep with synchronization to the sweep end must be performed between the activation of the delta marker and the query of the y-value. This is only possible in single sweep mode.

Depending on the unit defined with `CALC:UNIT` or on the activated statistics functions, the query result is output in the units below:

- DBM | DBPW | DBUV | DBMV | DBUA: Output unit DB
- WATT | VOLT | AMPere: Output unit W | V | A
- Statistics function (APD or CCDF) on: Dimensionless output

Example:

"INIT:CONT OFF"	Switches to single-sweep mode.
"CALC:DELT2 ON"	Switches on delta marker 2 in screen A.
"INIT;*WAI"	Starts a sweep and waits for its end.
"CALC:DELT2:Y?"	Outputs measurement value of delta marker 2 in screen A.

Characteristics: *RST value: -
SCPI: device-specific

Mode: A, MS

CALCulate<1|2>:DELTamarker<1 to 4>:MAXimum[:PEAK]

This command positions the delta marker to the current maximum value on the measured curve. If necessary, the corresponding delta marker will be activated first.

Example: "CALC2:DELT3:MAX" Sets delta marker 3 in screen B to the maximum value of the associated trace.

Characteristics: *RST value: -
SCPI: device-specific

Mode: A, MS

This command is an event and is therefore not assigned an *RST value and has no query.

CALCulate<1|2>:DELTamarker<1 to 4>:MAXimum:NEXT

This command positions the delta marker to the next smaller maximum value on the measured curve. The corresponding delta marker will be activated first, if necessary.

Example: "CALC1:DELT2:MAX:NEXT" Sets delta marker 2 in screen A to the next smaller maximum value.

Characteristics: *RST value: -
SCPI: device-specific

Mode: A, MS

This command is an event and is therefore not assigned an *RST value and has no query.

CALCulate<1|2>:DELTamarker<1 to 4>:MAXimum:RIGHt

This command positions the delta marker to the next smaller maximum value to the right of the current value (ie ascending X values). The corresponding delta marker is activated first, if necessary.

Example: "CALC2:DELT:MAX:RIGH" Sets delta marker 1 in screen B to the next smaller maximum value to the right of the current value.

Characteristics: *RST value: -
SCPI: device-specific

Mode: A, MS

This command is an event and is therefore not assigned an *RST value and has no query.

CALCulate<1|2>:DELTamarker<1 to 4>:MAXimum:LEFT

This command positions the delta marker to the next smaller maximum value to the left of the current value (ie descending X values). The corresponding delta marker will be activated first, if necessary.

Example: "CALC:DELT:MAX:LEFT" Sets delta marker 1 in screen A to the next smaller maximum value to the left of the current value.

Characteristics: *RST value: -
SCPI: device-specific

Mode: A, MS

This command is an event and is therefore not assigned an *RST value and has no query.

CALCulate<1|2>:DELTamarker<1 to 4>:MINimum[:PEAK]

This command positions the delta marker to the current minimum value on the measured crve. The corresponding delta marker will be activated first, if necessary.

Example: "CALC2:DELT3:MIN" Sets delta marker 3 in screen B to the minimum value of the associated trace.

Characteristics: *RST value: -
SCPI: device-specific

Mode: A, MS

This command is an event and is therefore not assigned an *RST value and has no query.

CALCulate<1|2>:DELTamarker<1 to 4>:MINimum:NEXT

This command positions the delta marker to the next higher minimum value of the measured curve. The corresponding delta marker will be activated first, if necessary.

Example: "CALC1:DELT2:MIN:NEXT" Sets delta marker 2 in screen A to the next higher minimum value.

Characteristics: *RST value: -
SCPI: device-specific

Mode: A, MS

This command is an event and is therefore not assigned an *RST value and has no query.

CALCulate<1|2>:DELTamarker<1 to 4>:MINimum:RIGHt

This command positions the delta marker to the next higher minimum value to the right of the current value (ie ascending X values). The corresponding delta marker will be activated first, if necessary.

Example: "CALC2:DELT:MIN:RIGH" Sets delta marker 1 in screen B to the next higher minimum value to the right of the current value.

Characteristics: *RST value: -
SCPI: device-specific

Mode: A, MS

This command is an event and is therefore not assigned an *RST value and has no query.

CALCulate<1|2>:DELTamarker<1 to 4>:MINimum:LEFT

This command positions the delta marker to the next higher minimum value to the left of the current value (ie descending X values). The corresponding delta marker will be activated first, if necessary.

Example: "CALC:DELT:MIN:LEFT" Sets delta marker 1 in screen A to the next higher minimum to the left of the current value.

Characteristics: *RST value: -
SCPI: device-specific

Mode: A, MS

This command is an event and is therefore not assigned an *RST value and has no query.

CALCulate<1|2>:DELTamarker<1 to 4>:FUNCtion:FIXed[:STATe] ON | OFF

This command switches the relative measurement to a fixed reference value on or off. Marker 1 will be activated previously and a peak search will be performed, if necessary. If marker 1 is activated, its position becomes the reference point for the measurement. The reference point can then be modified with commands `CALCulate:DELTamarker:FUNCtion:FIXed:RPOint:X` and `...:RPOint:Y` independently of the position of marker 1 and of a trace. It is valid for all delta markers in the selected measurement window as long as the function is active.

Example: "CALC2:DELT:FUNC:FIX ON" Switches on the measurement with fixed reference value for all delta markers in screen B.

"CALC2:DELT:FUNC:FIX:RPO:X 128 MHZ" Sets the reference frequency in screen B to 128 MHz.

"CALC2:DELT:FUNC:FIX:RPO:Y 30 DBM" Sets the reference level in screen B to +30 dBm

Characteristics: *RST value: OFF
SCPI: device-specific.

Mode: A, MS

CALCulate<1|2>:DELTamarker<1...4>:FUNCtion:FIXed:RPOint:MAXimum[:PEAK] <numeric_value>

Dieser Befehl setzt den Bezugspunkt für alle Deltamarker im ausgewählten Meßfenster bei Messung mit festem Bezugspunkt (`CALCulate:DELTamarker:FUNCtion:FIXed:STATe ON`) auf das Maximum der ausgewählten Meßkurve. .

Bei Messung des Phasenrauschens (`CALCulate:DELTamarker:FUNCtion:PNOise:STATe ON`) definiert der Befehl einen neuen Bezugspunkt für Deltamarker 2 im ausgewählten Meßfenster.

Beispiel:	`"CALC:DELT:FUNC:FIX:RPO:MAX"`	setzt den Bezugspegel für die Deltamarker in Screen A auf das Maximum der Meßkurve.

Eigenschaften:	*RST-Wert:	-
	SCPI:	gerätespezifisch

Betriebsart: A, MS

Dieser Befehl ist ein "Event" und hat daher keinen *RST-Wert und keine Abfrage.

CALCulate<1|2>:DELTamarker<1 to 4>:FUNCtion:FIXed:RPOint:Y <numeric_value>

This command defines a new reference point level for all delta markers in the selected measurement window for a measurement with fixed reference point. (`CALCulate:DELTamarker:FUNCtion:FIXed:STATe ON`).

For phase-noise measurements (`CALCulate:DELTamarker:FUNCtion:PNOise:STATe ON`), the command defines a new reference point level for delta marker 2 in the selected measurement window.

Example:	`"CALC:DELT:FUNC:FIX:RPO:Y -10dBm"`	Sets the reference point level for delta markers in screen A to -10 dBm.

Characteristics:	*RST value:	- (`FUNction:FIXed[:STATe]` is set to OFF)
	SCPI:	device-specific

Mode: A, MS

CALCulate<1|2>:DELTamarker<1 to 4>:FUNCtion:FIXed:RPOint:Y:OFFSet <numeric_value>

This command defines an additional level offset for the measurement with fixed reference value (`CALCulate:DELTamarker:FUNCtion:FIXed:STATe ON`). For this measurement, the offset is included in the display of all delta markers of the selected measurement window.

For phase-noise measurements (`CALCulate:DELTamarker:FUNCtion:PNOise:STATe ON`), the command defines an additional level offset which is included in the display of delta marker 2 in the selected measurement window.

Example: `"CALC:DELT:FUNC:FIX:RPO:Y:OFFS 10dB"`

sets the level offset for the measurement with fixed reference value or the phase-noise measurement in screen A to 10 dB.

Characteristics:	*RST value:	0 dB
	SCPI:	device-specific

Mode: A, MS

CALCulate<1|2>:DELTamarker<1 to 4>:FUNCtion:FIXed:RPOint:X <numeric_value>

This command defines a new reference frequency (span > 0) or time (span = 0) for all delta markers in the selected measurement window for a measurement with fixed reference value (`CALCulate:DELTamarker:FUNCtion:FIXed:STATe ON`).

For phase-noise measurements (`CALCulate:DELTamarker:FUNCtion:PNOise:STATe ON`), the command defines a new reference frequency or time for delta marker 2 in the selected measurement window.

Example:	"CALC2:DELT:FUNC:FIX:RPO:X 128MHz"	Sets the reference frequency in screen B to 128 MHz.
Characteristics:	*RST value:	- (`FUNction:FIXed[:STATe]` is set to `OFF`)
	SCPI:	device-specific
Mode:	A, MS	

CALCulate<1|2>:DELTamarker<1 to 4>:FUNCtion:PNOise[:STATe] ON | OFF

This command switches on or off the phase-noise measurement with all active delta markers in the selected measurement window. The correction values for the bandwidth and the log amplifier are taken into account in the measurement..

Marker 1 will be activated, if necessary, and a peak search will be performed. If marker 1 is activated, its position becomes the reference point for the measurement.

The reference point can then be modified with commands `CALCulate:DELTamarker:FUNCtion:FIXed:RPOint:X` and `...:RPOint:Y` independently of the position of marker 1 and of a trace (the same commands used for the measurment with fixed reference point).

The numeric suffix <1 to 4> with `DELTamarker` is not relevant for this command.

Note: *This function is not available during active GSM measurements.*

Example:	"CALC:DELT:FUNC:PNO ON"	Switches on the phase-noise measurement with all delta markers in screen A.
	"CALC:DELT:FUNC:FIX:RPO:X 128 MHZ"	Sets the reference frequency to 128 MHz.
	"CALC:DELT:FUNC:FIX:RPO:Y 30 DBM"	Sets the reference level to +30 dBm
Characteristics:	*RST value:	OFF
	SCPI:	device-specific
Mode:	A	

CALCulate<1|2>:DELTamarker<1 to 4>:FUNCtion:PNOise:RESult?

This command queries the result of the phase-noise measurement in the selected measurement window.The measurement will be switched on, if necessary.

Note: *This function is not available during active GSM measurements.*

Example:	"CALC:DELT:FUNC:PNO:RES?"	Outputs the result of phase-noise measurement of the selected delta marker in screen A.
Characteristics:	*RST value:	-
	SCPI:	device-specific
Mode:	A	

This command is only a query and is therefore not assigned an *RST value.

CALCulate:LIMit Subsystem

The CALCulate:LIMit subsystem consists of the limit lines and the corresponding limit checks. Limit lines can be defined as upper or lower limit lines. The individual Y values of the limit lines correspond to the values of the X-axis (CONTrol). The number of X- and Y-values must be identical.

8 limit lines can be active at the same time (marked by LIMIT1 to LIMIT8) in screen A and/or screen B. The measurement windows is selected via CALCulate 1 (screen A) or 2 (screen B).

The limit check can be switched on separately for each measurement screen and limit line. WINDow1 corresponds to screen A, WINDow2 to screen B.

Each limit line can be assigned a name (max. 8 letters) under which the line is stored in the instrument. An explanatory comment can also be given for each line (max. 40 characters).

Example:
Definition and use of a new limit line 5 for trace 2 in screen A and trace 1 in screen B with the following features:

- upper limit line
- absolute X-axis in the frequency domain
- 5 ref. values: 126 MHz/-40 dB, 127 MHz/-40 dB, 128 MHz/-20 dB, 129 MHz/-40 dB, 130 MHz/-40 dB
- relative Y-axis with unit dB
- absolute threshold value at -35 dBm
- no safety margin

Definition of the line:

1. Defining the name:	`CALC:LIM5:NAME 'TEST1'`
2. Entering the comment:	`CALC:LIM5:COMM 'Upper limit line'`
3. Associated trace in screen A:	`CALC1:LIM5:TRAC 2`
4. Associated trace in screen B:	`CALC2:LIM5:TRAC 1`
5. Defining the X-axis range:	`CALC:LIM5:CONT:DOM FREQ`
6. Defining the X-axis scaling:	`CALC:LIM5:CONT:MODE ABS`
7. Defining the Y-axis unit:	`CALC:LIM5:UNIT DB`
8. Defining the Y-axis scaling:	`CALC:LIM5:UPP:MODE REL`
9. Defining the X-axis values:	`CALC:LIM5:CONT 126MHZ, 127MHZ, 128MHZ, 129 MHZ, 130MHZ`
10. Defining the y values:	`CALC:LIM5:UPP -40, -40, -30, -40, -40`
11. Defining the y threshold value:	`CALC:LIM5:UPP:THR -35DBM`

The definition of the safety margin and shifting in X- and/or Y-direction can take place as from here (see commands below).

Switching on and evaluating the line in screen A:

1. Switching on the line in screen A:	`CALC1:LIM5:UPP:STAT ON`
2. Switching on the limit check in screen A:	`CALC1:LIM5:STAT ON`
3. Starting a new measurement with synchronization:	`INIT;*WAI`
4. Querying the limit check result:	`CALC1:LIM5:FAIL?`

Switching on and evaluating the line in screen B is performed in the same way by using `CALC2` instead of `CALC1`.

Note:
The functions of this subsystem are not available during the option GSM MS Analyzer (FS-K5) if the measurement of the phase and frequency error is selected.

COMMAND	PARAMETERS	UNIT	COMMENT
CALCulate<1|2>			
:LIMit<1 to 8>			
:TRACe	<numeric_value>		
:STATe	<Boolean>	--	
:UNIT	DBM | DBPW | WATT | DBUV | DBMV | VOLT | DBUA | AMPere | DB | DBUV_M | DBUA_M | DEG | RAD | S | HZ | PCT | UNITLESS		
:FAIL?		--	query only
:CLEar			
[:IMMediate]	--	--	no query
:COMMent	<string>	--	
:COPY	1 to 8 | < name>	--	
:NAME	<string>		
:DELete	--		

CALCulate<1|2>:LIMit<1 to 8>:TRACe 1 to 3

This command assigns a limit line to a trace in the indicated measurement window.

Examples:	`"CALC:LIM2:TRAC 3"`	Assigns limit line 2 to trace 3 in screen A.
	`"CALC2:LIM2:TRAC 1"`	Assigns limit line 2 to trace 1 in screen B at the same time.

Characteristics: *RST value: 1
SCPI: device-specific

Mode: A, MS

CALCulate<1|2>:LIMit<1 to 8>:STATe ON | OFF

This command switches on or off the limit check for the selected limit line in the selected measurement window.

The result of the limit check can be queried with `CALCulate:LIMit<1 to 8>:FAIL?`.

Example:	`"CALC:LIM:STAT ON"`	Switches on the limit check for limit line 1 in screen A.
	`"CALC2:LIM:STAT OFF"`	Switches off the limit check for limit line 1 in screen B.

Characteristics: *RST value: OFF
SCPI: conforming

Mode: A, MS

CALCulate<1|2>:LIMit<1...8>:UNIT DBM | DBPW | WATT | DBUV | DBMV | VOLT |DBUA | AMPere | DB | DBUV_M | DBUA_M | DBM | DBPW | WATT || DBPT | DB | DBUV_MHZ | DBMV_MHZ | DBUA_MHZ DBUV_MMHZ | DBUA_MMHZ |

The definition is valid independently of the measurement window.

Upon selection of the unit DB the limit line is automatically switched to the relative mode. For units different from DB the limit line is automatically switched to absolute mode.

The units DEG, RAD, S, HZ, PCT are not available in *SPECTRUM* mode.

Example: "CALC:LIM4:UNIT DBUV" Sets the unit of limit line 4 to dBµV.

Characteristics: *RST value: DBM
SCPI: device-specific

Mode: A, MS

CALCulate<1|2>:LIMit<1 to 8>:FAIL?

This command queries the result of the limit check of the limit line indicated in the selected measurement window. It should be noted that a complete sweep must have been performed for obtaining a valid result. A synchronization with *OPC, *OPC? or *WAI should therefore be provided.

The result of the limit check responds with 0 for PASS, 1 for FAIL, and 2 for MARGIN.

Example: "INIT;*WAI" Starts a new sweep and waits for its end.

"CALC2:LIM3:FAIL?" Queries the result of the check for limit line 3 in screen B.

Characteristics: *RST value: -
SCPI: conforming

Mode: A, MS

CALCulate<1|2>:LIMit<1 to 8>:CLEar[:IMMediate]

This command deletes the result of the current limit check for all limit lines in the selected measurement window.

Example: "CALC:LIM:CLE" Deletes the result of the limit check in screen A

Characteristics: *RST value: -
SCPI: conforming

Mode: A, MS

This command is an event and is therefore not assigned an *RST value.

CALCulate<1|2>:LIMit<1 to 8>:COMMent <string>

This command defines a comment for the limit line selected (max. 40 characters). The comment is independent from the measurement window.

Example: "CALC:LIM5:COMM 'Upper limit for spectrum'"
Defines the comment for limit line 5.

Characteristics: *RST value: blank comment
SCPI: device-specific

Mode: A, MS

CALCulate<1|2>:LIMit<1 to 8>:COPY 1 to 8 | <name>

This command copies one limit line onto another one. It is independent of the measurement window.

The name of the limit line may consist of max 8 characters.

Parameter: 1 to 8 ::= number of the new limit line or:
<name> ::= name of the new limit line given as a string

Example: "CALC:LIM1:COPY 2" Copies limit line 1 to line 2.

"CALC:LIM1:COPY 'GSM2'" Copies limit line 1 to a new line named 'GSM2'.

Characteristics: *RST value: --
SCPI: device-specific

Mode: A, MS

This command is an event and is therefore not assigned an *RST value and has no query.

CALCulate<1|2>:LIMit<1 to 8>:NAME <name of limit line>

This command assigns a name to a limit line numbered 1 to 8. If it does not exist already, a limit line with this name is created. The command is independent of the measurement window.

The name of the limit line may contain a maximum of 8 characters.

Example: "CALC:LIM1:NAME 'GSM1'" Assigns the name 'GSM1' to limit line 1.

Characteristics: *RST value: 'REM1' to 'REM8' for lines 1 to 8
SCPI: device-specific

Mode: A, MS

CALCulate<1|2>:LIMit<1 to 8>:DELete

This command deletes the selected limit line. The command is independent of the measurement window.

Example: "CALC:LIM1:DEL" Deletes limit line 1.

Characteristics: *RST value: --
SCPI: device-specific

Mode: A, MS

This command is an event and is therefore not assigned an *RST value and has no query.

CALCulate:LIMit:ACPower Subsystem

The CALCulate:LIMit:ACPower subsystem defines the limit check for adjacent channel power measurement.

COMMAND	PARAMETERS	UNIT	COMMENT
CALCulate<1|2>			
LIMit<1 to 8>			
:ACPower			
[:STATe]	<Boolean>		
:ACHannel			
[:RELative]	<numeric_value>, <numeric_value>	DB, DB	
:STATe	<Boolean>		
:ABSolute	<numeric_value>, <numeric_value>	DBM, DBM	
:STATe	<Boolean>		
:RESult?	--		query only
:ALTernate<1|2>			
[:RELative]	<numeric_value>, <numeric_value>	DB, DB	
:STATe	<Boolean>		
:ABSolute	<numeric_value>, <numeric_value>	DBM, DBM	
:STATe	<Boolean>		
:RESult?	--		query only

CALCulate<1|2>:LIMit<1 to 8>:ACPower[:STATe] ON | OFF

This command switches on and off the limit check for adjacent channel power measurements in the selected measurement window. The commands `CALCulate:LIMit:ACPower:ACHannel:STATe` or `CALCulate:LIMit:ACPower:ALTernate:STATe` must be used in addition to specify whether the limit check is to be performed for the upper/lower adjacent channel or for the alternate adjacent channels.

The numeric suffixes <1 to 8> are irrelevant for this command.

Example: "`CALC:LIM:ACP ON`" Switches on the ACP limit check in screen A.

Characteristics: *RST value: OFF
SCPI: device-specific

Mode: A

CALCulate<1|2>:LIMit<1 to 8>:ACPower:ACHannel[:RELative] 0 to 100dB, 0 to 100dB

This command defines the relative limit of the upper/lower adjacent channel for adjacent channel power measurements in the selected measurement window. The reference value for the relative limit value is the measured channel power.

It should be noted that the relative limit value has no effect on the limit check as soon as it is below the absolute limit value defined with `CALCulate:LIMit:ACPower:ACHannel:ABSolute`. This mechanism allows automatic checking of the absolute basic values of adjacent channel power as defined in mobile radio standards.

The numeric suffixes <1 to 8> are irrelevant for this command.

Parameter: The first numeric value is the limit for the upper (lower) adjacent channel. The second value is ignored but must be indicated for reasons of compatibility with the FSE family.

Example: `"CALC:LIM:ACP:ACH 30DB, 30DB"` Sets the relative limit value in screen A for the power in the lower and upper adjacent channel to 30 dB below the channel power.

Characteristics: *RST value: 0 dB
SCPI: device-specific

Mode: A

CALCulate<1|2>:LIMit<1 to 8>:ACPower:ACHannel[:RELative]:STATe ON | OFF

This command activates the limit check for the relative limit value of the adjacent channel when adjacent channel power measurement is performed. Before the command, the limit check must be activated using `CALCulate:LIMit:ACPower:STATe ON`.

The result can be queried with `CALCulate:LIMit:ACPower:ACHannel:RESult?`. It should be noted that a complete measurement must be performed between switching on the limit check and the result query, since otherwise no valid results are available.

The numeric suffixes <1 to 8> are irrelevant for this command.

Example:

`"CALC:LIM:ACP:ACH 30DB, 30DB"`	Sets the relative limit value in screen A for the power in the lower and upper adjacent channel to 30 dB below the channel power.
`"CALC:LIM:ACP:ACH:ABS -35DBM, -35DBM"`	Sets the absolute limit value in screen A for the power in the lower and upper adjacent channel to -35 dBm.
`"CALC:LIM:ACP ON"`	Switches on globally the limit check for the channel/adjacent channel measurement in screen A.
`"CALC:LIM:ACP:ACH:REL:STAT ON"`	Switches on the check of the relative limit values for adjacent channels in screen A.
`"CALC:LIM:ACP:ACH:ABS:STAT ON"`	Switches on the check of absolute limit values for the adjacent channels in screen A.
`"INIT;*WAI"`	Starts a new measurement and waits for the sweep end.
`"CALC:LIM:ACP:ACH:RES?"`	Queries the limit check result in the adjacent channels in screen A.

Characteristics: *RST value: OFF
SCPI: device-specific

Mode: A

CALCulate<1|2>:LIMit<1 to 8>:ACPower:ACHannel:ABSolute -200DBM to 200DBM, -200 to 200DBM

This command defines the absolute limit value for the lower/upper adjacent channel during adjacent-channel power measurement (Adjacent Channel Power) in the selected measurement window.

It should be noted that the absolute limit value has no effect on the limit check as soon as it is below the relative limit value defined with `CALCulate:LIMit:ACPower:ACHannel:RELative`. This mechanism allows automatic checking of the absolute basic values of adjacent channel power as defined in mobile radio standards.

The numeric suffixes <1 to 8> in LIMIt are irrelevant for this command.

Parameter: The first value is the limit for the lower and the upper adjacent channel. The second limit value is ignored but must be indicated for reasons of compatibiltiy with the FSE family.

Example: `"CALC:LIM:ACP:ACH:ABS -35DBM, -35DBM"`
Sets the absolute limit value in screen A for the power in the lower and upper adjacent channel to -35 dBm.

Characteristics: *RST value: -200DBM
SCPI: device-specific

Mode: A

CALCulate<1|2>:LIMit<1 to 8>:ACPower:ACHannel:ABSolute:STATe ON | OFF

This command activates the limit check for the adjacent channel when adjacent-channel power measurement (Adjacent Channel Power) is performed. Before the command, the limit check for the channel/adjacent-channel measurement must be globally switched on using `CALC:LIM:ACP ON`.

The result can be queried with `CALCulate:LIMit:ACPower:ACHannel:RESult?`. It should be noted that a complete measurement must be performed between switching on the limit check and the result query, since otherwise no valid results are available.

The numeric suffixes <1 to 8> in LIMIt are irrelevant for this command.

Example:

"CALC:LIM:ACP:ACH 30DB, 30DB"	Sets the relative limit value in screen A for the power in the lower and upper adjacent channel to 30 dB below the channel power.
"CALC:LIM:ACP:ACH:ABS -35DBM, -35DBM"	Sets the absolute limit value in screen A for the power in the lower and upper adjacent channel to -35 dBm.
"CALC:LIM:ACP ON"	Switches on globally the limit check for the channel/adjacent channel measurement in screen A.
"CALC:LIM:ACP:ACH:REL:STAT ON"	Switches on the check of the relative limit values for adjacent channels in screen A.
"CALC:LIM:ACP:ACH:ABS:STAT ON"	Switches on the check of absolute limit values for the adjacent channels in screen A.
"INIT;*WAI"	Starts a new measurement and waits for the sweep end.
"CALC:LIM:ACP:ACH:RES?"	Queries the limit check result in the adjacent channels in screen A.

Characteristics: *RST value: OFF
SCPI: device-specific

Mode: A

CALCulate<1|2>:LIMit<1 to 8>:ACPower:ACHannel:RESult?

This command queries the result of the limit check for the upper/lower adjacent channel in the selected measurement window when adjacent channel power measurement is performed.

If the power measurement of the adjacent channel is switched off, the command produces a query error.
The numeric suffixes <1 to 8> are irrelevant for this command.

Parameter: The result is returned in the form <result>, <result> where <result> = PASSED | FAILED, and where the first returned value denotes the lower, the second denotes the upper adjacent channel.

Example:

`"CALC:LIM:ACP:ACH 30DB, 30DB"`	Sets the relative limit value in screen A for the power in the lower and upper adjacent channel to 30 dB below the channel power.
`"CALC:LIM:ACP:ACH:ABS -35DBM, -35DBM"`	Sets the absolute limit value in screen A for the power in the lower and upper adjacent channel to -35 dB.
`"CALC:LIM:ACP ON"`	Switches on globally the limit check for the channel/adjacent channel measurement in screen A.
`"CALC:LIM:ACP:ACH:STAT ON"`	Switches on the limit check for the adjacent channels in screen A.
`"INIT;*WAI"`	Starts a new measurement and waits for the sweep end.
`"CALC:LIM:ACP:ACH:RES?"`	Queries the limit check result in the adjacent channels in screen A.

Characteristics: *RST value: --
SCPI: device-specific

Mode: A

This command is a query and therefore not assigned an *RST value.

CALCulate<1|2>:LIMit<1 to 8>:ACPower:ALTernate<1|2>[:RELative] 0 to 100dB, 0 to 100dB.

This command defines the limit for the first/second alternate adjacent channel in the selected measurement window for adjacent channel power measurements. The reference value for the relative limit value is the measured channel power.

The numeric suffix after `ALTernate<1|2>` denotes the first or the second alternate channel. The numeric suffixes <1 to 8> are irrelevant for this command.

It should be noted that the relative limit value has no effect on the limit check as soon as it is below th absolute limit defined with `CALCulate:LIMit:ACPower:ALTernate<1|2>:ABSolute`. This mechanism allows automatic checking of the absolute basic values of adjacent channel power as defined in mobile radio standards.

Parameter: The first value is the limit for the lower and the upper alternate adjacent channel. The second limit value is ignored but must be indicated for reasons of compatibility with the FSE family.

Example: `"CALC:LIM:ACP:ALT2 30DB, 30DB"` Sets the relative limit value in screen A for the power in the lower and upper alternate adjacent channel to 30 dB below the channel power.

Characteristics: *RST value: 0DB
SCPI: device-specific

Mode: A

CALCulate<1|2>:LIMit<1 to 8>:ACPower:ALTernate<1|2>[:RELative]:STATe ON | OFF

This command activates the limit check for the first/second alternate adjacent channel in the selected measurement window for adjacent channel power measurements. Before the command, the limit check must be activated using `CALCulate:LIMit:ACPower:STATe ON`.

The numeric suffix after `ALTernate<1|2>` denotes the first or the second alternate channel. The numeric suffixes <1 to 8> are irrelevant for this command.

The result can be queried with `CALCulate:LIMit:ACPower:ALTernate<1|2>:RESult?`. It should be noted that a complete measurement must be performed between switching on the limit check and the result query, since otherwise no valid results are obtained.

Example:

"CALC:LIM:ACP:ALT2 30DB, 30DB"	Sets the relative limit value in screen A for the power in the lower and upper second alternate adjacent channel to 30 dB below the channel power.
"CALC:LIM:ACP:ALT2:ABS -35DBM, -35DBM"	Sets the absolute limit value in screen A for the power in the lower and upper second alternate adjacent channel to -35 dBm.
"CALC:LIM:ACP ON"	Switches on globally the limit check for the channel/adjacent channel measurement in screen A.
"CALC:LIM:ACP:ACH:REL:STAT ON"	Switches on the check of the relative limit values for the alternate adjacent channels in screen A.
"CALC:LIM:ACP:ACH:ABS:STAT ON"	Switches on the check of absolute limit values for the alternate adjacent channels in screen A.
"INIT;*WAI"	Starts a new measurement and waits for the sweep end.
"CALC:LIM:ACP:ACH:RES?"	Queries the limit check result in the second alternate adjacent channels in screen A.

Characteristics: *RST value: OFF
SCPI: device-specific

Mode: A

CALCulate<1|2>:LIMit<1 to 8>:ACPower:ALTernate<1|2>:ABSolute -200DBM to 200DBM, -200DBM to .200DBM

This command defines the absolute limit value for the lower/upper alternate adjacent channel power measurement (Adjacent Channel Power) in the selected measurement window.

The numeric suffix after `ALTernate<1|2>` denotes the first or the second alternate channel. The numeric suffixes <1 to 8> are irrelevant for this command.

It should be noted that the absolute limit value for the limit check has no effect as soon as it is below the relative limit value defined with `CALCulate:LIMit:ACPower:ALTernate<1|2>:RELative`. This mechanism allows automatic checking of the absolute basic values defined in mobile radio standards for the power in adjacent channels.

Parameter: The first value is the limit for the lower and the upper alternate adjacent channel. The second limit value is ignored but must be indicated for reasons of compatibility with the FSE family.

Example: `"CALC:LIM:ACP:ALT2:ABS -35DBM, -35DBM"`
Sets the absolute limit value in screen A for the power in the lower and upper second alternate adjacent channel to -35 dBm.

Characteristics: *RST value: -200DBM
SCPI: device-specific

Mode: A

CALCulate<1|2>:LIMit<1 to 8>:ACPower:ALTernate<1|2>:ABSolute:STATe ON | OFF

This command activates the limit check for the first/second alternate adjacent channel in the selected measurement window for adjacent channel power measurement (Adjacent Channel Power).

Before the command, the limit check must be globally switched on for the channel/adjacent channel power with the command `CALCulate:LIMit:ACPower:STATe ON`.

The numeric suffix after `ALTernate<1|2>` denotes the first or the second alternate channel. The numeric suffixes <1 to 8> are irrelevant for this command.

The result can be queried with `CALCulate:LIMit:ACPower:ALTernate<1|2>:RESult?`. It should be noted that a complete measurement must be performed between switching on the limit check and the result query, since otherwise no valid results are available.

Example:

"CALC:LIM:ACP:ALT2 30DB, 30DB"	Sets the relative limit value in screen A for the power in the lower and upper second alternate adjacent channel to 30 dB below the channel power.
"CALC:LIM:ACP:ALT2:ABS -35DBM, -35DBM"	Sets the absolute limit value in screen A for the power in the lower and upper second alternate adjacent channel to -35 dBm.
"CALC:LIM:ACP ON"	Switches on globally the limit check for the channel/adjacent channel measurement in screen A.
"CALC:LIM:ACP:ACH:REL:STAT ON"	Switches on the check of the relative limit values for the alternative adjacent channels in screen A.
"CALC:LIM:ACP:ACH:ABS:STAT ON"	Switches on the check of absolute limit values for the alternative adjacent channels in screen A.
"INIT;*WAI"	Starts a new measurement and waits for the sweep end.
"CALC:LIM:ACP:ACH:RES?"	Queries the limit check result in the second alternate adjacent channels in screen A.

Characteristics: *RST value: OFF
SCPI: device-specific

Mode: A

CALCulate<1|2>:LIMit<1 to 8>:ACPower:ALTernate<1|2>:RESult?

This command queries the result of the limit check for the first/second alternate adjacent channel in the selected measurement window for adjacent channel power measurements.

The numeric suffix after `ALTernate<1|2>` denotes the first or the second alternate channel. The numeric suffixes <1 to 8> are irrelevant for this command.

If the power measurement of the adjacent channel is switched off, the command produces a query error.

Parameter: The result is returned in the form <result>, <result> where <result> = PASSED | FAILED and where the first (second) returned value denotes the lower (upper) alternate adjacent channel.

Example:

"CALC:LIM:ACP:ALT2 30DB, 30DB" — Sets the relative limit value in screen A for the power in the lower and upper second alternate adjacent channel to 30 dB below the channel power.

"CALC:LIM:ACP:ALT2:ABS -35DBM, -35DBM" — Sets the absolute limit value in screen A for the power in the lower and upper second alternate adjacent channel to -35 dBm.

"CALC:LIM:ACP ON" — Switches on globally the limit check for the channel/adjacent channel measurement in screen A.

"CALC:LIM:ACP:ALT:STAT ON" — Switches on the limit check for the adjacent channels in screen A.

"INIT;*WAI" — Starts a new measurement and waits for the sweep end.

"CALC:LIM:ACP:ALT:RES?" — Queries the limit check result in the second alternate adjacent channels in screen A.

Characteristics: *RST value: --
SCPI: device-specific

Mode: A

This command is a query and therefore not assigned an *RST value.

CALCulate:LIMit:CONTrol Subsystem

The CALCulate:LIMit:CONTrol subsystem defines the x-axis (CONTrol-axis).

COMMAND	PARAMETERS	UNIT	COMMENT
CALCulate<1|2>			
:LIMit<1 to 8>			
:CONTrol			
[:DATA]	<numeric_value>,<numeric_value>..	HZ | S	
:DOMain	FREQuency|TIME		
:OFFSet	<numeric_value>	HZ | S	
:MODE	RELative|ABSolute		
:SHIFt	<numeric_value>	HZ | S	

CALCulate<1|2>:LIMit<1 to 8>:CONTrol[:DATA] <numeric_value>,<numeric_value>..

This command defines the X-axis values (frequencies or times) of the upper or lower limit lines.The values are defined independently of the measurement window.

Example: "CALC:LIM2:CONT 1MHz,30MHz,100MHz, 300MHz,1GHz"
Defines 5 reference values for the X-axis of limit line 2

"CALC:LIM2:CONT?" Outputs the reference values for the X-axis of limit line 2 separated by a comma.

Characteristics: *RST value: - (LIMit:STATe is set to OFF)
SCPI: conforming

Mode: A, MS

CALCulate<1|2>:LIMit<1 to 8>:CONTrol:DOMain FREQuency | TIME

This command defines the frequency or time domain for the x-axis values.

Example: "CALC:LIM2:CONT:DOM TIME" Defines the time domain for the X-axis of limit line 2.

Characteristics: *RST value: FREQuency
SCPI: device-specific

Mode: A, MS

CALCulate<1|2>:LIMit<1 to 8>:CONTrol:OFFSet <numeric_value>

This command defines an offset for the X-axis value of the selected relative limit line in the frequency or time domain.

The unit of values depends on the frequency or time domain of the X-axis, ie it is `HZ` with `CALC:LIM:CONT:DOM FREQ und S bei CALC:LIM:CONT:DOM TIME.`

Example: "`CALC:LIM2:CONT:OFFS 100us`" Sets the X offset for limit line 2 (defined in the time domain) to 100µs.

Characteristics: *RST value: 0
SCPI: device-specific

Mode: A, MS

CALCulate<1|2>:LIMit<1 to 8>:CONTrol:MODE RELative | ABSolute

This command selects the relative or absolute scaling for the X-axis of the selected limit line. The definition is independent of the measurement window.

Example: "`CALC:LIM2:CONT:MODE REL`" Defines the X-axis of limit line 2 as relatively scaled.

Characteristics: *RST value: ABSolute
SCPI: device-specific

Mode: A, MS

CALCulate<1|2>:LIMit<1 to 8>:CONTrol:SHIFt <numeric_value>

This command moves a limit line by the indicated value in x direction. In contrast to `CALC:LIM:CONT:OFFS`, the line is shifted by modifying the individual x values and not by means of an additive offset. The shift is independent of the measurement window.

Example: "`CALC:LIM2:CONT:SHIF 50KHZ`" Shifts all reference values of limit line 2 by 50 kHz.

Characteristics: *RST value: --
SCPI: device-specific

Mode: A, MS

This command is an event and is therefore not assigned an *RST value and has no query.

CALCulate:LIMit:LOWer Subsystem

The CALCulate:LIMit:LOWer subsystem defines the lower limit line.

<table>
<tr><th>COMMAND</th><th>PARAMETERS</th><th>UNIT</th><th>COMMENT</th></tr>
<tr><td>CALCulate<1|2>
:LIMit<1 to 8>
:LOWer
[:DATA]</td><td><numeric_value>,<numeric_value>..</td><td>DBM | DB |
DEG | RAD |
S | HZ | PCT</td><td></td></tr>
<tr><td>:STATe</td><td><Boolean></td><td>--</td><td></td></tr>
<tr><td>:OFFSet</td><td><numeric_value></td><td>DB| DEG| RAD|
S | HZ | PCT</td><td></td></tr>
<tr><td>:MARGin</td><td><numeric_value></td><td>DB| DEG| RAD|
S | HZ | PCT</td><td></td></tr>
<tr><td>:MODE</td><td>RELative|ABSolute</td><td>--</td><td></td></tr>
<tr><td>:SHIFt</td><td><numeric_value></td><td>DB| DEG| RAD|
S | HZ | PCT</td><td></td></tr>
<tr><td>:THReshold</td><td><numeric_value></td><td>DBM | DB |
DEG | RAD |
S | HZ | PCT</td><td></td></tr>
</table>

CALCulate<1|2>:LIMit<1 to 8>:LOWer[:DATA] <numeric_value>,<numeric_value>..

This command defines the values for the selected lower limit line independently of the measurement window.

The unit must be identical with the unit selected by `CALC:LIM:UNIT`. If no unit is indicated, the unit defined with `CALC:LIM:UNIT` is automatically used.

If the measured values are smaller than the LOWer limit line, the limit check signals errors.

The units DEG, RAD, S, HZ, PCT are not available in the *SPECTRUM* mode.

Example: `"CALC:LIM2:LOW -30,-40,-10,-40,-30"`
Defines 5 lower limit values for limit line 2 in the preset unit.

`"CALC:LIM2:LOW?"` Outputs the lower limit values of limit line 2 separated by a comma.

Characteristics: *RST value: - (LIMit:STATe is set to OFF)
SCPI: conforming

Mode: A, MS

CALCulate<1|2>:LIMit<1 to 8>:LOWer:STATe ON | OFF

This command switches on or off the indicated limit line in the selected measurement window. The limit check is activated separately with `CALC:LIM:STAT ON`.

The result of the limit check can be queried with `CALCulate:LIMit<1 to 8>:FAIL?`.

Example:	"CALC:LIM4:LOW:STAT ON"	Switches on limit line 4 (lower limit) in screen A.
	"CALC2:LIM4:LOW:STAT ON"	Switches on limit line 4 (lower limit) also in screen B.

Characteristics: *RST value: OFF
SCPI: conforming

Mode: A, MS

CALCulate<1|2>:LIMit<1 to 8>:LOWer:OFFSet <numeric_value>

This command defines an offset for the Y-axis of the selected relative lower limit line. In contrast to `CALC:LIM:LOW:SHIFt`, the line is not shifted by modifying the individual Y values but by means of an additive offset. The offset is independent of the measurement window.

Example:	"CALC:LIM2:LOW:OFFS 3dB"	Shifts limit line 2 in the corresponding measurement windows by 3 dB upwards.

Characteristics: *RST value: 0
SCPI: device-specific

Mode: A, MS

CALCulate<1|2>:LIMit<1 to 8>:LOWer:MARGin <numeric_value>

This command defines a margin to a lower limit line, at which out-of-limit values are signalled (if the limit check is active), but not handled as a violation of the limit value. The margin is independent of the measurement window.

Example: "CALC:LIM:LOW:MARG 10dB"

Characteristics: *RST value: 0
SCPI: device-specific

Mode: A, MS

CALCulate<1|2>:LIMit<1 to 8>:LOWer:MODE RELative | ABSolute

This command selects the relative or absolute scaling for the Y-axis of the selected lower limit line. The setting is independent of the measurement window.

Selecting RELative causes the unit to be switched to DB.

Example:	"CALC:LIM:LOW:MODE REL"	Defines the Y-axis of limit line 2 as relative scaled.

Characteristics: *RST value: ABSolute
SCPI: device-specific

Mode: A, MS

CALCulate<1|2>:LIMit<1 to 8>:LOWer:SHIFt <numeric_value>

This command shifts a limit line by the indicated value in Y-direction. In contrast to `CALC:LIM:LOW:OFFS`, the line is shifted by modifying the individual Y values but not by means of an additive offset. The shift is independent of the measurement window.

Example:	"CALC:LIM3:LOW:SHIF 20DB"	Shifts all Y values of limit line 3 by 20 dB.

Characteristics:	*RST value:	--
	SCPI:	device-specific
Mode:	A, MS	

This command is an event and is therefore not assigned an *RST value and has no query.

CALCulate<1|2>:LIMit<1 to 8>:LOWer:THReshold <numeric_value>

This command defines an absolute threshold value for limit lines with relative Y-axis scaling independently of the measurement window. The absolute threshold value is used in the limit check as soon as it exceeds the relative limit value.

The unit must correspond to the unit selected with `CALC:LIM:UNIT` (except dB which is not allowed). If no unit is indicated, the unit defined with `CALC:LIM:UNIT` is automatically used (exception: dBm instead of dB).

The units DEG, RAD, S, HZ, PCT are not available in the *SPECTRUM* mode.

Example:	"CALC:LIM2:LOW:THR -35DBM"	Defines an absolute threshold value for limit line 2.

Characteristics:	*RST value:	-200 dBm
	SCPI:	device-specific
Mode:	A, MS	

CALCulate:LIMit:UPPer Subsystem

The CALCulate:LIMit:UPPer subsystem defines the upper limit line.

COMMAND	PARAMETERS	UNIT	COMMENT
CALCulate<1|2> :LIMit<1 to 8> :UPPer			
[:DATA]	<numeric_value>,<numeric_value>..	DBM | DB | DEG | RAD | S | HZ | PCT	
:STATe	<Boolean>	--	
:OFFSet	<numeric_value>	DB| DEG| RAD| S | HZ | PCT	
:MARGin	<numeric_value>	DB| DEG| RAD| S | HZ | PCT	
:MODE	RELative|ABSolute	--	
:SHIFt	<numeric_value>	DB |DEG| RAD| S | HZ | PCT	
:THReshold	<numeric_value>	DBM | DB | DEG | RAD | S | HZ | PCT	

CALCulate<1|2>:LIMit<1 to 8>:UPPer[:DATA] <numeric_value>,<numeric_value>..

This command defines the values for the upper limit lines independently of the measurement window.

The number of values for the CONTrol axis and for the corresponding UPPer and/or LOWer limit line have to be identical. Otherwise default values are entered for missing values or not necessary values are deleted.

The unit must be identical with the unit selected by `CALC:LIM:UNIT`. If no unit is indicated, the unit defined with `CALC:LIM:UNIT` is automatically used.

The units DEG, RAD, S, HZ, PCT are not available in *SPECTRUM* mode.

If the measured values exceed the UPPer limit line, the limit check signals errors.

Example: `"CALC:LIM2:UPP -10,0,0,-10,-5"` Defines 5 upper limit values for limit line 2 in the preset unit.

`"CALC:LIM2:UPP?"` Outputs the upper limit values for limit line 2 separated by a comma.

Characteristics: *RST value: - (LIMit:STATe is set to OFF)
SCPI: conforming

Mode: A, MS

CALCulate<1|2>:LIMit<1 to 8>:UPPer:STATe ON | OFF

This command switches on or off the indicated limit line in the selected measurement window. The limit check is activated separately with `CALC:LIM:STAT ON`.

The result of the limit check can be queried with `CALCulate:LIMit<1 to 8>:FAIL?`.

Example:	"CALC1:LIM4:UPP:STAT ON"	Switches on limit line 4 (upper limit) in screen A.
	"CALC2:LIM4:UPP:STAT ON"	Switches on limit line 4 (upper limit) in screen B.

Characteristics: *RST value: OFF
SCPI: conforming

Mode: A, MS

CALCulate<1|2>:LIMit<1 to 8>:UPPer:OFFSet <numeric_value>

This command defines an offset for the Y-axis of the selected relative upper limit line. In contrast to `CALC:LIM:UPP:SHIFt`, the line is not shifted by modifying the individual Y values but by means of an additive offset. The offset is independent of the measurement window.

Example:	"CALC:LIM2:UPP:OFFS 3dB"	Shifts limit line 2 by 3 dB upwards in the corresponding measurement windows.

Characteristics: *RST value: 0
SCPI: device-specific

Mode: A, MS

CALCulate<1|2>:LIMit<1 to 8>:UPPer:MARGin <numeric_value>

This command defines a margin to an upper limit line, at which out-of-limit values are signalled (if the limit check is active), but not handled as a violation of the limit value. The margin is independent of the measurement window.

Example:	"CALC:LIM2:UPP:MARG 10dB"	Defines the margin of limit line 2 to 10 dB below the limit value.

Characteristics: *RST value: 0
SCPI: device-specific

Mode: A, MS

CALCulate<1|2>:LIMit<1 to 8>:UPPer:MODE RELative | ABSolute

This command selects the relative or absolute scaling for the Y-axis of the selected upper limit line. The setting is independent of the measurement window.

Selecting RELative causes the unit to be switched to DB.

Example:	`"CALC:LIM2:UPP:MODE REL"`	Defines the Y-axis of limit line 2 as relative scaled.

Characteristics:	*RST value:	ABSolute
	SCPI:	device-specific
Mode:	A, MS	

CALCulate<1|2>:LIMit<1 to 8>:UPPer:SHIFt <numeric_value>

This command moves a limit line by the indicated value in Y-direction. In contrast to `CALC:LIM:UPP:OFFS`, the line is shifted by modifying the individual Y values and not by means of an additive offset. The shift is independent of the measurement window.

Example:	`"CALC:LIM3:UPP:SHIF 20DB"`	Shifts all Y values of limit line 3 by 20 dB.

Characteristics:	*RST value:	--
	SCPI:	device-specific
Mode:	A, MS	

This command is an event and is therefore not assigned an *RST value and has no query.

CALCulate<1|2>:LIMit<1 to 8>:UPPer:THReshold <numeric_value>

This command defines an absolute threshold value for limit lines with relative Y-axis scaling independently of the measurement window. The absolute threshold value is used in the limit check as soon as it exceeds the relative limit value.

The unit must correspond to the unit selected with `CALC:LIM:UNIT` (except dB which is not possible). If no unit is indicated, the unit defined with `CALC:LIM:UNIT` is automatically used (exception: dBm instead of dB).

The units DEG, RAD, S, HZ, PCT are not available in the *SPECTRUM* mode.

Example:	`"CALC:LIM2:UPP:THR -35DBM"`	Defines an absolute threshold value for limit line 2.

Characteristics:	*RST value:	-200 dBm
	SCPI:	device-specific
Mode:	A, MS	

CALCulate:MARKer Subsystem

The CALCulate:MARKer subsystem checks the marker functions in the instrument. The measurement windows are assigned to CALCulate 1 (screen A) or 2 (screen B).

COMMAND	PARAMETERS	UNIT	COMMENT
CALCulate<1|2>			
:MARKer<1 to 4>			
[:STATe]	<Boolean>	--	
:AOFF			no query
:TRACe	<numeric_value>	--	
:X	<numeric_value>	HZ | S | DBM | DB	
:SLIMits			
[:STATe]	<Boolean>		
:LEFT	<numeric_value>	HZ | S	
:RIGHt	<numeric_value>	HZ | S	
:COUNt	<Boolean>	--	
:RESolution	<numeric_value>	HZ	
:FREQuency?	--	--	query only
:LOEXclude	<Boolean>		
:Y?	--	--	query only
:PERCent	<numeric_value>	PCT	
:MAXimum		--	
[:PEAK]	--	--	no query
:NEXT	--	--	no query
:RIGHt	--	--	no query
:LEFT	--	--	no query
:MINimum			
[:PEAK]	--	--	no query
:NEXT	--	--	no query
:RIGHt	--	--	no query
:LEFT	--	--	no query
:PEXCursion	<numeric_value>	DB	

CALCulate<1|2>:MARKer<1 to 4>[:STATe] ON | OFF

This command switches on or off the currently selected marker in the selected measurement window. If no indication is made, marker 1 is selected automatically. If marker 2, 3 or 4 is selected and used as a delta marker, it is switched to marker mode.

Example: "`CALC:MARK3 ON`" Switches marker 3 in screen A on or to marker mode.

Characteristics: *RST value: OFF
SCPI: device-specific

Mode: A, MS

CALCulate<1|2>:MARKer<1 to 4>:AOFF

This command switches off all active markers in the selected measurement window. All delta markers and active marker/delta marker measurement functions are switched off.

Example:	`"CALC:MARK:AOFF"`	Switches off all markers in screen A.
Characteristics:	*RST value:	-
	SCPI:	device-specific
Mode:	A, MS	

This command is an event and is therefore not assigned an *RST value and has no query.

CALCulate<1|2>:MARKer<1 to 4>:TRACe 1 to 3

This command assigns the selected marker (1 to 4) to the indicated measurement curve in the selected measurement window. The corresponding trace must be active, ie its status must be different from "BLANK".

If necessary the corresponding marker is switched on prior to the assignment.

Example:	`"CALC:MARK3:TRAC 2"`	Assigns marker 3 in screen A to trace 2.
	`"CALC2:MARK:TRAC 3"`	Assigns marker 1 in screen B to trace 3.
Characteristics:	*RST value	-
	SCPI:	device-specific
Mode:	A, MS	

CALCulate<1|2>:MARKer<1 to 4>:X 0 to MAX (frequency | sweep time)

This command positions the selected marker to the indicated frequency (span > 0), time (span = 0) or level (APD measurement or CCDF measurement ON) in the selected measurement window. If marker 2, 3 or 4 is selected and used as delta marker, it is switched to marker mode.

Example:	`"CALC1:MARK2:X 10.7MHz"`	Positions marker 2 in screen A to frequency 10.7 MHz.
Characteristics:	*RST value:	-
	SCPI:	device-specific
Mode:	A, MS	

CALCulate<1|2>:MARKer<1 to 4>:X:SLIMits[:STATe] ON | OFF

This command switches between a limited (ON) and unlimited (OFF) search range in the selected measurement window. The function is independent of the selection of a marker, ie the numeric suffix MARKer<1 to 4> is irrelevant.

If the time domain power measurement is active, this command limits the evaluation range on the trace.

Example:	`"CALC:MARK:X:SLIM ON"`	Switches on search limitation in screen A.
Characteristics:	*RST value:	OFF
	SCPI:	device-specific
Mode:	A, MS	

CALCulate<1|2>:MARKer<1 to 4>:X:SLIMits:LEFT 0 to MAX (frequency | sweep time)

This command sets the left limit of the search range for markers and delta markers in the selected measurement window. Depending on the x-axis domain the indicated value defines a frequency (span > 0) or time (span = 0). The function is independent of the selection of a marker, ie the numeric suffix in MARKer<1 to 4> is irrelevant.

If the time domain power measurement is active, this command limits the evaluation range to the trace.

Note: *The function is only available if the search limit for marker and delta marker is switched on* `(CALC:MARK:X:SLIM ON)`.

Example:

"CALC:MARK:X:SLIM ON"	Switches the search limit function on for screen A.
"CALC:MARK:X:SLIM:LEFT 10MHz"	Sets the left limit of the search range in screen A to 10 MHz.

Characteristics: *RST value: - (is set to the left diagram border on switching on search limits)
SCPI: device-specific

Mode: A, MS

CALCulate<1|2>:MARKer<1 to 4>:X:SLIMits:RIGHT 0 to MAX (frequency | sweep time)

This command sets the right limit of the search range for markers and delta markers in the selected measurement window. Depending on the x-axis domain the indicated value defines a frequency (span > 0) or time (span = 0). The function is independent of the selection of a marker, ie the numeric suffix in MARKer<1 to 4> is irrelevant.

If the time domain power measurement is active, this command limits the evaluation range to the trace.

Note:
The function is only available if the search limit for marker and delta marker is switched on `(CALC:MARK:X:SLIM ON)`.

Example:

"CALC:MARK:X:SLIM ON"	Switches the search limit function on for screen A.
"CALC:MARK:X:SLIM:RIGH 20MHz"	Sets the right limit of the search range in screen A to 20 MHz.

Characteristics: *RST value: - is set to the right diagram border on switching on search limits)
SCPI: device-specific

Mode: A, MS

CALCulate<1|2>:MARKer<1 to 4>:COUNt ON | OFF

This command switches on or off the frequency counter at the marker position in the selected measurement window. The count result is queried with `CALCulate:MARKer:COUNt:FREQuency?`.

Frequency counting is possible only for one marker at a time for each measurement window. If it is activated for another marker, it is automatically de-activated for the previous marker.

It should be noted that a complete sweep must be performed after switching on the frequency counter to ensure that the frequency to be measured is actually reached. The synchronization to the sweep end required for this is possible only in single-sweep mode.

Note: *This function is not available during GSM measurements phase-frequency error/power vs. time.*

Example:	`"INIT:CONT OFF"`	Switches to single-sweep mode.
	`"CALC:MARK ON"`	Switches on marker 1 in screen A.
	`"CALC:MARK:COUN ON"`	Switches on the frequency counter for marker 1.
	`"INIT;*WAI"`	Starts a sweep and waits for the end.
	`"CALC:MARK:COUN:FREQ?"`	Outputs the measured value in screen A.

Characteristics: *RST value: OFF
SCPI: device-specific

Mode: A, MS

CALCulate<1|2>:MARKer<1 to 4>:COUNt:RESolution 0.1 | 1 | 10 | 100 | 1000 | 10000 Hz

This command specifies the resolution of the frequency counter in the selected measurement window.The setting is independent of the selected marker, ie the numeric suffix in MARKer<1 to 4> is irrelevant.

Note: *This function is not available during GSM measurements phase-frequency error/power vs. time.*

Example: `"CALC:MARK:COUN:RES 1kHz"` Sets the resolution of the frequency counter to 1 kHz.

Characteristics: *RST value: 1kHz
SCPI: device-specific

Mode: A, MS

CALCulate<1|2>:MARKer<1 to 4>:COUNt:FREQuency?

This command queries the result of the frequency counter for´the indicated marker in the selected measurement window. Before the command, the frequency counter should be switched on and a complete measurement performed to obtain a valid count result. Therefore, a single sweep with synchronization must be performed between switching on the frequency counter and querying the count result.

Note: *This function is not available during GSM measurements phase-frequency error/power vs. time.*

Example:	`"INIT:CONT OFF"`	Switches to single-sweep mode.
	`"CALC:MARK2 ON"`	Switches marker 2 in screen A.
	`"CALC:MARK2:COUN ON"`	Switches the frequency counter for marker 2.
	`"INIT;*WAI"`	Starts a sweep and waits for the end.
	`"CALC:MARK2:COUN:FREQ?"`	Outputs the measured value of delta marker 2 in screen A.

Characteristics: *RST value: -
SCPI: device-specific

Mode: A, MS

This command is only a query and thus has no *RST value.

CALCulate<1|2>:MARKer<1 to 4>:LOEXclude ON | OFF

This command switches the local oscillator suppression for peak search on or off. This setting is valid for all markers and delta markers in all measurement windows.

Example: "CALC:MARK:LOEX ON"

Characteristics: *RST value: ON
SCPI: device-specific

Mode: A-F, MS

The numeric suffixes 1|2 and 1 to 4 are irrelevant.

CALCulate<1|2>:MARKer<1 to 4>:Y?

This command queries the selected marker value in the selected measurement window. The corresponding marker is activated first or switched to the marker mode, if necessary.

A complete sweep with synchronization to sweep end must be performed between switching on the marker and querying the y value to obtain a valid query result. This is only possible in single sweep mode.

The query result is output in the unit defined with CALCulate:UNIT.

Example:	"INIT:CONT OFF"	Switches to single-sweep mode.
	"CALC:MARK2 ON"	Switches marker 2 in screen A.
	"INIT;*WAI"	Starts a sweep and waits for the end.
	"CALC:MARK2:Y?"	Outputs the measured value of marker 2 in screen A.

Characteristics: *RST value: -
SCPI: device-specific

Mode: A, MS

CALCulate<1|2>:MARKer<1...4>:Y:PERCent 0 to100%

This command positions the selected marker in the selected window to the given probability. If marker 2, 3 or 4 is selected and used as a delta marker, it is switched to marker mode.

Note: *The command is only available with the CCDF measurement switched on. The associated level value can be determined with the CALC:MARK:X? command.*

Example: "CALC1:MARK:Y:PERC 95PCT" positions marker 1 in screen A to a probability of 95%.

Characteristics: *RST value: -
SCPI: device-specific

CALCulate<1|2>:MARKer<1 to 4>:MAXimum[:PEAK]

This command positions the marker to the current maximum value of the corresponding trace in the selected measurement window. The corresponding marker is activated first or switched to the marker mode.

Note: *If no maximum value is found on the trace (level spacing to adjacent values < peak excursion), an execution error (error eode: -200) is produced.*

Example: `"CALC:MARK2:MAX"` Positions marker 2 in screen A to the maximum value of the trace.

Characteristics: *RST value: -
SCPI: device-specific

Mode: A, MS

This command is an event and is therefore not assigned an *RST value and has no query.

CALCulate<1|2>:MARKer<1 to 4>:MAXimum:NEXT

This command positions the marker to the next smaller maximum value of the corresponding trace in the selected measurement window.

Note: *If no next smaller maximum value is found on the trace (level spacing to adjacent values < peak excursion), an execution error (error code: -200) is produced.*

Example: `"CALC:MARK2:MAX:NEXT"` Positions marker 2 in screen A to the next lower maximum value.

Characteristics: *RST value: -
SCPI: device-specific

Mode: A, MS

This command is an event and is therefore not assigned an *RST value and has no query.

CALCulate<1|2>:MARKer<1 to 4>:MAXimum:RIGHt

This command positions the marker to the next smaller maximum value to the right of the current value (ie in ascending X values) on the corresponding trace in the selected measurement window.

Note: *If no next smaller maximum value is found on the trace (level spacing to adjacent values < peak excursion), an execution error (error code: -200) is produced.*

Example: `"CALC:MARK2:MAX:RIGH"` Positions marker 2 in screen A to the next lower maximum value to the right of the current value.

Characteristics: *RST value: -
SCPI: device-specific

Mode: A, MS

This command is an event and is therefore not assigned an *RST value and has no query.

CALCulate<1|2>:MARKer<1 to 4>:MAXimum:LEFT

This command positions the marker to the next smaller maximum value to the left of the current value (ie in descending X values) on the trace in the selected measurement window.

Note: *If no next smaller maximum value is found on the trace (level spacing to adjacent values < peak excursion), an execution error (error code: -200) is produced.*

Example: "CALC:MARK2:MAX:LEFT" Positions marker 2 in screen A to the next lowe maximum value to the left of the current value.

Characteristics: *RST value: -
SCPI: device-specific

Mode: A, MS

This command is an event and is therefore not assigned an *RST value and has no query.

CALCulate<1|2>:MARKer<1 to 4>:MINimum[:PEAK]

This command positions the marker to the current minimum value of the corresponding trace in the selected measurement window. The corresponding marker is activated first or switched to marker mode, if necessary.

Note: *If no minimum value is found on the trace (level spacing to adjacent values < peak excursion), an execution error (error code: -200) is produced.*

Example: "CALC:MARK2:MIN" Positions marker 2 in screen A to the minimum value of the trace.

Characteristics: *RST value: -
SCPI: device-specific

Mode: A, MS

This command is an event and is therefore not assigned an *RST value and has no query.

CALCulate<1|2>:MARKer<1 to 4>:MINimum:NEXT

This command positions the marker to the next higher minimum value of the corresponding trace in the selected measurement window.

Note: *If no next higher minimum value is found on the trace (level spacing to adjacent values < peak excursion), an execution error (error code: -200) is produced.*

Example: "CALC:MARK2:MIN:NEXT" Positions marker 2 in screen A to the next higher maximum value.

Characteristics: *RST value: -
SCPI: device-specific

Mode: A, MS

This command is an event and is therefore not assigned an *RST value and has no query.

CALCulate<1|2>:MARKer<1 to 4>:MINimum:RIGHt

This command positions the marker to the next higher minimum value to the right of the current value (ie in ascending X direction) on the corresponding trace in the selected measurement window.

Note: *If no next higher minimum value is found on the trace (level spacing to* adjacent values < *peak excursion), an execution error (error code: -200) is produced.*

Example: "CALC:MARK2:MIN:RIGH" Positions marker 2 in screen A to the next higher minimum value to the right of the current value.

Characteristics: *RST value: -
SCPI: device-specific

Mode: A, MS

This command is an event and is therefore not assigned an *RST value and has no query.

CALCulate<1|2>:MARKer<1 to 4>:MINimum:LEFT

This command positions the marker to the next higher minimum value to the left of the current value (ie in descending X direction) on the corresponding trace in the selected measurement window.

Note: *If no next higher minimum value is found on the trace (level spacing to* adjacent values < *peak excursion), an execution error (error code: -200) is produced.*

Example: "CALC:MARK2:MIN:LEFT" Positions marker 2 in screen A to the next higher minimum value to the left of the current value.

Characteristics: *RST value: -
SCPI: device-specific

Mode: A, MS

This command is an event and is therefore not assigned an *RST value and has no query.

CALCulate<1|2>:MARKer<1 to 4>:PEXCursion <numeric_value>

This command defines the peak excursion., ie the spacing below a trace maximum which must be attained before a new maximum is recognized, or the spacing above a trace minimum which must be attained before a new minimum is recognized. The set value is valid for all markers and delta markers.

Example: "CALC:MARK:PEXC 10dB"

Characteristics: *RST value: 6dB
SCPI: device-specific

Mode: A, MS

The numeric suffix in MARKer<1 to 4> is irrelevant.

CALCulate:MARKer:FUNCtion Subsystem

The measurement window is selected by CALCulate 1 (screen A) or 2 (screen B).

COMMAND	PARAMETERS	UNIT	COMMENT
CALCulate<1|2>			
:MARKer<1 to 4>			
:FUNCtion			
:NDBDown	<numeric_value>	DB	
:STATe	<Boolean>		
:RESult?	--	--	query only
:FREQuency?	--	--	query only
:ZOOM	<numeric_value>	HZ	no query
:NOISe			
[:STATe]	<Boolean>		
:RESult?	--	--	query only
:DEModulation			option audio demodulator
:SELect	AM|FM		
[:STATe]	<Boolean>		
:HOLDoff	<numeric_value>	S	
:CONTinuous	<Boolean>		
:MDEPth			
[:STATe]	<Boolean>	--	
:RESult?	--		query only
:TOI			
[:STATe]	<Boolean>	--	
:RESult?	--		query only
:CENTer			no query
:CSTep			no query
:REFerence			no query

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:NDBDown <numeric_value>

This command defines the level spacing of the two delta markers to the right and left of marker 1 in the selected measurement window. Marker 1 is always used as the reference marker. The numeric suffix <1 to 4> is irrelevant for this command.

The temporary markers T1 and T2 are positioned by n dB below the active reference marker. The frequency spacing of these markers can be queried with `CALCulate:MARKer:FUNCtion:NDBDown:RESult?`.

Note:
This function is not available during GSM measurements phase-frequency error/power vs. time.

Example: "`CALC:MARK:FUNC:NDBD 3dB`" Sets the level spacing in screen A to 3 dB.

Characteristics: *RST value: 6dB
SCPI: device-specific

Mode: A, MS

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:NDBDown:STATe ON | OFF

This command switches the "N dB Down" function on or off in the selected measurement window. Marker 1 is activated first, if necessary. The numeric suffix <1 to 4> is irrelevant for this command.

Note: *This function is not available during GSM measurements phase-frequency error/power vs. time.*

Example:	`"CALC:MARK:FUNC:NDBD:STAT ON"`	Switches on the N-dB-down function in screen A.

Characteristics: *RST value: OFF
SCPI: device-specific

Mode: A, MS

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:NDBDown:RESult?

This command queries the frequency spacing (bandwidth) of the N-dB-down markers in the selected measurement window. The numeric suffix <1 to 4> is irrelevant for this command.

A complete sweep with synchronization to sweep end must be performed between switching on the function and querying the measured value in order to obtain a valid query result. This is only possible in single sweep mode.

Note: *This function is not available during GSM measurements phase-frequency error/power vs. time.*

Example:	`"INIT:CONT OFF"`	Switches to single-sweep mode.
	`"CALC:MARK:FUNC:NDBD ON"`	Switches on the n-dB-down function in screen A.
	`"INIT;*WAI"`	Starts a sweep and waits for the end.
	`"CALC:MARK:FUNC:NDBD:RES?"`	Outputs the measured value of screen A.

Characteristics: *RST value: -
SCPI: device-specific

Mode: A, MS

This command is only a query and is therefore not assigned an *RST value.

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:NDBDown:FREQuency?

This command queries the two frequencies of the N-dB-down marker in the selected measurement window. The numeric suffix <1 to 4> is irrelevant for this command. The two frequency values are separated by comma and output in ascending order.

A complete sweep with synchronization to sweep end must be performed between switching on the function and querying the measured value to obtain a valid query result. This is only possible in single sweep mode.

Note: *This function is not available during GSM measurements phase-frequency error/power vs. time.*

Example:	`"INIT:CONT OFF"`	Switches to single-sweep mode.
	`"CALC:MARK:FUNC:NDBD ON"`	Switches on the n-dB-down function in screen A.
	`"INIT;*WAI"`	Starts a sweep and waits for the end.
	`"CALC:MARK:FUNC:NDBD:FREQ?"`	Outputs the frequencies of the temporary markers in screen A.

Characteristics: *RST value: -
SCPI: device-specific

Mode: A, MS

This command is only a query and is therefore not assigned an *RST value.

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:ZOOM <numeric_value>

This command defines the range to be zoomed around marker 1 in the selected measurement window. Marker 1 is activated first, if necessary.

The subsequent frequency sweep is stopped at the marker position and the frequency of the signal is counted. This frequency becomes the new center frequency, and the zoomed span is set. In order to recognize the end of the operation the synchronization to the sweep end should be activated. This is only possible in single sweep mode.

Example:	"INIT:CONT OFF"	Switches to single-sweep mode
	"CALC:MARK:FUNC:ZOOM 1kHz;*WAI"	Activates zooming in screen A and waits for its end.

Characteristics: *RST value: -
SCPI: device-specific

Mode: A-F

This command is an event and is therefore not assigned an *RST value and has no query.

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:NOISe[:STATe] ON | OFF

This command switches the noise measurement on or off for all markers of the indicated measurement window. The noise power density is measured at the position of the markers. The result can be queried with `CALCulate:MARKer:FUNCtion:NOISe:RESult?`.

Note:
This function is not available during GSM measurements phase-frequency error/power vs. time.

Example:	"CALC2:MARK:FUNC:NOIS ON"	Switches on the noise measurement for screen B.

Characteristics: *RST value: OFF
SCPI: device-specific

Mode: A, MS

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:NOISe:RESult?

This command queries the result of the noise measurement.

A complete sweep with synchronization to the sweep end must be performed between switching on the function and querying the measured value in order to obtain a valid query result. This is only possible in single sweep mode.

Note:
This function is not available during GSM measurements phase-frequency error/power vs. time.

Example:	"INIT:CONT OFF"	Switches to single-sweep mode.
	"CALC:MARK2 ON"	Switches on marker 2 in screen A.
	"CALC:MARK:FUNC:NOIS ON"	Switches on noise measurement in screen A.
	"INIT;*WAI"	Starts a sweep and waits for the end.
	"CALC:MARK2:NOIS:RES?"	Outputs the noise result of marker 2 in screen A.

Characteristics: *RST value: -
SCPI: device-specific

Mode: A, MS

This command is an event and is therefore not assigned an *RST value and has no query.

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:DEModulation:SELect AM | FM

This command selects the demodulation type for the audio demodulator. The command is independent of the measurement window and of the selected marker, ie suffixes 1|2 and 1 to 4 are irrelevant.

Example: "CALC:MARK:FUNC:DEM:SEL FM"

Characteristics: *RST value: AM
SCPI: device-specific

Mode: A, MS

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:DEModulation[:STATe] ON | OFF

This command switches on or off the audio demodulator when the indicated marker is reached in the selected measurement window. In the frequency domain (span > 0) the hold time can be defined at the corresponding marker position with `CALCulate:MARKer:FUNCtion: DEModulation:HOLD`. In the time domain (span = 0) the demodulation is permanently active.

Example: "CALC2:MARK3:FUNC:DEM ON" Switches on the demodulation for marker 3 in screen B.

Characteristics: *RST value: OFF
SCPI: device-specific

Mode: A, MS

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:DEModulation:HOLDoff 10ms to 1000s

This command defines the hold time at the marker position for the demodulation in the frequency domain (span > 0). The setting is independent of the measurement window and the selected marker, ie the suffixes <1|2> and <1 to 4> are irrelevant

Example: "CALC:MARK:FUNC:DEM:HOLD 3s"

Characteristics: *RST value: - (DEModulation is set to OFF)
SCPI: device-specific

Mode: A, MS

CALCulate<1|2>:MARKer<1...4>:FUNCtion:DEModulation:CONTinuous ON | OFF

This command switches on or off the continuous demodulation in the frequency domain (span >0) in the selected measurement window. Thus acoustic monitoring of the signals can be performed in the frequency domain. The function does not depend on the selected marker, ie the numeric suffix <1 to 4> is irrelevant.

Example: "CALC2:MARK3:FUNC:DEM:CONT ON" switches on the continuous demodulation in screen B.

Characteristics: *RST value: OFF
SCPI: device-specific

Mode: A, MS

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:MDEPth:[:STATe]

This command switches on the measurement of the AM modulation depth. An AM-modulated carrier is required on the screen for correct operation. If necessary, marker 1 is previously activated and set to the largest signal available.

The level value of marker 1 is regarded as the carrier level. On activating the function, marker 2 and marker 3 are automatically set as delta markers symetrically to the carrier to the adjacent maxima of the trace.

If the position of delta marker 2 is changed, delta marker 3 is moved symetrically with respect to the reference marker (marker 1). If the position of delta marker 3 is changed, fine adjustment can be performed independently of delta marker 2.

The FSU calculates the power at the marker positions from the measured levels.

The AM modulation depth is calculated from the ratio of power values at the reference marker and the delta markers. If the two AM sidebands differ in power, the average value of the two power values is used for calculating the AM modulation depth.

The numeric suffix <1 to 4> of :MARKer is irrelevant with this command.

Example:	`"CALC:MARK:X 10MHZ"`	Sets the reference marker (marker 1) to the carrier signal at 10 MHz
	`"CALC:MARK:FUNC:MDEP ON"`	Switches on the modulation depth measurement in screen A.
	`"CALC:DELT2:X 10KHZ"`	Sets delta markers 2 and 3 to the signals at 10 kHz from the carrier signal
	`"CALC:DELT3:X 9.999KHZ"`	Corrects the position of delta marker 3 relative to delta marker 2.

Characteristics: *RST value: OFF
SCPI: device-specific

Mode: A, MS

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:MDEPth:RESult?

This command queries the AM modulation depth in the indicated measurement window.

A complete sweep with synchronization to sweep end must be performed between switching on the function and querying the measured value to obtain a valid query result. This is only possible in single sweep mode.

The numeric suffix <1 to 4> of :MARKer is irrelevant for this command.

Example:	`"INIT:CONT OFF"`	Switches to single-sweep mode.
	`"CALC:MARK:X 10MHZ"`	Sets the reference marker (marker 1) to the carrier signal at 10 MHz.
	`"CALC:MARK:FUNC:MDEP ON"`	Switches on the modulation depth measurement in screen A.
	`"INIT;*WAI"`	Starts a sweep and waits for the end.
	`"CALC:MARK:FUNC:MDEP:RES?"`	Outputs the measured value of screen A.

Characteristics: *RST value: -
SCPI: device-specific

Mode: A, MS

This command is only a query and thus has no *RST value assigned.

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:TOI[:STATe] ON | OFF

This command initiates the measurement of the third-order intercept point.

A two-tone signal with equal carrier levels is expected at the RF input of the instrument. Marker 1 and marker 2 (both normal markers) are set to the maximum of the two signals. Delta marker 3 and delta marker 4 are positioned to the intermodulation products. The delta markers can be modified sperately afterwards with the commands `CALCulate:DELTamarker3:X` and `CALCulate:DELTamarker4:X`.

The third-order intercept is calculated from the level spacing between the normal markers and the delta markers.

The numeric suffix <1 to 4> of :MARKer is irrelevant for this command.

Note:
This function is not available during GSM measurements phase-frequency error/power vs. time/carrier power..

Example: `"CALC:MARK:FUNC:TOI ON"` Switches on the measurement of the third-order intercept in screen A.

Characteristics: *RST value: OFF
SCPI: device-specific

Mode: A, MS

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:TOI:RESult?

This command queries the third-order intercept point measurement in the indicated measurement window.

A complete sweep with synchronization to sweep end must be performed between switching on the function and querying the measured value to obtain a valid query result. This is only possible in single sweep mode.

The numeric suffix <1 to 4> of :MARKer is irrelevant of this command.

Note:
This function is not available during GSM measurements phase-frequency error/power vs. time/carrier power..

Example:

`"INIT:CONT OFF"`	Switches to single-sweep mode.
`"CALC:MARK:FUNC:TOI ON"`	Switches the intercept measurement in screen A.
`"INIT;*WAI"`	Starts a sweep and waits for the end.
`"CALC:MARK:FUNC:TOI:RES?"`	Outputs the measured value of screen A.

Characteristics: *RST value: -
SCPI: device-specific

Mode: A, MS

This command is only a query and thus has no *RST value assigned.

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:CENTer

This command sets the center frequency of the selected measurement window equal to the frequency of the indicated marker.

If marker 2, 3 or 4 is selected and used as delta marker, it is switched to the marker mode.

Example: "CALC:MARK2:FUNC:CENT" Sets the center frequency of screen A to the frequency of marker 2.

Characteristics: *RST value: -
SCPI: device-specific

Mode: A-F, MS

This command is an "event" and therefore has no *RST value assigned and has no query.

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:CSTep

This command sets the step width of the center frequency in the selected measurement window to the X value of the current marker. If marker 2, 3 or 4 is selected and used as delta marker, it is switched to the marker mode.

Example: "CALC2:MARK3:FUNC:CST" Sets the center frequency of screen B to the same value as the frequency of marker 3.

Characteristics: *RST value: -
SCPI: device-specific

Mode: A-F, MS

This command is an event and therefore has no *RST value assigned and has no query.

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:REFerence

This command sets the reference level in the selected measurement window to the power measured by the indicated marker. If marker 2, 3 or 4 is selected and used as delta marker, it is switched to marker mode.

Example: "CALC:MARK2:FUNC:REF" Sets the reference level of screen A to the the level of marker 2.

Characteristics: *RST value: -
SCPI: device-specific

Mode: A, MS

This command is an event and therefore has no *RST value assigned and has no query.

CALCulate:MARKer:FUNCtion:POWer Subsystem

The CALCulate:MARKer:FUNCtion:POWER subsystem contains the commands for control of power measurement.

COMMAND	PARAMETERS	UNIT	COMMENT
CALCulate<1|2>			
:MARKer			
:FUNCtion			
:POWer			
:SELect	ACPower | CPOWer | OBANdwidth | OBWidth		
:RESult?	ACPower | CPOWer | OBANdwidth | OBWidth<Boolean>		query only
:PHZ	<Boolean>		
:PRESet	NADC | TETRA | PDC | PHS | CDPD | FWCDma | RWCDma | F8CDma | R8CDma | F19Cdma | R19Cdma | FW3Gppcdma | RW3Gppcdma | D2CDma | S2CDma | M2CDma | FIS95A | RIS95A | FIS95C0 | RIS95C0 | FIS95C1 | RIS95C1 | FJ008 | RJ008 | NONE		
[:STATe]	OFF		no query

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:POWer:SELect ACPower | CPOWer | OBANdwidth | OBWidth

This command selects the indicated power measurement and switches it on in the selected measurement window.. The function is independent of the selected marker, ie the numeric suffix <1 to 4> of MARKer is irrelevant.
The configuration of channel spacings and channel bandwidths is performed by means of subsystem `SENSe:POWer:ACHannel`.
It should be noted that selecting CPOWer causes the number of adjacent channels (command: `[SENSe<1|2>:]POWer:ACHannel:ACPairs`) to be set to 0. Selecting ACPower causes the number of adjacent channels to be set to 1, if the adjacent channel power measurement is not yet switched on.
In both cases the behaviour of FSU differs from that of the FSE family.

Note: *The measurement of the channel/adjacent channel power is performed on the trace which has been selected with `SENSe:POWer:TRACe 1|2|3`.*

The measurement of the occupied bandwidth is performed on the trace on which marker 1 is positioned. In order to evaluate another trace, marker 1 should be positioned on another trace with `CALC:MARK:TRAC 1|2|3`.

Note: *This function is not available during active GSM measurements.*

Parameter:	ACPower	adjacent channel power measurement
	CPOWer	channel power measurement (same as adjacent channel power measurement with No. of Adj Channels = 0)
	OBANdwidth | OBWidth	occupied bandwidth power measurement

Example: `"CALC:MARK:FUNC:POW:SEL ACP"` Switches on the adjacent channel power measurement in screen A.

Characteristics: *RST value: -
SCPI: device-specific

Mode: A-F

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:POWer:RESult? ACPower | CPOWer | OBANdwidth | OBWidth

This command queries the results of the power measurement in the selected measurement window.The measurement is switched on first, if necessary.

The configuration of channel spacings and channel bandwidths is performed with subsytem `SENSe:POWer:ACHannel`.

To obtain a valid result, a complete sweep with synchronization to the sweep end must be performed before the query is executed. This is possible in single sweep mode only.

Note:
This function is not available during active GSM measurements.

Parameter:

ACPower: adjacent channel power measurement

Results are output separated by commas in the following order:

1. Power of main channel
2. Power of lower adjacent channel
3. Power of upper adjacent channel
4. Power of lower alternate adjacent channel 1
5. Power of upper alternate adjacent channel 1
6. Power of lower alternate adjacent channel 2
7. Power of upper alternate adjacent channel 2

The number of results depends on the number of adjacent channels selected with command `SENSe:POWer:ACHannel:ACPairs`.

With logarithmic scaling (RANGE LOG), the power is output in dBm, with linear scaling (RANGE LIN dB or LIN %) in W. If SENSe:POWer:ACHannel:MODE REL is selected, adjacent channel power is output in dB.

CPOWer channel power measurement

With logarithmic scaling (RANGE LOG), the channel power is output in dBm, with linear scaling (RANGE LIN dB or LIN %) in W.

OBANdwidth | OBWidth occupied bandwidth power measurement

The return value is the occupied bandwidth in Hz.

Example of channel/adjacent power measurement:

`"SENS2:POW:ACH:ACP 3"`	Sets the number of adjacent channels in screen B to 3.
`"SENS2:POW:ACH:BAND 30KHZ"`	Sets the bandwidth of the main channel to 30 kHz.
`"SENS2:POW:ACH:BAND:ACH 40KHZ"`	Sets the bandwidth of all adjacent channels to 40 kHz.
`"SENS2:POW:ACH:BAND:ALT1 50KHZ"`	Sets the bandwidth of all alternate adjacent channels to 50 kHz.
`"SENS2:POW:ACH:BAND:ALT2 60KHZ"`	Sets the bandwidth of alternate adjacent channel 2 to 60 kHz.
`"SENS2:POW:ACH:SPAC 30KHZ"`	Sets the spacing between channel to adjacent channel to 30 kHz as well as between channel and alternate adjacent

	channel to 60 kHz and 2nd alternate adjacent channel to 90 kHz.
`"SENS2:POW:ACH:SPAC:ALT1 100KHZ"`	Sets the spacing between channel and alternate adjacent channel to 100 kHz as well as 2nd alternate adjacent channel to 150 kHz.
`"SENS2:POW:ACH:SPAC:ALT2 140KHZ"`	Sets the spacing between channel and alternate adjacent channel 2 to 140 kHz.
`"SENS2:POW:ACH:MODE ABS"`	Switches on the measurement of absolute power values.
`"CALC2:MARK:FUNC:POW:SEL ACP"`	Switches the adjacent channel power measurement in screen B.
`"INIT:CONT OFF"`	Switches to single-sweep mode.
`"INIT;*WAI"`	Starts a sweep and waits for the end
`"CALC2:MARK:FUNC:POW:RES? ACP"`	Queries the result of the adjacent channel power measurement in screen B.
	In case of relative measurement, the measured channel power can be defined as the reference power with command.
`"SENS2:POW:ACH:REF:AUTO ONCE".`	

If only the **channel power** is to be measured, all commands for defining the bandwidths of adjacent channels as well as the channel spacings are not necessary. The number of adjacent channels is set to 0 with `SENS2:POW:ACH:ACP 0`.

Example of occupied bandwidth measurement:

`"SENS2:POW:BAND 90PCT"`	Sets the percentage of the power contained in the bandwidth under request to 90%.
`"INIT:CONT OFF"`	Switches to single-sweep mode.
`"INIT;*WAI"`	Starts a sweep and waits for the end.
`"CALC2:MARK:FUNC:POW:RES? OBW"`	Queries the result of the occupied bandwidth in screen B.

Characteristics: *RST value: -
SCPI: device-specific

Mode: A-F

This command is only a query and is therefore not assigned an *RST value.

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:POWer:RESult:PHZ ON | OFF

This command switches the query response of the power measurement results in the indicated measurement window between output of absolute values (OFF) and output referred to the measurement bandwith (ON).

The measurement results are output with `CALCulate:MARKer:FUNCtion:POWer:RESult?`

Note:
This function is not available during active GSM measurements.

Parameter:

ON: Results output referred to measurement bandwidth.

OFF: Results output in absolute values.

Example of channel/adjacent channel measurement:

`"SENS2:POW:ACH:ACP 3"`	Sets the number of adjacent channels in screen B to 3.
`"SENS2:POW:ACH:BAND 30KHZ"`	Sets the bandwidth of the main channel to 30 kHz.
`"SENS2:POW:ACH:BAND:ACH 40KHZ"`	Sets the bandwidth of all adjacent channels to 40 kHz.
`"SENS2:POW:ACH:BAND:ALT1 50KHZ"`	Sets the bandwidth of all alternate adjacent channels to 50 kHz.
`"SENS2:POW:ACH:BAND:ALT2 60KHZ"`	Sets the bandwidth of alternate adjacent channel 2 to 60 kHz.
`"SENS2:POW:ACH:SPAC 30KHZ"`	Sets the spacing between channel and adjacent channel as well as between all adjacent channels to 30 kHz.
`"SENS2:POW:ACH:SPAC:ALT1 40KHZ"`	Sets the spacing between adjacent channel and alternate adjacent channel as well as between all alternate adjacent channels to 40 kHz.
`"SENS2:POW:ACH:SPAC:ALT2 50KHZ"`	Sets the spacing between alternate adjacent channel 1 and alternate adjacent channel 2 to 50 kHz.
`"SENS2:POW:ACH:MODE ABS"`	Switches on absolute power measurement.
`"CALC2:MARK:FUNC:POW:SEL ACP"`	Switches the adjacent channel power measurement in screen B.
`"INIT:CONT OFF"`	Switches to single-sweep mode.
`"INIT;*WAI"`	Starts a sweep and waits for the end.
`"CALC2:MARK:FUNC:POW:RES:PHZ ON"`	Output of results referred to the channel bandwidth.
`"CALC2:MARK:FUNC:POW:RES? ACP"`	Queries the result of the adjacent channel power measurement in screen B referred to the channel bandwidth.

If only the **channel power** is to be measured, all commands for defining the bandwidths of adjacent channels as well as the channel spacings are not necessary. The number of adjacent channels is set to 0 with `SENS2:POW:ACH:ACP 0`.

Characteristics: *RST value: -
SCPI: device-specific

Mode: A-F

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:POWer[:STATe] OFF

This command switches off the power measurement in the selected measurement window.

Note: *This function is not available during active GSM measurements.*

Example: "CALC:MARK:FUNC:POW OFF" Switches off the power measurement in screen B.

Characteristics: *RST value: -
SCPI: device-specific

Mode: A-F

This command is an event and is therefore not assigned an *RST value.

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:POWer:PRESet NADC | TETRA | PDC | PHS | CDPD | FWCDma | RWCDma | F8CDma | R8CDma | F19Cdma | R19Cdma | FW3Gppcdma | RW3Gppcdma | D2CDma | S2CDma | M2CDma | FIS95A | RIS95A | FIS95C0 | RIS95C0 | FJ008 | RJ008 | FIS95C1 | RIS95C1 | NONE

This command selects the power measurement setting for a standard in the indicated measurement window and previously switches on the corresponding measurement, if required. The function is independent of the marker selection, ie the numeric suffix <1 to 4> of MARKer is irrelevant.

The configuration for a standard comprises of the parameters weighting filter, channel bandwidth and spacing, resolution and video bandwidth, as well as detector and sweep time.

Meaning of the CDMA standard abbreviations:

FIS95A, F8CDma	CDMA IS95A forward
RIS95A, R8CDma	CDMA IS95A reverse
FJ008, F19CDma	CDMA J-STD008 forward
RJ008, R19CDma	CDMA J-STD008 reverse
FIS95C0	CDMA IS95C Class 0 forward
RIS95C0	CDMA IS95C Class 0 reverse
FIS95C1	CDMA IS95C Class 1 forward
RIS95C1	CDMA IS95C Class 1 reverse
FWCDma	W-CDMA 4.096 MHz forward
RWCDma	W-CDMA 4.096 MHz reverse
FW3Gppcdma	W-CDMA 3.84 MHz forward
RW3Gppcdma	W-CDMA 3.84 MHz reverse
D2CDma	CDMA 2000 direct sequence
S2CDma	CDMA 2000 MC1 multi carrier with 1 carrier
M2CDma	CDMA 2000 MC3 multi carrier with 3 carriers

Note: *The settings for standards IS95A and C differ as far as the calculation method of channel spacings is concerned. For IS95A and J-STD008 the spacing is calculated from the center of the main channel to the center of the corresponding adjacent channel, for IS95C from the center of the main channel to the nearest border of the adjacent channel.*

This function is not available during active GSM measurements.

Example: "CALC2:MARK:FUNC:POW:PRES NADC" selects the standard setting for NADC in screen B

Characteristics: *RST value: -
SCPI: device-specific

Mode: A-F

CALCulate:MARKer:FUNCtion:STRack Subsystem

COMMAND	PARAMETERS	UNIT	COMMENT
CALCulate<1|2>			
:MARKer			
:FUNCtion			
:STRack			
[:STATe]	<Boolean>		
:BANDwidth	<numeric_value>	HZ	
:BWIDth	<numeric_value>	HZ	
:THReshold	<numeric_value>	DBM	
:TRACe	<numeric_value>		

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:STRack[:STATe] ON | OFF

This command switches the signal-track function on or off for the the selected measurement window. The function is independent of the selected marker, ie the numeric suffix <1 to 4> of MARKer is irrelevant.

With signal track activated, the maximum signal is determined after each frequency sweep and the center frequency is set to the frequency of this signal. Thus with drifting signals the center frequency follows the signal.

Example: `"CALC:MARK:FUNC:STR ON"` Switches on the signal track function for screen A.

Characteristics: *RST value: OFF
SCPI: device-specific

Mode: A-F, MS

CALCulate<1|2>:MARKer<1...4>:FUNCtion:STRack:BANDwidth 10Hz to MAX(SPAN)
CALCulate<1|2>:MARKer<1...4>:FUNCtion:STRack:BWIDth 10Hz to MAX(SPAN)

These commands have the same function. For the selected measurement window they define the bandwidth around the center frequency within which the largest signal is searched. The function is independent of the selected marker, ie the numeric suffix <1 to 4> of MARKer is irrelevant. It is only available in the frequency domain (span > 0).

Note:
The entry of the search bandwidth is only possible if the Signal Track function is switched on (`CALC:MARK:FUNC:STR ON`).

Example: `"CALC:MARK:FUNC:STR:BAND 1MHZ"` Sets the search bandwidth for screen A to 1 MHz.

`"CALC:MARK:FUNC:STR:BWID 1MHZ"` Alternative command for the same function.

Characteristics: *RST value: -- (= span/10 on activating the function)
SCPI: device-specific

Mode: A-F, MS

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:STRack:THReshold -330dBm to +30dBm

This command defines the threshold above which the largest signal is searched for in the selected measurement window. The function is independent of the selected marker, ie the numeric suffix <1 to 4> of MARKer is irrelevant. It is only available in the frequency domain (span > 0)..

The response unit depends on the settings defined with `CALC:UNIT`.

Note:
The entry of the search bandwidth is only possible if the Signal Track function is switched on (`CALC:MARK:FUNC:STR ON`).

Example: "`CALC:MARK:FUNC:STR:THR -50DBM`" Sets the threshold for signal tracking in screen A to -50 dBm.

Characteristics: *RST value: -120 dBm
SCPI: device-specific

Mode: A-F, MS

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:STRack:TRACe 1 to 3

This command defines the trace on which the largest signal is searched for in the selected measurement window. The function is independent of the selected marker, ie the numeric suffix <1 to 4> of MARKer is irrelevant. It is only available in the frequency domain (span > 0).

Example: "`CALC2:MARK:FUNC:STR:TRAC 3`" Defines trace 3 in screen B as the trace for signal tracking.

Characteristics: *RST value: 1
SCPI: device-specific

Mode: A-F, MS

CALCulate:MARKer:FUNCtion:SUMMary Subsystem

This subsystem contains the commands for controlling the time domain power functions. These are provided in the marker subsytem for reasons of compatibility with the FSE family.

COMMAND	PARAMETERS	UNIT	COMMENT
CALCulate<1|2>			
:MARKer			
:FUNCtion			
:SUMMary			
[:STATe]	<Boolean>		
:PPEak			
[:STATe]	<Boolean>		
:RESult?			query only
:AVERage			
:RESult?			query only
:PHOLd			
:RESult?			query only
:RMS			
[:STATe]	<Boolean>		
:RESult?			query only
:AVERage			
:RESult?			query only
:PHOLd			
:RESult?			query only
:MEAN			
[:STATe]	<Boolean>		
:RESult?			query only
:AVERage			
:RESult?			query only
:PHOLd			
:RESult?			query only
:SDEViation			
[:STATe]	<Boolean>		
:RESult?			query only
:AVERage			
:RESult?			query only
:PHOLd			
:RESult?			query only
:PHOLd	<Boolean>		
:AVERage	<Boolean>		
:MODE	ABSolute|RELative		
:REFerence			
:AUTO	ONCE		
:AOFF			no query

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary[:STATe] ON | OFF

This command switches on or off the previously selected time domain power measurements. Thus one or several measurements can be first selected and then switched on and off together with `CALC:MARK:FUNC:SUMMary:STATe`.

The function is independent of the marker selection, ie the suffix of MARKer is irrelevant. It is only available in the time domain (span = 0).

Example: `"CALC:MARK:FUNC:SUMM:STAT ON"`

Characteristics: *RST value: OFF
SCPI: device-specific

Mode: A-T, MS

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:PPEak[:STATe] ON | OFF

This command switches on or off the measurement of the positive peak value in the selected measurement window.

The function is independent of the marker selection, ie the numeric suffix <1 to 4> of MARKer is irrelevant. It is only available in the time domain (span = 0).

Example: `"CALC:MARK:FUNC:SUMM:PPE ON"` Switches on the function in screen A.

Characteristics: *RST value: OFF
SCPI: device-specific

Mode: A-T, MS

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:PPEak:RESult?

This command is used to query the result of the measurement of the positive peak value in the selected measurement window. The measurement may have to be switched on previously.

The function is independent of the marker selection, ie the numeric suffix <1 to 4> of MARKer is irrelevant. It is only available in the time domain (span = 0).

A complete sweep with synchronization to sweep end must be performed between switching on the function and querying the measured value to obtain a valid query result. This is only possible in single sweep mode.

Example:

`"INIT:CONT OFF"`	Switches to single-sweep mode.
`"CALC:MARK:FUNC:SUMM:PPE ON"`	Switches on the function in screen A.
`"INIT;*WAI"`	Starts a sweep and waits for the end.
`"CALC:MARK:FUNC:SUMM:PPE:RES?"`	Outputs the result of screen A.

Characteristics: *RST value: -
SCPI: device-specific

Mode: A-T, MS

This command is only a query and thus has no *RST value assigned.

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:PPEak:AVERage:RESult?

This command is used to query the result of the measurement of the averaged positive peak value in the selected measurement window. The query is only possible if averaging has been activated previously using `CALCulate<1|2>:MARKer<1 to 4>:FUNCtion: SUMMary:AVERage`.

The function is independent of the marker selection, ie the numeric suffix <1 to 4> in MARKer is irrelevant. It is only available in the time domain (span = 0).

A complete sweep with synchronization to sweep end must be performed between switching on the function and querying the measured value to obtain a valid query result. This is only possible in single sweep mode.

Example:	`"INIT:CONT OFF"`	Switches to single-sweep mode.
	`"CALC:MARK:FUNC:SUMM:PPE ON"`	Switches on the function in screen A.
	`"CALC:MARK:FUNC:SUMM:AVER ON"`	Switches on the calculation of average in screen A.
	`"INIT;*WAI"`	Starts a sweep and waits for the end.
	`"CALC:MARK:FUNC:SUMM:PPE:AVER:RES?"`	Outputs the result of screen A.

Characteristics: *RST value: -
SCPI: device-specific

Mode: A-T, MS

This command is only a query and thus has no *RST value assigned.

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:PPEak:PHOLd:RESult?

This command is used to query the result of the measurement of the positive peak value with active peak hold function. The query is only possible if the peak hold function has been activated previously using `CALCulate<1|2>:MARKer<1 to 4>: FUNCtion:SUMMary:PHOLd`.

The function is independent of the marker selection, ie the numeric suffix <1 to 4> of `:MARKer` is irrelevant. It is only available in the time domain (span = 0).

A complete sweep with synchronization to sweep end must be performed between switching on the function and querying the measured value to obtain a valid query result. This is only possible in single sweep mode.

Example:	`"INIT:CONT OFF"`	Switches to single-sweep mode.
	`"CALC:MARK:FUNC:SUMM:PPE ON"`	Switches on the function in screen A.
	`"CALC:MARK:FUNC:SUMM:PHOL ON"`	Switches on the measurement of the peak value in screen A.
	`"INIT;*WAI"`	Starts a sweep and waits for the end.
	`"CALC:MARK:FUNC:SUMM:PPE:PHOL:RES?"`	Outputs the result of screen A.

Characteristics: *RST value: -
SCPI: device-specific

Mode: A-T, MS

This command is only a query and thus has no *RST value assigned.

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:RMS[:STATe] ON | OFF

This command switches on or off the measurement of the effective (RMS) power in the selected measurement window. If necessary the function is switched on previously.

The function is independent of the marker selection, ie the numeric suffix <1 to 4> of `:MARKer` is irrelevant. It is only available in the time domain (span = 0).

Example:	`"CALC2:MARK:FUNC:SUM:RMS ON"`	Switches on the function in screen B.
Characteristics:	*RST value:	OFF
	SCPI:	device-specific
Mode:	A-T, MS	

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:RMS:RESult?

This command queries the result of the measurement of the RMS power value in the selected measurement window.

The function is independent of the marker selection, ie the numeric suffix <1 to 4> of `:MARKer` is irrelevant. It is only available in the time domain (span = 0).

A complete sweep with synchronization to sweep end must be performed between switching on the function and querying the measured value to obtain a valid query result. This is only possible in single sweep mode.

Example:	`"INIT:CONT OFF"`	Switches to single-sweep mode.
	`"CALC:MARK:FUNC:SUMM:RMS ON"`	Switches on the function in screen A.
	`"INIT;*WAI"`	Starts a sweep and waits for the end.
	`"CALC:MARK:FUNC:SUMM:RMS:RES?"`	Outputs the result of screen A.
Characteristics:	*RST- value:	-
	SCPI:	device-specific
Mode:	A-T, MS	

This command is only a query and thus has no *RST value assigned.

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:RMS:AVERage:RESult?

This command queries the result of the measurement of the averaged RMS value in the selected measurement window. The query is only possible if averaging has been activated previously using `CALCulate<1|2>:MARKer<1 to 4>:FUNCtion: SUMMary:AVERage`.

The function is independent of the marker selection, ie the numeric suffix <1 to 4> of `:MARKer` is irrelevant. It is only available in the time domain (span = 0).

A complete sweep with synchronization to sweep end must be performed between switching on the function and querying the measured value to obtain a valid query result. This is only possible in single sweep mode.

Example:	`"INIT:CONT OFF"`	Switches to single-sweep mode.
	`"CALC:MARK:FUNC:SUMM:RMS ON"`	Switches on the function in screen A.
	`"CALC:MARK:FUNC:SUMM:AVER ON"`	Swtiches on the average value calculation in screen A.
	`"INIT;*WAI"`	Starts a sweep and waits for the end.
	`"CALC:MARK:FUNC:SUMM:RMS:AVER:RES?"`	Outputs the result of screen A.
Characteristics:	*RST- value:	-
	SCPI:	device-specific
Mode:	A-T, MS	

This command is only a query and thus has no *RST value assigned.

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:RMS:PHOLd:RESult?

This command queries the result of the measurement of the RMS value with active peak hold in the selected measurement window. The query is only possible only if the peak hold function has been activated previously using `CALCulate<1|2>:MARKer<1 to 4>: FUNCtion:SUMMary:PHOLd`.

The function is independent of the marker selection, ie the numeric suffix <1 to 4> of `:MARKer` is irrelevant. It is only available in the time domain (span = 0).

A complete sweep with synchronization to sweep end must be performed between switching on the function and querying the measured value to obtain a valid query result. This is only possible in single sweep mode.

Example:

"INIT:CONT OFF"	Switches to single-sweep mode.
"CALC:MARK:FUNC:SUMM:RMS ON"	Switches on the function in screen A.
"CALC:MARK:FUNC:SUMM:PHOL ON"	Switches on the peak value measurement in screen A.
"INIT;*WAI"	Starts a sweep and waits for the end.
"CALC:MARK:FUNC:SUMM:RMS:PHOL:RES?"	Outputs the result of screen A.

Characteristics: *RST- value: -
SCPI: device-specific

Mode: A-T, MS

This command is only a query and thus has no *RST value assigned.

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:MEAN[:STATe] ON | OFF

This command switches on or off the measurement of the mean value in the selected measurement window.

The function is independent of the marker selection, ie the numeric suffix <1 to 4> of `:MARKer` is irrelevant. It is only available in the time domain (span = 0)..

Note: *The measurement is performed on the trace on which marker 1 is positioned. In order to evaluate another trace, marker 1 must be positioned on another trace with* `CALC:MARK:TRAC 1|2|3`.

Example: "CALC:MARK:FUNC:SUMM:MEAN ON" Switches on the function in screen A.

Characteristics: *RST value: OFF
SCPI: device-specific

Mode: A-T, MS

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:MEAN:RESult?

This command queries the result of the measurement of the mean value in the selected measurement window. The function is independent of the marker selection, ie the numeric suffix <1 to 4> of `:MARKer` is irrelevant. It is only available in the time domain (span = 0).

A complete sweep with synchronization to sweep end must be performed between switching on the function and querying the measured value to obtain a valid query result. This is only possible in single sweep mode.

Example:	"INIT:CONT OFF"	Switches to single-sweep mode.
	"CALC:MARK:FUNC:SUMM:MEAN ON"	Switches on the function in screen A.
	"INIT;*WAI"	Starts a sweep and waits for the end.
	"CALC:MARK:FUNC:SUMM:MEAN:RES?"	Outputs the result of screen A.
Characteristics:	*RST- value:	-
	SCPI:	device-specific
Mode:	A-T, MS	

This command is only a query and thus has no *RST value assigned.

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:MEAN:AVERage:RESult?

This command queries the result of the measurement of the averaged mean value in the selected measurement window. The query is only possible if averaging has been activated previously using `CALCulate<1|2>:MARKer<1 to 4>:FUNCtion: SUMMary:AVERage`.

The function is independent of the marker selection, ie the numeric suffix <1 to 4> of `:MARKer` is irrelevant. It is only available in the time domain (span = 0).

A complete sweep with synchronization to sweep end must be performed between switching on the function and querying the measured value to obtain a valid query result. This is only possible in single sweep mode.

Example:	"INIT:CONT OFF"	Switches to single-sweep mode.
	"CALC:MARK:FUNC:SUMM:MEAN ON"	Switches on the function in screen A.
	"CALC:MARK:FUNC:SUMM:AVER ON"	Switches on the average value calculation in screen A.
	"INIT;*WAI"	Starts a sweep and waits for the end.
	"CALC:MARK:FUNC:SUMM:MEAN:AVER:RES?"	Outputs the result of screen A.
Characteristics:	*RST- value:	-
	SCPI:	device-specific
Mode:	A-T, MS	

This command is only a query and thus has no *RST value assigned.

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:MEAN:PHOLd:RESult?

This command queries the result of the measurement of the mean value with active peak hold in the selected measurement window. The query is only possible if the peak hold function has been switched on previously using `CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:PHOLd`.

The query is possible only if the peak hold function is active. The function is independent of the marker selection, ie the numeric suffix <1 to 4> of `:MARKer` is irrelevant. It is only available in the time domain (span = 0).

A complete sweep with synchronization to sweep end must be performed between switching on the function and querying the measured value to obtain a valid query result. This is only possible in single sweep mode.

Example:	`"INIT:CONT OFF"`	Switches to single-sweep mode
	`"CALC:MARK:FUNC:SUMM:MEAN ON"`	Switches on the function in screen A
	`"CALC:MARK:FUNC:SUMM:PHOL ON"`	Switches on the peak value measurement in screen A
	`"INIT;*WAI"`	Starts a sweep and waits for the end
	`"CALC:MARK:FUNC:SUMM:MEAN:PHOL:RES?"`	Outputs the result of screen A.

Characteristics: *RST- value: -
SCPI: device-specific

Mode: A-T, MS

This command is only a query and thus has no *RST value assigned.

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:SDEViation[:STATe] ON | OFF

This command switches on or off the measurement of the standard deviation in the selected measurement window.The function is independent of the marker selection, ie the numeric suffix <1 to 4> of `:MARKer` is irrelevant. It is only available in the time domain (span = 0)..

On switching on the measurement, the mean power measurement is switched on as well.

Example:	`"CALC2:MARK:FUNC:SUMM:SDEV ON"`	Switches on the measurement of the standard deviation in screen B.

Characteristics: *RST value: OFF
SCPI: device-specific

Mode: A, MS

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:SDEViation:RESult?

This command queries the results of the standard deviation measurement. The function is independent of the marker selection, ie the numeric suffix <1 to 4> of `:MARKer` is irrelevant. It is only available in the time domain (span = 0).

A complete sweep with synchronization to sweep end must be performed between switching on the function and querying the measured value to obtain a valid query result. This is only possible in single sweep mode.

Example:

"INIT:CONT OFF"	Switches to single-sweep mode.
"CALC:MARK:FUNC:SUMM:SDEV ON"	Switches on the function in screen A.
"INIT;*WAI"	Starts a sweep and waits for the end.
"CALC:MARK:FUNC:SUMM:SDEV:RES?"	Outputs the result of screen A.

Characteristics: *RST value: -
SCPI: device-specific

Mode: A-T, MS

This command is only a query and thus has no *RST value assigned.

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:SDEViation:AVERage:RESult?

This command queries the result of the averaged standard deviation determined in several sweeps in the selected measurement window. The query is possible only if averaging is active. The function is independent of the marker selection, ie the numeric suffix <1 to 4> of `:MARKer` is irrelevant. It is only available in the time domain (span = 0).

A complete sweep with synchronization to sweep end must be performed between switching on the function and querying the measured value to obtain a valid query result. This is only possible in single sweep mode.

Example:

"INIT:CONT OFF"	Switches to single-sweep mode.
"CALC:MARK:FUNC:SUMM:SDEV ON"	Switches on the function in screen A.
"CALC:MARK:FUNC:SUMM:AVER ON"	Switches on the calculation of average in screen A.
"INIT;*WAI"	Starts a sweep and waits for the end.
"CALC:MARK:FUNC:SUMM:MEAN:SDEV:RES?"	Outputs the result of screen A.

Characteristics: *RST value: -
SCPI: device-specific

Mode: A-T, MS

This command is only a query and thus has no *RST value assigned.

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:SDEViation:PHOLd:RESult?

This command queries the maximum standard deviation value determined in several sweeps in the selected measurement window. The query is possible only if the peak hold function is active.

The function is independent of the marker selection, ie the numeric suffix <1 to 4> of `:MARKer` is irrelevant. It is only available in the time domain (span = 0).

A complete sweep with synchronization to sweep end must be performed between switching on the function and querying the measured value to obtain a valid query result. This is only possible in single sweep mode.

Example:

"INIT:CONT OFF"	Switches to single-sweep mode.
"CALC:MARK:FUNC:SUMM:SDEV ON"	Switches on the function in screen A.
"CALC:MARK:FUNC:SUMM:PHOL ON"	Switches on the peak value measurement in screen A.
"INIT;*WAI"	Starts a sweep and waits for the end.
"CALC:MARK:FUNC:SUMM:SDEV:PHOL:RES?"	Outputs the result of screen A.

Characteristics: *RST value: -
SCPI: device-specific

Mode: A-T, MS

This command is only a query and thus has no *RST value assigned.

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:PHOLd ON | OFF

This command switches on or off the peak-hold function for the active time domain power measurement in the indicated measurement window. The function is independent of the marker selection, ie the numeric suffix <1 to 4> of `:MARKer` is irrelevant. It is only available in the time domain (span = 0).

The peak-hold function is reset by switching it off and on again.

Example: "CALC:MARK:FUNC:SUMM:PHOL ON" Switches on the function in screen A.

Characteristics: *RST value: OFF
SCPI: device-specific

Mode: A-T, MS

The peak-hold function is reset by switching off and on, again.

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:AVERage ON | OFF

This command switches on or off averaging for the active time domain power measurement in the indicated window. The function is independent of the marker selection, ie the numeric suffix <1 to 4> of `:MARKer` is irrelevant. It is only available in the time domain (span = 0).

Averaging is reset by switching it off and on again.

The number of results required for the calculation of average is defined with `[SENSe<1|2>:]AVERage:COUNt`.

It should be noted that synchronization to the end of averaging is only possible in single sweep mode.

Example:	`"INIT:CONT OFF"`	Switches to single-sweep mode.
	`"CALC2:MARK:FUNC:SUMM:AVER ON"`	Switches on the calculation of average in screen B.
	`"AVER:COUN 200"`	Sets the measurement counter to 200.
	`"INIT;*WAI"`	Starts a sweep and waits for the end.

Characteristics: *RST value: OFF
SCPI: device-specific

Mode: A-T, MS

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:MODE ABSolute | RELative

This command selects absolute or relative time domain power measurement in the indicated measurement window. The function is independent of the marker selection, ie the numeric suffix <1 to 4> of `:MARKer` is irrelevant. It is only available in the time domain (span = 0).

The reference power for relative measurement is defined with `CALCulate:MARKer:FUNCtion:SUMMary:REFerence:AUTO ONCE`. If the reference power is not defined, the value 0 dBm is used.

Example: `"CALC:MARK:FUNC:SUMM:REF:MODE REL"`
Switches the time domain power measurement to relative.

Characteristics: *RST value: ABSolute
SCPI: device-specific

Mode: A-T, MS

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:REFerence:AUTO ONCE

With this command the currently measured average value (`..:SUMMary:MEAN`) and RMS value (`..:SUMMary:RMS`) are declared as reference values for relative measurements in the indicated measurement window. The function is independent of the marker selection, ie the numeric suffix <1 to 4> of `:MARKer` is irrelevant. It is only available in the time domain (span = 0).

If the measurement of RMS value and average is not activated, the reference value 0 dBm is used.

If the function `...:SUMMary:AVERage` or `...:SUMMary:PHOLd` is switched on, the current value is the accumulated measurement value at the time considered.

Example: `"CALC:MARK:FUNC:SUMM:REF:AUTO ONCE"`
Takes the currently measured power in screen A as reference value for the relative time domain power measurement.

Characteristics: *RST value: -
SCPI: device-specific

Mode: A-T, MS

This command is an event and therefore has no *RST value assigned and has no query.

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:AOFF

This command switches off all time domain measurements in the selected measurement window.The function is independent of the marker selection, ie the numeric suffix <1 to 4> of `:MARKer` is irrelevant. It is only available in the time domain (span = 0).

Example: `"CALC2:MARK:FUNC:SUMM:AOFF"` Switches off the time domain power measurement functions in screen B.

Characteristics: *RST value: –
SCPI: device-specific

Mode: A-T, MS

This command is an event and therefore has no *RST value assigned and has no query.

CALCulate:MATH Subsystem

The CALCulate:MATH subsystem allows to process data from the SENSe-subsystem in numeric expressions. The measurement windows are selected by CALCulate1 (screen A) or CALCulate2 (screen B).

COMMAND	PARAMETERS	UNIT	COMMENT
CALCulate<1|2>			
:MATH			
[:EXPRession]			
[:DEFine]	<expr>	--	
:POSition	<numeric_value>	PCT	
:STATe	<Boolean>	--	
:MODE	LINear | LOGarithmic	--	

CALCulate<1|2>:MATH[:EXPression][:DEFine] <expr>

This command defines the mathematical expression for relating traces to trace1.

The zero point of the result display can be defined with `CALC:MATH:POS`. Command `CALCulate:MATH:STATe` switches the mathematical relation of traces on or off .

Parameter: <expr>::= 'OP1 - OP2'
OP1 ::= TRACE1
OP2 ::= TRACE2 | TRACE3

Example: `"CALC1:MATH (TRACE1 - TRACE2)"` Selects the subtraction of trace 1 from trace 2 in screen A.

`"CALC2:MATH (TRACE1 - TRACE3)"` Selects the subtraction of trace 1 from trace 3 in screen B.

Characteristics: *RST value: -
SCPI: conforming

Mode: A, MS

CALCulate<1|2>:MATH:POSition -100PCT to 200PCT

This command defines the position of the result of the trace mathematics in the selected measurement window. The indication is in % of the screen height, with 100% corresponding to the upper diagram border.

Example: `"CALC:MATH:POS 50PCT"` Sets the position in screen A to the horizontal diagram center.

Characteristics: *RST value: 50 %
SCPI: device-specific

Mode: A, MS

CALCulate<1|2>:MATH:STATe ON | OFF

This command switches the mathematical relation of traces on or off.

Example: `"CALC:MATH:STAT ON"` Switches on the trace mathematics in screen A.

Characteristics: *RST value: OFF
SCPI: conforming

Mode: A, MS

CALCulate<1|2>:MATH:MODE LINear | LOGarithmic

This command selects linear or logarithmic (= video) calculation of the mathematical functions related to the traces. The calculation of the average is one of the affected functions. The setting is valid for all measurement windows, ie the numeric suffix `<1|2>` of `CALCulate` is irrelevant.

Example: `"CALC:MATH:MODE LIN"` Switches on the linear calculation.

Characteristics: *RST value: LOG
SCPI: device-specific

Mode: A, MS

CALCulate:STATistics Subsystem

The CALCulate:STATistics subsystem controls the statistical measurement functions in the instrument. The measurement window cannot be selected with these functions. The numeric suffix in CALCulate is therefore ignored.

Note:
The functions of this subsystem are not available during GSM measurements.

COMMAND	PARAMETERS	UNIT	COMMENT
CALCulate			
:STATistics			
:APD			
[:STATe]	<Boolean>	--	
:CCDF			
[:STATe]	<Boolean>	--	
:NSAMples	<numeric_value>		
:SCALe			
:AUTO	ONCE		
:X			
:RLEVel	<numeric_value>	DBM	
:RANGe	<numeric_value>	DB	
:Y			
:UPPer	<numeric_value>		
:LOWer	<numeric_value>		
:PRESet			
:RESult<1 to 3>?	MEAN | PEAK | CFACtor | ALL		query only

CALCulate:STATistics:APD[:STATe] ON | OFF

This command switches on or off the measurement of amplitude distribution (APD). On activating this function, the CCDF measurement is switched off.

Example: "`CALC:STAT:APD ON`" Switches on the APD measurement.

Characteristics: *RST value: OFF
SCPI: device-specific

Mode: A

CALCulate:STATistics:CCDF[:STATe] ON | OFF

This command switches on or off the measurement of the complementary cumulative distribution function (CCDF). On activating this function, the APD measurement is switched off.

Example: "`CALC:STAT:CCDF ON`" Switches on the `CCDF` measurement.

Characteristics: *RST value: OFF
SCPI: device-specific

Mode: A

CALCulate:STATistics:NSAMples 100 to 1E9

This command sets the number of measurement points to be acquired for the statistical measurement functions.

Example: "CALC:STAT:NSAM 500" Sets the number of measurement points to be acquired to 500.

Characteristics: *RST value: 100000
SCPI: device-specific

CALCulate:STATistics:SCALe:AUTO ONCE

This command optimizes the level setting of the instrument depending on the measured peak power, in order to obtain maximum instrument sensitivity.

To obtain maximum resolution, the level range is set as a function of the measured spacing between peak power and the minimum power for the APD measurement and of the spacing between peak power and mean power for the CCDF measurement. In addition, the probability scale for the number of test points is adapted.

Note:
*Subsequent commands have to be synchronized with *WAI, *OPC or *OPC? to the end of the autorange process which would otherwise be aborted.*

Example: "CALC:STAT:SCAL:AUTO ONCE;*WAI" Adapts the level setting for statistical measurements.

Characteristics: *RST value: --
SCPI: device-specific

Mode: A

This command is an event and therefore has no *RST value assigned and has no query.

CALCulate:STATistics:SCALe:X:RLEVel -130dBm to 30dBm

This command defines the reference level for the X-axis of the measurement diagram. The setting is identical to the reference level setting using the command `DISPlay:WINDow:TRACe:Y: RLEVel`.

With the reference level offset <> 0 the indicated value range of the reference level is modified by the offset.

The unit depends on the setting performed with `CALC:UNIT`.

Example: "CALC:STAT:SCAL:X:RLEV -60dBm"

Characteristics: *RST value: -20dBm
SCPI: device-specific

Mode: A

CALCulate:STATistics:SCALe:X:RANGe 10dB to 200dB

This command defines the level range for the X-axis of the measurement diagram. The setting is identical to the level range setting defined with the command `DISPlay:WINDow:TRACe:Y:SCALe`.

Example: "CALC:STAT:SCAL:X:RANG 20dB"

Characteristics: *RST value: 100dB
SCPI: device-specific

Mode: A

CALCulate:STATistics:SCALe:Y:UPPer 1E-8 to 1.0

This command defines the upper limit for the Y-axis of the diagram in statitistical measurements. Since probabilities are specified on the Y-axis, the entered numerical values are dimensionless.

Example: "CALC:STAT:Y:UPP 0.01"

Characteristics: *RST value: 1.0
SCPI: device-specific

Mode: A

CALCulate:STATistics:SCALe:Y:LOWer 1E-9 to 0.1

This command defines the lower limit for th Y-axis of the diagram in statistical measurements. Since probabilities are specified on the Y-axis, the entered numerical values are dimensionless.

Example: "CALC:STAT:SCAL:Y:LOW 0.001"

Characteristics: *RST value: 1E-6
SCPI: device-specific

Mode: A

CALCulate:STATistics:PRESet

This command resets the scaling of the X- and Y-axes in a statistical measurement. The following values are set:

X-axis ref level: -20 dBm
X-axis range APD: 100 dB
X-axis range CCDF: 20 dB

Y-axis upper limit: 1.0
Y-axis lower limit: 1E-6

Example: "CALC:STAT:PRES" Resets the scaling for statistical functions

Characteristics: *RST value: --
SCPI: device-specific

Mode: A

This command is an event and therefore has no *RST value assigned and has no query.

CALCulate:STATistics:RESult<1 to 3>? MEAN | PEAK | CFACtor | ALL

This command reads out the results of statistical measurements of a recorded trace. The trace is selected with the numeric suffix <1 to 3> attached to RESult.

Parameter: The required result is selected via the following parameters:

MEAN Average (=RMS) power in dBm measured during the measurement time.

PEAK Peak power in dBm measured during the measurement time.

CFACtor Determined CREST factor (= ratio of peak power to average power) in dB.

ALL Results of all three measurements mentioned before, separated by commas:
<mean power>,<peak power>,<crest factor>

Example: "CALC:STAT:RES2? ALL" Reads out the three measurement results of trace 2. Example of answer string:
5.56,19.25,13.69
ie mean power: 5.56 dBm, peak power 19.25 dBm, CREST factor 13.69 dB

Characteristics: *RST value: --
SCPI: device-specific

Mode: A

CALCulate:THReshold Subsystem

The CALCulate:THReshold subsystem controls the threshold value for the maximum/minimum search of markers. The measurement windows are selected by CALCulate 1 (screen A) or 2 (screen B).

COMMAND	PARAMETERS	UNIT	COMMENT
CALCulate<1|2>			
:THReshold	<numeric_value>	DBM | DB	
:STATe	<Boolean>		

CALCulate<1|2>:THReshold MINimum to MAXimum (depending on current unit)

This command defines the threshold value for the maximum/minimum search of markers with marker search functions MAX PEAK, NEXT PEAK, etc. in the selected measurement window. The associated display line is automatically switched on.

Example: "CALC:THR -82DBM" Sets the threshold value for screen A to -82 dBm.

Characteristics: *RST value: - (STATe to OFF)
SCPI: device-specific

Mode: A, MS

CALCulate<1|2>:THReshold:STATe ON | OFF

This command switches on or off the threshold line in the selected measurement window.The unit depends on the setting performed with CALC:UNIT.

Example: "CALC2:THR:STAT ON" Switches on the threshold line in screen B.

Characteristics: *RST value: OFF
SCPI: device-specific

Mode: A, MS

CALCulate:UNIT Subsystem

The CALCulate:Unit subsystem defines the units for power measurement settings.

COMMAND	PARAMETERS	UNIT	COMMENT
CALCulate<1|2>			
:UNIT			
:POWer	DBM | V | A | W | DBPW | WATT | DBUV | DBMV | VOLT | DBUA | AMPere		

CALCulate<1|2>:UNIT:POWer DBM | V | A | W | DBPW | WATT | DBUV | DBMV | VOLT | DBUA | AMPere

This command selects the unit for power in the selected measurement window.

Note:
This function is not available during active GSM measurements.
During GSM measurements the unit is either dBm (power measurements) or deg (phase error measurements).

Example: "CALC:UNIT:POW DBM" Sets the power unit for screen A to dBm.

Characteristics: *RST value: dBm
SCPI: device-specific

Mode: A

CALibration Subsystem

The commands of the CALibration subsystem determine the data for system error correction in the instrument.

COMMAND	PARAMETERS	UNIT	COMMENT
CALibration			
[:ALL]?	--	--	query only
:ABORt	--	--	no query
:RESult?	--	--	query only
:STATe	<Boolean>	--	

CALibration[:ALL]?

This command initiates the acquisition of system error correction data. A "0" is returned if the acquisition was successful.

Note: *During the acquisition of correction data the instrument does not accept any remote control commands, except*
**RST*
CALibration:ABORt

In order to recognize when the acquisition of correction data is completed, the MAV bit in the status byte can be used. If the associated bit is set in the Service Request Enable Register, the instrument generates a service request after the acquisition of correction data has been completed.

Example:	`"*CLS"`	Resetting the status management.
	`"*SRE 16"`	Enable MAV bit in the Service Request Enable Register.
	`"*CAL?"`	Starts the correction data recording and then a service request is generated.

Characteristics: *RST value: -
SCPI: conforming

Mode: all

CALibration:ABORt

This command aborts the acquisition of correction data and restores the last complete correction data set.

Example: `"CAL:ABOR"`

Characteristics: *RST value: -
SCPI: device-specific

Mode: all

This command is an event and therefore has no *RST value assigned and has no query.

CALibration:RESult?

This command outputs the results of the correction data acquisition. The lines of the result table (see section "Recording the correction data of FSU – *CAL* key") are output as string data separated by commas:

```
"Total Calibration Status: PASSED","Date (dd/mm/yyyy): 12/07/1999",
"Time: 16:24:54","Runtime:00.06"
```

Example: "CAL:RES?"

Characteristics: *RST value: --
SCPI: device-specific

Mode: all

CALibration:STATe ON | OFF

This command determines whether the current calibration data are taken into account by the instrument (ON) or not (OFF).

Example: "CAL:STAT OFF" Sets up the instrument to ignore the calibration data.

Characteristics: *RST value: -
SCPI: conforming

Mode: all

CONFigure – Subsystem

The CONFigure subsystem contains commands for configuring complex measurement tasks, like those provided by the options GSM MS Analyzer (FS-K5). The CONFigure subsystem is closely linked to the functions of the FETCH and READ subsystems, where the measurement cycles are started and/or the results of the measurements are queried.

The purpose of the following commands is configuring the GSM MS Analyzer mode (Option FS-K5) for mobiles corresponding to the standards P-GSM, E-GSM, R-GSM, DCS1800 or PCS1900.

Note:
Besides the notation `CONFigure:<command>` the FSP supports also the notation `CONFigure:MS:<command>` for reasons of compatibility with the FSE-family.
Besides the notation CONFigure:<command> the FSU supports also the notation CONFigure:MS:<command> for reasons of compatibility with the FSE-family.

COMMAND	PARAMETERS	UNIT	COMMENT
CONFigure			Option FS-K5
:CHANnel			
:TSC	<numeric_value>	--	
:RESTore	--	--	no query

CONFigure:CHANnel:TSC <numeric_value>

This command selects the midamble used by the mobile.
It is only available with the GSM MS Analyzer FS-K5 option.

Note:
The selected midamble is only regarded in the phase-frequency error and power vs. time measurement.

Parameter: <numeric_value> ::= 0...7 (training sequence for the Normal Burst)

Example:
`"INST MGSM"` Switches the instrument to GSM MS mode
`"CONF:CHAN:TSC 3"` Selects TSC 3

Characteristics: *RST-Wert: 0
SCPI: device-specific

Mode: MS

CONFigure:RESTore

This command restores the GSM limit lines. All previous changesto the GSM limit lines are lost, and the default Limit Lines from the delivery state are restored.
This command is only available with GSM MS Analyzer FS-K5 option .

Example:
`"INST MGSM"` Switches the instrument to GSM MS mode
`"CONF:REST"` Set the GSM limit lines to default

Characteristics: *RST-Wert: --
SCPI: device-specific

Mode: A, MS

This command is an event and is therefore not assigned a query and has no *RST value.

CONFigure:BURSt - Subsystem

This subsystem provides the commands for configuring the measurements in the GSM MS Analyzer mode (option FS-K5) which are performed on individual bursts. (carrier power, phase-frequency error, power vs. time).

COMMAND	PARAMETERS	UNIT	COMMENT
CONFigure			Option FS-K5
:BURSt			
:PFERror			
[:IMMediate]	--	--	no query
:POWer			
[:IMMediate]	--	--	no query
:PTEMplate			
[:IMMediate]	--	--	no query
:SELect	FULL | TOP | RISing | FALLing	--	

CONFigure:BURSt:PFERror[:IMMediate]

This command selects measurement of the phase and frequency error of the mobile.
The analyzer is set to single sweep if the measurement is selected.
This command is only available with GSM MS Analyzer FS-K5 option .

Example:

"INST MGSM"	Switches the instrument to GSM MS mode
"CONF:BURS:PFER"	Selects the phase-frequency error measurement
"SWE:COUN 20"	Sets the sweep counter/no. of bursts
"INIT:IMM;*WAI"	Executes the measurement

Characteristics: *RST-Wert: --
SCPI: device-specific

Mode: MS

This command is an event and is therefore not assigned a query and has no *RST value.

CONFigure:BURSt:POWer[:IMMediate]

This command selects measurement of the average carrier power of the mobile.
The analyzer is set to single sweep if the measurement is selected.
This command is only available with GSM MS Analyzer FS-K5 option .

Example:

"INST MGSM"	Switches the instrument to GSM MS mode
"CONF:BURS:POW"	Selects the carrier power measurement
"SWE:COUN 20"	Sets the sweep counter/no. of bursts
"INIT:IMM;*WAI"	Executes the measurement

Characteristics: *RST-Wert: --
SCPI: device-specific

Mode: MS

This command is an event and is therefore not assigned a query and has no *RST value.

CONFigure:BURSt:PTEMplate[:IMMediate]

This command selects measurement of power of the mobile vs. time.
The analyzer is set to single sweep if the measurement is selected.
This command is only available with GSM MS Analyzer FS-K5 option .

Example:	`"INST MGSM"`	Switches the instrument to GSM MS mode
	`"CONF:BURS:PTEM"`	Selects the power vs. time measurement
	`"SWE:COUN 20"`	Sets the sweep counter/no. of bursts
	`"INIT:IMM;*WAI"`	Executes the measurement

Characteristics: *RST-Wert: --
SCPI: device-specific

Mode: MS

This command is an event and is therefore not assigned a query and has no *RST value.

CONFigure:BURSt:PTEMplate:SELect FULL | TOP | RISing | FALLing

This command defines the burst section to be measured.

FULL	: full burst	
RISing	: rising edge	
FALLing	: falling edge	
TOP	: top high resolution	(top of burst with smaller display range and therefore higher resolution on y-axis (power axis)

This command is only available with GSM MS Analyzer FS-K5 option .

Example:	`"INST MGSM"`	Switches the instrument to GSM MS mode
	`"CONF:BURS:PTEM"`	Selects the power vs. time measurement
	`"CONF:BURS:PTEM:SEL TOP"`	Selects the top high resolution mode
	`"SWE:COUN 20"`	Sets the sweep counter/no. of bursts
	`"INIT:IMM;*WAI"`	Executes the measurement

Characteristics: *RST-Wert: FULL
SCPI: device-specific

Mode: MS

CONFigure:SPECtrum - Subsystem

This subsystem provides the commands for configuring the measurements in thein the GSM MS Analyzer mode (FS-K5) used to determine the power of the spectral contributions due to modulation and switching (modulation spectrum, transient spectrum).

COMMAND	PARAMETERS	UNIT	COMMENT
CONFigure			Option FS-K5
:SPECtrum			
:MODulation			
[:IMMediate]	--	--	no query
:SWITching			
[:IMMediate]	--	--	no query

CONFigure:SPECtrum:MODulation[:IMMediate]

This command selects the measurement of the spectrum due to modulation.
The overview measurement can be started directly with the command `INITate[:IMMediate]`.
The list-measurement is to be started with the `READ:SPECtrum:MODulation[:ALL]?` command.
The analyzer is set to single sweep if the measurement is selected.
This command is only available with GSM MS Analyzer FS-K5 option .

Example:

"INST MGSM"	Switches the instrument to GSM MS mode
"CONF:SPEC:MOD"	Selects the spectrum due to modulation measurement
"SWE:COUN 20"	Sets the sweep counter/no. of bursts
"INIT:IMM;*WAI"	Executes the measurement

Characteristics: *RST-Wert: --
SCPI: device-specific

Mode: MS

This command is an event and is therefore not assigned a query and has no *RST value.

CONFigure:SPECtrum:SWITching[:IMMediate]

This command selects measurement of the spectrum due to switching transients.
The overview measurement can be started directly with the command `INITate[:IMMediate]`.
The list-measurement is to be started with the `READ:SPECtrum:SWITching[:ALL]?` command.
The analyzer is set to single sweep if the measurement is selected.
This command is only available with GSM MS Analyzer FS-K5 option .

Example:

"INST MGSM"	Switches the instrument to GSM MS mode
"CONF:SPEC:SWIT"	Selects the spectrum due to switching measurement
"SWE:COUN 20"	Sets the sweep counter/no. of bursts
"INIT:IMM;*WAI"	Executes the measurement

Characteristics: *RST-Wert: -
SCPI: device-specific

Mode: MS

This command is an event and is therefore not assigned a query and has no *RST value.

CONFigure:SPURious - Subsystem

This subsystem provides commands for configuring the measurements in the GSM MS (FS-K5) Analyzer mode used for measuring the power of spurious emissions.

COMMAND	PARAMETERS	UNIT	COMMENT
CONFigure			Option FS-K5
:SPURious			
[:IMMediate]	--	--	no query

CONFigure:SPURious[:IMMediate]

This command selects measurement of spurious emissions.
The analyzer is set to single sweep if the measurement is selected.
This command is only available with GSM MS Analyzer FS-K5 option .

Example:

"INST MGSM"	Switches the instrument to GSM MS mode
"CONF:SPUR"	Selects the spurious emission measurement
"SWE:COUN 20"	Sets the sweep counter/no. of bursts
"INIT:IMM;*WAI"	Executes the measurement

Characteristics: *RST-Wert: --
SCPI: device-specific

Mode: MS

This command is an event and is therefore not assigned a query and has no *RST value.

DIAGnostic Subsystem

The DIAGnostic subsystem contains the commands which support instrument diagnostics for maintenance, service and repair. In accordance with the SCPI standard, all of these commands are device-specific.
The measurement windows are selected by DIAGnostic1 (screen A) or DIAGnostic2 (screen B) .

COMMAND	PARAMETERS	UNIT	COMMENT
DIAGnostic<1|2>			
:SERVice			
:INPut			
[:SELect]	CALibration | RF	--	no query
:PULSed			
[:STATe]	<Boolean>		
:PRATe	<numeric_value>		
:SFUNCtion	<string>		
:NSOurce	<Boolean>		
:CSOurce			
[:POWer]	<numeric_value>	DBM	
:STESt			
:RESult?			query only

DIAGnostic<1|2>:SERVice:INPut[:SELect] CALibration | RF

This command toggles between the RF input on the front panel and the internal 128-MHz reference signal in the selected measurement window. The level of the 128-MHz signals can be selected by command `DIAG:SERV:CSOurce`.

Example: `"DIAG:SERV:INP CAL"`

Characteristics: *RST value: RF
SCPI: device-specific

Mode: all

DIAGnostic<1|2>:SERVice:INPut:PULSed[:STATe] ON | OFF

This command toggles the calibration signal in the selected measurement window between pulsed and non-pulsed. The selection takes effect only if the RF input has been set to the internal reference signal using `DIAG:SERV:INP CAL`.

Example: `"DIAG:SERV:INP CAL;`
`DIAG:SERV:INP:PULS ON"`

Characteristics: *RST value: OFF
SCPI: device-specific

Mode: all

DIAGnostic<1|2>:SERVice:INPut:PULSed:PRATe 10 kHz | 100 kHz | 1 MHz | 640 MHz

This command selects the pulse rate for the pulsed calibration signal in the selected measurement window.

Available pulse frequencies are 10 kHz, 100 kHz, 1 MHz, 128 MHz and 640 MHz.

Example: `"DIAG:SERV:INP:PRAT 128 MHz`

Characteristics: *RST value: 128 MHz
SCPI: device-specific

Mode: all

DIAGnostic<1|2>:SERVice:SFUNction <string>...

This command activates a service function which can be selected by indicating the five parameters: function group number, board number, function number, parameter 1 and parameter 2 (see service manual). The contents of the parameter string is identical to the code to be entered in the data entry field of manual operation.

The entry of a service function is accepted only if the system password Level 1 or Level 2 has been entered previously (command: `SYSTem:SECurity`).

The numeric suffix <1|2> is ignored with this command.

Note: *The service functions of the FSU family are not identical to those of the FSE family. That is why the IEC/IEEE-bus command differs in syntax and data format.*

Example: `"DIAG:SERV:SFUN '2.0.2.12.1'"`

Characteristics: *RST value: -
SCPI: device-specific

Mode: all

DIAGnostic<1|2>:SERVice:NSOurce ON | OFF

This command switches the 28-V supply of the noise source at the rear panel on or off.

The numeric suffix <1|2> is ignored with this command.

Example: `"DIAG:SERV:NSO ON"`

Characteristics: *RST value: OFF
SCPI: device-specific

Mode: all

DIAGnostic<1|2>:SERVice:CSOource[:POWer] <numeric_value>

This command switches the level of the 128 MHz reference signal source between 0 dBm and -30 dBm in the selected measurement window.

Example: `"DIAG:SERV:CSO 0DBM"`

Characteristics: *RST value: -30 dBm
SCPI: device-specific

Mode: all

DIAGnostic<1|2>:SERVice:STESt:RESult?

This command reads the results of the selftest out of the instrument. The lines of the result table are output as string data separated by commas:

```
"Total Selftest Status: PASSED","Date (dd/mm/yyyy): 09/07/1999
TIME: 16:24:54","Runtime: 00:06","...
```

The numeric suffix <1|2> is ignored with this command.

Example:	"DIAG:SERV:STES:RES?"	
Characteristics:	*RST value:	--
	SCPI:	device-specific
Mode:	all	

DISPlay Subsystem

The DISPLay subsystem controls the selection and presentation of textual and graphic information as well as of measurement data on the display.
The measurement windows are selected by WINDow1 (screen A) or WINDow2 (screen B) .

COMMAND	PARAMETERS	UNIT	COMMENT
DISPlay			
:FORMat	SINGle|SPLit		
:ANNotation			
:FREQuency	<Boolean>		
:LOGO	<Boolean>		
:PSAVe			
[:STATe]	<Boolean>		
:HOLDoff	1...60	--	
:CMAP<1...26>			
:DEFault<1|2>			
:HSL	0..1,0..1,0..1		
:PDEFined	BLACk | BLUE | BROWn | GREen | CYAN | RED | MAGenta | YELLow | WHITe | DGRAy | LGRAy | LBLUe | LGREen | LCYan | LRED | LMAGenta		
[:WINDow<1|2>]			no query
:SELect			
:TEXT			
[:DATA]	<string>		
:STATe	<Boolean>		
:TIME	<Boolean>		
:TRACe<1...3>			
:X			
[:SCALe]			
:Y			
[:SCALe]	<numeric_value>	DB	
:MODE	ABSolute | RELative		
:RLEVel	<numeric_value>	DBM	
:OFFSet	<numeric_value>	DB	
:RVALue	<numeric_value>	DB	
:RPOSition	<numeric_value>	PCT	
:SPACing	LINear|LOGarithmic	--	
:MODE	WRITe|VIEW|AVERage|MAXHold|MINHold	--	
[:STATe]	<Boolean>	--	

DISPlay:FORMat SINGle | SPLit

This command switches the measurement result display between FULL SCREEN and SPLIT SCREEN. The coupling of settings between screen A and screen B can be selected with the command `INSTrument:COUPle`.
In full-screen display the active measurement window can be selected with `DISPlay:WINDow<1|2>:SELect`.

Note: *This function is not available during active GSM measurements.*

Example: `"DISP:FORM SPL"` Switches the display to 2 measurement windows.

Characteristics: *RST value: SINGle
SCPI: device-specific

Mode: A

DISPlay:ANNotation:FREQuency ON | OFF

This command switches the X-axis annotation on or off.

Example: `"DISP:ANN:FREQ OFF"`

Characteristics: *RST value: ON
SCPI: conforming

Mode: all

DISPlay:LOGO ON | OFF

This command switches the company logo on the screen on or off.

Example: `"DISP:LOGO OFF"`

Characteristics: *RST value: ON
SCPI: device-specific

Mode: all

DISPlay:PSAVe[:STATe] ON | OFF

This command switches on or off the power-save mode of the display. With the power-save mode activated the display including backlight is completely switched off after the elapse of the response time (see command `DISPlay:PSAVe:HOLDoff`).

Note: *This mode is recommended for preserving the display especially if the instrument is exclusively operated via remote control.*

Example: `"DISP:PSAVe ON"` Switches on the power-save mode.

Characteristics: *RST value: OFF
SCPI: device-specific

Mode: all

DISPlay:PSAVe:HOLDoff 1 to 60

This command sets the holdoff time for the power-save mode of the display. The available value range is 1 to 60 minutes, the resolution 1 minute. The entry is dimensionless.

Example: `"DISP:PSAV:HOLD 30"`

Characteristics: *RST value: 15
SCPI: device-specific

Mode: all

DISPlay:CMAP<1 to 26>:DEFault<1|2>

This command resets the screen colors of all display items to their default settings. Two default settings DEFault1 and DEFault2 are available. The numeric suffix of CMAP is irrelevant.

Example: `"DISP:CMAP:DEF2"` Selects default setting 2 for setting the colors.

Characteristics: *RST value: --
SCPI: conforming

Mode: all

This command is an event and is therefore not assigned a query and has no *RST value.

DISPlay:CMAP<1 to 26>:HSL <hue>,<sat>,<lum>

This command defines the color table of the instrument.

Each numeric suffix of CMAP is assigned one or several graphical elements which can be modified by varying the corresponding color setting. The following assignment applies:

CMAP1 Background
CMAP2 Grid
CMAP3 Function field + status field + data entry text
CMAP4 Function field LED on
CMAP5 Function field LED warn
CMAP6 Enhancement label text
CMAP7 Status field background
CMAP8 Trace 1
CMAP9 Trace 2
CMAP10 Trace 3
CMAP11 Marker
CMAP12 Lines
CMAP13 Measurement status + limit check pass
CMAP14 Limit check fail
CMAP15 Table + softkey background
CMAP16 Table + softkey text
CMAP17 Table selected field text
CMAP18 Table selected field background
CMAP19 Table + data entry field opaq titlebar
CMAP20 Data entry field opaq text
CMAP21 Data entry field opaq background
CMAP22 3D shade bright part
CMAP23 3D shade dark part
CMAP24 Softkey state on
CMAP25 Softkey state data entry
CMAP26 Logo

Parameter: hue = TINT

sat = SATURATION

lum = BRIGHTNESS

The value range is 0 to 1 for all parameters.

Example: `"DISP:CMAP2:HSL 0.3,0.8,1.0"` Changes the grid color.

Characteristics: *RST value: --
SCPI: conforming

Mode: all

The values set are not changed by *RST.

DISPlay:CMAP<1 to 26>:PDEFined BLACk | BLUE | BROWn | GREen | CYAN | RED | MAGenta | YELLow | WHITe | DGRAy | LGRAy | LBLUe | LGREen | LCYan | LRED | LMAGenta

This command defines the color table of the instrument using predefined color values. Each numeric suffix of CMAP is assigned one or several graphical elements which can be modified by varying the corresponding color setting.
The same assignment as for `DISPlay:CMAP<1 to 26>:HSL` applies.

Example: `"DISP:CMAP2:PDEF GRE"`

Characteristics: *RST value: --
SCPI: conforming

Mode: all

The values set are not changed by *RST.

DISPlay[:WINDow<1|2>]:SELect

This command selects the active measurement window. WINDow1 corresponds to SCREEN A, WINDow2 to SCREEN B.
In FULL SCREEN mode, the measurements are only performed in the active measurement window. Measurements are therefore initiated in the active window and result queries (marker, trace data and other results) answered also in the active window.
Initiating measurements and querying results in the inactive window yields an error message (execution error).

In split screen mode, the selection of the active window for result queries is irrelevant.

Note: *In FULL SCREEN mode, settings can also be performed in the inactive measurement window. They become effective as soon as the corresponding window becomes active.*
The GSM option works always in `WINDow1` *(SCREEN A). This window is automatically selected during command* `INSTrument:SELect:MGSM`.

Example: `"DISP:WIND2:SEL` Selects SCREEN B as active measurement window.

Characteristics: *RST value: SCREEN A active
SCPI: device-specific

Mode: A

This command is an event and is therefore not assigned a query.

DISPlay[:WINDow<1|2>]:TEXT[:DATA] <string>

This command defines a comment (max. 20 characters) which can be displayed on the screen in the selected measurement window.

Example: `"DISP:WIND2:TEXT 'Noise Measurement'"`
Defines the title for screen B

Characteristics: *RST value: "" (empty)
SCPI: conforming

Mode: all

DISPlay[:WINDow<1|2>]:TEXT:STATe ON | OFF

This command switches on or off the display of the comment (screen title) in the selected measurement window.

Example:	"DISP:TEXT:STAT ON"	Switches on the title of screen B.
Characteristics:	*RST value: OFF SCPI: conforming	
Mode:	all	

DISPlay[:WINDow<1|2>]:TIME ON | OFF

This command switches on or off the screen display of date and time. The numeric suffix in WINDow<1| 2> is irrelevant.

Example:	"DISP:TIME ON"
Characteristics:	*RST value: OFF SCPI: device-specific
Mode:	all

DISPlay[:WINDow<1|2>]:TRACe<1 to 3>:Y[:SCALe] 10dB to 200dB

This command defines the display range of the Y-axis (level axis) in the selected measurement window with logarithmic scaling (`DISP:TRAC:Y:SPAC LOG`).

For linear scaling, (`DISP:TRAC:Y:SPAC LIN | PERC`) the display range is fixed and cannot be modified. The numeric suffix in TRACe<1 to 3> is irrelevant.

Example:	"DISP:TRAC:Y 110dB"
Characteristics:	*RST value: 100dB SCPI: device-specific
Mode:	A, MS

DISPlay[:WINDow<1|2>]:TRACe<1 to 3>:Y[:SCALe]:MODE ABSolute | RELative

This command defines the scale type of the Y-axis (absolute or relative) in the selected measurement window.

When `SYSTem:DISPlay` is set to `OFF`, this command has no immediate effect on the screen. The numeric suffix in TRACe<1 to 3> is irrelevant.

Example:	"DISP:TRAC:Y:MODE REL"
Characteristics:	*RST value: ABS SCPI: device-specific
Mode:	A, MS

DISPlay[:WINDow<1|2>]:TRACe<1 to 3>:Y[:SCALe]:RLEVel -130dBm to 30dBm

This command defines the reference level in the selected measurement window. Depending on the coupling of the measurement windows, it is valid for both screens (`INSTrument:COUPle ALL`) or only for the selected measurement window (`INSTrument:COUPle NONE`).

With the reference level offset <> 0 the indicated value range of the reference level is modified by the offset.

The unit depends on the setting defined with `CALCulate:UNIT`. The numeric suffix in TRACe<1 to 3> is irrelevant.

Example: "`DISP:TRAC:Y:RLEV -60dBm`"

Characteristics: *RST value: -20dBm
SCPI: conforming

Mode: A, MS

DISPlay[:WINDow<1|2>]:TRACe<1 to 3>:Y[:SCALe]:RLEVel:OFFSet -200dB to 200dB

This command defines the offset of the reference level in the selected measurement window. Depending on the coupling of the measurement windows, it is valid for both screens (`INSTrument:COUPle ALL`) or only for the selected measurement window (`INSTrument:COUPle NONE`).

The numeric suffix at TRACe<1 to 3> is irrelevant.

Example: "`DISP:TRAC:Y:RLEV:OFFS -10dB`"

Characteristics: *RST value: 0dB
SCPI: conforming

Mode: A, MS

DISPlay[:WINDow<1|2>]:TRACE<1 to 3>:Y[:SCALe]:RVALue <numeric_value>

If the external generator control option (FSP-B10) is mounted and the normalization in the NETWORK mode is activated, this value defines the power value assigned to the reference position in the selected measurement window. This value corresponds to the parameter REFERENCE VALUE in manual operation.

The numeric suffix at TRACe<1 to 3> is irrelevant.

Example:

"`DISP:TRAC:Y:RVAL 0`" sets the power value assigned to the reference position to 0 dB.

Characteristics: *RST value: 0 dB
SCPI: device specific

Modes: A, MS

DISPlay[:WINDow<1|2>]:TRACe<1 to 3>:Y[:SCALe]:RPOSition 0 to 100PCT

This command defines the position of the reference value in the selected measurement window. The numeric suffix in TRACe<1 to 3> is irrelevant.

In operating mode NETWORK (Ext. Generator Option FSP-B10) with active normalization, RPOSition defines the reference point for the output of the normalized measurement results.

Example:	"DISP:TRAC:Y:RPOS 50PCT"	
Characteristics:	*RST value:	100PCT
	SCPI:	conforming
Mode:	A, MS	

DISPlay[:WINDow<1|2>]:TRACe<1 to 3>:Y:SPACing LINear | LOGarithmic

This command toggles between linear and logarithmic display in the selected measurement window..

The numeric suffix in TRACe<1 to 3> is irrelevant.

Note:
This function is not available during active GSM measurements.

Example:	"DISP:TRAC:Y:SPAC LIN"	
Characteristics:	*RST value:	LOGarithmic
	SCPI:	conforming
Mode:	A	

DISPlay[:WINDow<1|2>]:TRACe<1 to 3>:MODE WRITe | VIEW | AVERage | MAXHold | MINHold

This command defines the type of display and the evaluation of the traces in the selected measurement window. WRITE corresponds to the Clr/Write mode of manual operation. The trace is switched off (= BLANK in manual operation) with `DISP:WIND:TRAC:STAT OFF`.

The number of measurements for AVERage, MAXHold and MINHold is defined with the command `SENSe:AVERage:COUNt` or `SENSe:SWEep:COUNt`. It should be noted that synchronization to the end of the indicated number of measurements is only possible in single sweep mode.

If calculation of average values is active, selection between logarithmic and linear averaging is possible. For more detail see command `SENSe:AVERage:TYPE`.

Example:	"SWE:CONT OFF"	Switching to single-sweep mode.
	"SWE:COUN 16"	Sets the number of measurements to 16.
	"DISP:WIND1:TRAC3:MODE MAXH"	Switches on the calculation of the for trace 3 in screen A.
	"INIT;*WAI"	Starts the measurement and waits for the end of the 16 sweeps.

Characteristics:	*RST value:	WRITe for TRACe1, STATe OFF for TRACe2/3
	SCPI:	device-specific
Mode:	all	

DISPlay[:WINDow<1|2>]:TRACE<1 to 3>[:STATe] ON | OFF

This command switches on or off the display of the corresponding trace in the selected measurement window.

Example: "DISP:WIND1:TRAC3 ON"

Characteristics: *RST value: ON for TRACe1, OFF for TRACe2 to 4
SCPI: conforming

Mode: all

FETCh - Subsystem

The FETCh subsystem contains commands for reading out results of complex measurement tasks like those provided by the GSM MS Analyzer option (FS-K5). The FETCh-subsystem is closely linked to the functions of the CONFigure and READ-subsystems, where the measurement sequences are configured, the measurements are started and their results are queried..

FETCh:BURSt - Subsystem

This subsystem provides the commands for reading out results of measurements in GSM MS (option FS-K5) Analyzer mode, which are performed on individual bursts (Carrier Power, Phase/Frequency Error and Power vs. Time) without starting the measurement by themselves.

COMMAND	PARAMETERS	UNIT	COMMENT
FETCh			Option FS-K5
:BURSt			
:PERRor			
:RMS			
:AVERage?	--	deg	query only
:MAXimum?	--	deg	query only
:PEAK			
:AVERage?	--	deg	query only
:MAXimum?	--	deg	query only
:FERRor			
:AVERage?	--	Hz	query only
:MAXimum?	--	Hz	query only
:PTEMplate			
:REFerence?	--	--	query only

FETCh:BURSt:PERRor:RMS:AVERage?

This command reads out the average of the RMS-measurement of the phase error taken over the selected number of bursts.
This command is only available with GSM MS Analyzer FS-K5 option and when measurement of the phase/frequency error is selected (see `:CONFigure:BURSt:PFERror`).

Example:

`"INST MGSM"`	Switches the instrument to GSM MS mode
`"CONF:BURS:PFER"`	Selects the phase-frequency error measurement
`"SWE:COUN 20"`	Sets the sweep counter/no. of bursts
`"INIT:IMM;*WAI"`	Executes the measurement
`"FETC:BURS:PERR:RMS:AVER?"`	Read out result

Characteristics: *RST-Wert: --
SCPI: device-specific

Mode: MS

If no measurement has been performed yet, a query error results.
This command is an event and is therefore not assigned a query and has no *RST value.

FETCh:BURSt:PERRor:RMS:MAXimum?

This command reads out the maximum of the RMS-measurement of the phase error for the selected number of bursts.
This command is only available with GSM MS Analyzer FS-K5 option and when measurement of the phase/frequency error is selected (see `:CONFigure:BURSt:PFERror`).

Example:	`"INST MGSM"`	Switches the instrument to GSM MS mode
	`"CONF:BURS:PFER"`	Selects the phase-frequency error measurement
	`"SWE:COUN 20"`	Sets the sweep counter/no. of bursts
	`"INIT:IMM;*WAI"`	Executes the measurement
	`"FETC:BURS:PERR:RMS:MAX?"`	Read out result

Characteristics: *RST-Wert: --
SCPI: device-specific

Mode: MS

If no measurement has been performed yet, a query error results.
This command is an event and is therefore not assigned a query and has no *RST value.

FETCh:BURSt:PERRor:PEAK:AVERage?

This command reads out the average of the peak measurement of the phase error taken over the selected number of bursts.
This command is only available with GSM MS Analyzer FS-K5 option and when measurement of the phase/frequency error is selected (see `:CONFigure:BURSt:PFERror`).

Example:	`"INST MGSM"`	Switches the instrument to GSM MS mode
	`"CONF:BURS:PFER"`	Selects the phase-frequency error measurement
	`"SWE:COUN 20"`	Sets the sweep counter/no. of bursts
	`"INIT:IMM;*WAI"`	Executes the measurement
	`"FETC:BURS:PERR:PEAK:AVER?"`	Read out result

Characteristics: *RST-Wert: --
SCPI: device-specific

Mode: MS

If no measurement has been performed yet, a query error results.
This command is an event and is therefore not assigned a query and has no *RST value.

FETCh:BURSt:PERRor:PEAK:MAXimum?

This command reads out the maximum of the peak measurement of the phase error for the selected number of bursts.
This command is only available with GSM MS Analyzer FS-K5 option and when measurement of the phase/frequency error is selected (see `:CONFigure:BURSt:PFERror`).

Example:	`"INST MGSM"`	Switches the instrument to GSM MS mode
	`"CONF:BURS:PFER"`	Selects the phase-frequency error measurement
	`"SWE:COUN 20"`	Sets the sweep counter/no. of bursts
	`"INIT:IMM;*WAI"`	Executes the measurement
	`"FETC:BURS:PERR:PEAK:AVER?"`	Read out result

Characteristics: *RST-Wert: --
SCPI: device-specific

Mode: MS

If no measurement has been performed yet, a query error results.
This command is an event and is therefore not assigned a query and has no *RST value.

FETCh:BURSt:FERRor:AVERage?

This command reads out the average of the measurement of the frequency error taken over the selected number of bursts.
This command is only available with GSM MS Analyzer FS-K5 option and when measurement of the phase/frequency error is selected (see `:CONFigure:BURSt:PFERror`).

Example:	`"INST MGSM"`	Switches the instrument to GSM MS mode
	`"CONF:BURS:PFER"`	Selects the phase-frequency error measurement
	`"SWE:COUN 20"`	Sets the sweep counter/no. of bursts
	`"INIT:IMM;*WAI"`	Executes the measurement
	`"FETC:BURS:FERR:AVER?"`	Read out result

Characteristics: *RST-Wert: --
SCPI: device-specific

Mode: MS

If no measurement has been performed yet, a query error results.
This command is an event and is therefore not assigned a query and has no *RST value.

FETCh:BURSt:FERRor:MAXimum?

This command reads out the maximum frequency error measured over the selected number of bursts.
This command is only available with GSM MS Analyzer FS-K5 option and when measurement of the phase/frequency error is selected (see `:CONFigure:BURSt:PFERror`).

Example:	`"INST MGSM"`	Switches the instrument to GSM MS mode
	`"CONF:BURS:PFER"`	Selects the phase-frequency error measurement
	`"SWE:COUN 20"`	Sets the sweep counter/no. of bursts
	`"INIT:IMM;*WAI"`	Executes the measurement
	`"FETC:BURS:FERR:MAX?"`	Read out result

Characteristics: *RST-Wert: --
SCPI: device-specific

Mode: MS

If no measurement has been performed yet, a query error results.
This command is an event and is therefore not assigned a query and has no *RST value.

FETCh:BURSt:PTEMplate:REFerence?

This command reads out the results of the premeasurement of power vs. time.

The result is output as a list of partial result strings separated by ',' in the following (ASCII) format:

<Level1>,<Level2>,<RBW>

<Level1>: measured level

<Level2>: level corrected by means of the bandwidth

<RBW>: bandwidth

This command is only available with GSM MS Analyzer FS-K5 option and when measurement of the power vs. time is selected (see `:CONFigure:BURSt:PTEMplate`).

Example:	`"INST MGSM"`	Switches the instrument to GSM MS mode
	`"CONF:BURS:PTEM"`	Selects the power vs. time measurement
	`"READ:BURS:PTEM:REF?"`	Executes premeasurement of power vs. time
	`"FETC:BURS:PTEM:REF?"`	Read out result

Ergebnis: 43.2,43.2,1000000

Characteristics: *RST-Wert: --
SCPI: device-specific

Mode: MS

If no measurement has been performed yet, a query error results.
This command is an event and is therefore not assigned a query and has no *RST value.

FETCh:PTEMplate - Subsystem

Note:
This subsystem was taken over from FSE-K10 for reasons of compatibility.
It is replaced by the command `FETCh:BURSt:PTEMplate:REFerence?`.
See detailed description at command `FETCh:BURSt:PTEMplate:REFerence?`.

COMMAND	PARAMETERS	UNIT	COMMENT
FETCh			Option FS-K5
:PTEMplate			
:REFerence?	--	--	query only

FETCh:SPECtrum - Subsystem

This subsystem provides the commands for reading out results of measurements in the GSM MS (FS-K5) Analyzer mode, used to measure the power of the spectral contributions due to modulation and switching (modulation spectrum, transient spectrum) without first restarting a new measurement.

COMMAND	PARAMETERS	UNIT	COMMENT
FETCh			Option FS-K5
:SPECtrum			
:MODulation			
[:ALL?]	ARFCn	--	query only
:REFerence?	--	--	query only
:SWITching			
[:ALL?]	--	--	query only

FETCh:SPECtrum:MODulation[:ALL]? ARFCn

This command reads out the result of the measurement of the modulation spectrum of the mobile.

Parameter: ARFCn::= ARFCN ± 1.8 MHz

The result is output as a list of partial result strings separated by ',' in the following (ASCII) format:

<Index>,<Freq1>,<Freq2>,<Level>,<Limit>, <Abs/Rel>,<Status> [,
<Index>,<Freq1>,<Freq2>,<Level>,<Limit>, <Abs/Rel>,<Status>]...

where the parts between '[...]' denote a partial result string that can be repeated n times.

<Index>: 0, if the partial result string characterizes a measurement range

current number <>0,
if the partial result string characterizes a single limit excess.

<Freq1>: Start frequency of the measurement range or frequency where the limit line is exceeded

<Freq2>: Start frequency of the measurement range or frequency exceeding the measurement range. The value of <Freq2> is equal to the value of <Freq1>, if either the measurement is performed in the time domain or if the partial result string contains a limit excess.

<Level>: Measured maximum level of the partial range or measured level at the test point.

<Limit>: Limit in the partial range or at the test point

<Abs/Rel>: ABS <Level> and <Limit> are in absolute units (dBm)
REL <Level> and <Limit> are in relative units (dB)

<Status>: Result of the limit check in character data form:
PASSED no limit exceeded
FAILED limit exceeded
MARGIN margin exceeded
EXC limit excess marked as an exception

The frequencies <Freq1> and <Freq2> are always absolute i. e. not referred to the carrier frequency.

This command is only available with GSM MS Analyzer FS-K5 option and when modulation spectrum measurement is selected (see `:CONFigure:SPECtrum:MODulation`).

Example:

"INST MGSM"	Switches the instrument to GSM MS mode
"CONF:SPEC:MOD"	Selects the spectrum due to modulation measurement
"READ:SPEC:MOD:REF?"	Executes premeasurement

	"READ:SPEC:MOD?"	Executes list-measurement
	"FETC:SPEC:MOD? ARFCn"	Reads out the results

Result: 0,890E6,915E6,-87.4,-108.0,ABS,FAILED,
1,893.2E6,893.2E6,-83.2,-108.0,ABS,FAILED,
2,895.7E6,895.7E6,-87.4,-108.0,ABS,FAILED

Characteristics: *RST-Wert: --
SCPI: device-specific

Mode: MS

If no measurement has been performed yet, a query error results.
This command is an event and is therefore not assigned a query and has no *RST value.

FETCh:SPECtrum:MODulation:REFerence?

This command reads out the results of the premeasurement of modulation due to spectrum measurement.

The result is output as a list of partial result strings separated by ',' in the following (ASCII) format:

<Level1>,<Level2>,<RBW>

<Level1>: measured level

<Level2>: level corrected by means of the bandwidth

<RBW>: bandwidth

This command is only available with GSM MS Analyzer FS-K5 option and when measurement of the modulation due to spectrum is selected (see `:CONFigure:SPECtrum:MODulation`).

Example:	"INST MGSM"	Switches the instrument to GSM MS mode
	"CONF:SPEC:MOD"	Selects the spectrum due to modulation measurement
	"READ:SPEC:MOD:REF?"	Executes premeasurement
	"FETC:SPEC:MOD:REF?"	Reads out the results
Ergebnis:	43.2,43.2,1000000	

Characteristics: *RST-Wert: --
SCPI: device-specific

Mode: MS

If no measurement has been performed yet, a query error results.
This command is an event and is therefore not assigned a query and has no *RST value.

FETCh:SPECtrum:SWITching[:ALL]?

This command reads out the result of the measurement of the transient spectrum of the mobile.

The result is output as a list of partial result strings separated by ',' as for the command `FETCh:SPECtrum:MODulation[:ALL]?`.

This command is only available with GSM MS Analyzer FS-K5 option and when modulation spectrum measurement is selected (see `:CONFigure:SPECtrum:MODulation`).

Example:	"INST MGSM"	Switches the instrument to GSM MS mode
	"CONF:SPEC:SWIT"	Selects the spectrum due to switching measurement
	"READ:SPEC:SWIT?"	Executes list-measurement
	"FETC:SPEC:SWIT?"	Reads out the results

Result:

```
0,833.4E6,833.4E6,37.4,-36.0,ABS,MARGIN,
1,834.0E6,834.0E6,-35.2,-36.0,ABS,FAILED,
2,834.6E6,834.6E6,-74.3,-75.0,REL,FAILED
0,835.0E6,835.0E6,-65,0,-60.0,REL,PASSED
```

Characteristics: *RST-Wert: --
SCPI: device-specific

Mode: MS

If no measurement has been performed yet, a query error results.
This command is an event and is therefore not assigned a query and has no *RST value.

FORMat Subsystem

The FORMat subsystem specifies the data format of the data transmitted from and to the instrument.

COMMAND	PARAMETERS	UNIT	COMMENT
FORMat			
[:DATA]	ASCii|REAL[,<numeric_value>]	-	
:DEXPort			
:DSEParator	POINt|COMMa		

FORMat[:DATA] ASCii | REAL [, 32]

This command specifies the data format for the data transmitted from the instrument to the control PC.

Example: `"FORM REAL,32"`
`"FORM ASC"`

Characteristics: *RST value: ASCII
SCPI: conforming

Mode: all

The data format is either ASCii or one of the formats REAL . ASCii data are transmitted in plain text, separated by commas. REAL data are transmitted as 32-bit IEEE 754 floating-point numbers in the "definite length block format".

The FORMat command is valid for the transmission of trace data. The data format of trace data received by the instrument is automatically recognized, regardless of the format which is programmed.

Format setting for the binary transmission of trace data (see also `TRACE:DATA?`):

Analyzer mode: REAL, 32

FORMat:DEXPort:DSEParator POINt|COMMA

This command defines which decimal separator (decimal point or comma) is to be used for outputting measurement data to the file in ASCII format. Different languages of evaluation programs (eg MS-Excel) can thus be supported.

Example: `"FORM:DEXP:DSEP POIN` Sets the decimal point as separator.

Characteristics: *RST value: -- (factory setting is POINt; *RST does not affect setting)
SCPI: device-specific

Mode: all

HCOPy Subsystem

The HCOPy subsystem controls the output of display information for documentation purposes on output devices or files. The instrument allows two independent printer configurations which can be set separately with the numeric suffix <1|2>.

COMMAND	PARAMETERS	UNIT	COMMENT
HCOPy			
:ABORt	--	--	no query
:DESTination<1|2>	<string>		no query
:DEVice			
:COLor	<Boolean>		
:LANGuage<1|2>	WMF|GDI|EWMF|BMP		
[:IMMediate<1|2>]	--	--	no query
:ITEM			
:ALL			no query
:WINDow<1|2>			
:TABle			
:STATe	<Boolean>		
:TEXT	<string>		
:TRACe			
:STATe	<Boolean>		
:PAGE			
:ORIentation<1|2>	LANDscape|PORTrait		

HCOPy:ABORt

This command aborts a running hardcopy output.

Example: "HCOP:ABOR"

Characteristics: *RST value: -
SCPI: conforming

Mode: all

This command is an event and is therefore not assigned an *RST value and has no query.

HCOPy:DESTination<1|2> <string>

This command selects the printer output medium (Disk, Printer or Clipboard) associated with configuration 1 or 2.

Note: *The type of instrument is selected with `SYSTem:COMMunicate:PRINter:SELect`, which will automatically select a default output medium. Therefore the command `HCOPy:DESTination` should always be sent after setting the device type.*

Parameter:	<string>::=	'MMEM' | 'SYST:COMM:PRIN' | 'SYST:COMM:CLIP'
	'MMEM'	directs the hardcopy to a file. Command `MMEM:NAME <file_name>` defines the file name. All formats can be selected for `HCOPy:DEVice:LANGuage`.
	'SYST:COMM:PRIN'	directs the hardcopy to the printer. The printer is selected with command `SYSTEM:COMMunicate:PRINter:SELect`. `GDI` should be selected for `HCOPy:DEVice:LANGuage`.
	'SYST:COMM:CLIP'	directs the hardcopy to the clipboard. `EWMF` should be selected for `HCOPy:DEVice:LANGuage`.

Example:

"SYST:COMM:PRIN:SEL2 'LASER on LPT1'"	Selects the printer and output medium for device 2
"HCOP:DEST2 'SYST:COMM:PRIN'"	Selects the printer interface as device 2.

Characteristics: *RST value: -
SCPI: conforming

Mode: all

This command is an event and is therefore not assigned an *RST value and has no query.

HCOPy:DEVice:COLor ON|OFF

This command selects between color and monochrome hardcopy of the screen.

Example: "HCOP:DEV:COL ON"

Characteristics: *RST value: OFF
SCPI: conforming

Mode: all

HCOPy:DEVice:LANGuage<1|2> GDI | WMF | EWMF | BMP

This command determines the data format of the printout.

Parameter:

GDI — Graphics Device Interface:
Default format for the output to a printer configured under Windows.
Must be selected for the output to the printer interface (`HCOPy:DEVice 'SYST:COMM:PRIN'`).
Can be used for the output to a file (`HCOPy:DEVice 'SYST:COMM:MMEM'`). The printer driver configured under Windows is used in this case and a printer-specific file format is thus generated.

WMF and EWMF — WINDOWS Metafile and Enhanced Metafile Format:
Data formats for output files which can be integrated in corresponding programs for documentation purposes at a later time. WMF can only be used for output to a file (`HCOPy:DEVice 'SYST:COMM:MMEM'`) and EWMF also for the output to the clipboard (`HCOPy:DEVice 'SYST:COMM:CLIP'`).

BMP — Bitmap.
Data format for output to files only (`HCOPy:DEVice 'SYST:COMM:MMEM'`).

Example: `"HCOP:DEV:LANG WMF"`

Characteristics: *RST value: -
SCPI: conforming

Mode: all

HCOPy[:IMMediate<1|2>]

This command starts a hardcopy output. The numeric suffix selects which printer configuration (1 or 2) is to be used for the hardcopy output. If there is no suffix, configuration 1 is automatically selected.

`HCOPy:IMM[1]` Starts the hardcopy output to device 1 (default).
`HCOPy:IMM2` Starts the output to device 2.

Example: `"HCOP"`

Characteristics: *RST value: -
SCPI: conforming

Mode: all

This command is an event and is therefore not assigned an *RST value and has no query.

HCOPy:ITEM:ALL

This command selects the complete screen to be output.

Example: "HCOP:ITEM:ALL"

Characteristics: *RST value: OFF
SCPI: conforming

Mode: all

The hardcopy output is always provided with comments, title, time and date. As an alternative to the whole screen, only traces (commands 'HCOPy:DEVice:WINDow:TRACe: STATe ON') or tables (command 'HCOPy:DEVice:WINDow:TABLe:STATe ON') can be output.

HCOPy:ITEM:WINDow<1|2>:TABle:STATe ON | OFF

This command selects the output of the currently displayed tables.

Example: "HCOP:ITEM:WIND:TABL:STAT ON"

Characteristics: *RST value: OFF
SCPI: device-specific

Mode: all

The command HCOPy:DEVice:ITEM:WINDow<1|2>:TABle:STATe OFF as well as command HCOPy:DEVice:ITEM:ALL enables the output of the whole screen.

HCOPy:ITEM:WINDow<1|2>:TEXT <string>

This command defines the comment text for measurement window 1 or 2 for printout, with a maximum of 100 characters; line feed by means of character @).

Example: "HCOP:ITEM:WIND2:TEXT 'comment'"

Characteristics: *RST value: -
SCPI: device-specific

Mode: all

HCOPy:ITEM:WINDow<1|2>:TRACe:STATe ON | OFF

This command selects the output of the currently displayed trace.

Example: "HCOP:ITEM:WIND:TRACe:STAT ON"

Characteristics: *RST value: OFF
SCPI: device-specific

Mode: all

The command HCOPy:ITEM:WINDow<1|2>:TRACe:STATe OFF as well as command HCOPy:ITEM:ALL enables the output of the whole screen.

HCOPy:PAGE:ORIentation<1|2> LANDscape | PORTrait

The command selects the format of the output (portrait and landscape) (hardcopy unit 1 or 2).

Note:
The command is only available provided that the output device "printer" (`HCOP:DEST 'SYST:COMM:PRIN'`) has been selected.

Example: `"HCOP:PAGE:ORI LAND"`

Characteristics: *RST value: -
SCPI: conforming

Mode: all

INITiate Subsystem

The INITiate subsystem is used to control the init-measurement function in the selected measurement window. The measurement windows are assigned to INITiate1 (screen A) and INITiate2 (screen B).

COMMAND	PARAMETERS	UNIT	COMMENT
INITiate<1|2>			
:CONTinuous	<boolean>	--	
:CONMeas	--	--	no query
[:IMMediate]	--	--	no query
:DISPlay	<boolean>	--	

INITiate<1|2>:CONTinuous ON | OFF

This command determines whether the trigger system is continuously initiated (continuous) or performs single measurements (single). In the spectrum analysis mode, this setting refers to the sweep sequence (switching between continuous/single sweep).

Example: `"INIT2:CONT OFF"` Switches the sequence in screen B to single sweep.

`"INIT2:CONT ON"` Switches the sequence to continuous sweep.

Characteristics: *RST value: ON
SCPI: conforming

Mode: all

INITiate<1|2>:CONMeas

This command continues a stopped measurement at the current position in single sweep mode. The function is useful especially for trace functions MAXHold, MINHold and AVERage if the previous results are not to be cleared with Sweep Count > 0 or Average Count > 0 on restarting the measurement (INIT:IMMediate resets the previous results on restarting the measurement).

The single-sweep mode is automatically switched on. Synchronization to the end of the indicated number of measurements can then be performed with the command *OPC, *OPC? or *WAI. In the continuous-sweep mode, synchronization to the sweep end is not possible since the overall measurement "never" ends.

Example:

`"INIT:CONT OFF"`	Switches to single-sweep mode.
`"DISP:WIND:TRAC:MODE AVER`	Switches on trace averaging.
`"SWE:COUN 20"`	Setting the sweep counter to 20 sweeps.
`"INIT;*WAI"`	Starts the measurement and waits for the end of the 20 sweeps.
`"INIT:CONM;*WAI"`	Continues the measurement (next 20 sequences) and waits for the end.

Characteristics: *RST value: -
SCPI: device-specific

Mode: all

This command is an event and therefore has no *RST value and has no query.

INITiate<1|2>[:IMMediate]

The command initiates a new sweep in the indicated measurement window. With Sweep Count > 0 or Average Count > 0, this means a restart of the indicated number of measurements. With trace functions MAXHold, MINHold and AVERage, the previous results are reset on restarting the measurement.

In single sweep mode, synchronization to the end of the indicated number of measurements can be achieved with the command *OPC, *OPC? or *WAI. In continuous-sweep mode, synchronization to the sweep end is not possible since the overall measurement never ends.

Example:	`"INIT:CONT OFF"`	Switches to single-sweep mode.
	`"DISP:WIND:TRAC:MODE AVER`	Switches on trace averaging.
	`"SWE:COUN 20"`	Setting the sweep counter to 20 sweeps.
	`"INIT;*WAI"`	Starts the measurement and waits for the end of the 20 sweeps.

Characteristics: *RST value: -
SCPI: conforming

Mode: all

This command is an event and is therefore not assigned an *RST value and has no query.

INITiate<1|2>:DISPlay ON | OFF

This command configures the behavior of the display during a single sweep.
`INITiate:DISPlay OFF` means that the display is switched off during the measurement,
`INITiate:DISPlay ON` means that the display is switched on during the measurement.
The numeric suffix of INITiate is irrelevant with this command.

Example:	`"INIT:CONT OFF"`	Switches to single-sweep mode
	`"INIT:DISP OFF"`	Sets the display behavior to `OFF`
	`"INIT;*WAI"`	Starts the measurement with display switched off.

Characteristics: *RST value: ON
SCPI: device-specific

Mode: A, MS

INPut Subsystem

The INPut subsystem controls the input characteristics of the RF inputs of the instrument. The measurement windows are assigned to INPut1 (screen A) and INPut2 (screen B).

COMMAND	PARAMETERS	UNIT	COMMENT
INPut<1|2>			
:ATTenuation	<numeric_value>	DB	
:AUTO	<Boolean>	--	
:PROTection			
:RESet			no query
:EATT	<numeric_value>	DB	Only with option B25
:AUTO	<Boolean>	--	Only with option B25
:STATe	<Boolean>	--	Only with option B25
:IMPedance	50 | 75	OHM	
:MIXer	<numeric_value>	DBM	
:GAIN			
:STATe	<Boolean>		Only with option B25

INPut<1|2>:ATTenuation 0 to 70/75 dB

This command programs the input attenuator. To protect the input mixer against damage from overloads, the setting 0 dB can be obtained by entering numerals, not by using the command DEC.

The step width is 10 dB without the option electronic attenuator, the range 0 dB to 70 dB.
The input attenuation can be set in 5 dB steps between 0 dB and 75 dB with the option electronic attenuator.

In the default state, the attenuation set on the step attenuator is coupled to the reference level of the instrument. If the attenuation is programmed directly, the coupling to the reference level is switched off.

Example: "INP:ATT 40dB" Sets the attenuation on the attenuator to 40 dB and switches off the coupling to the reference level.

Characteristics: *RST value: 10 dB (AUTO is set to ON)
SCPI: conforming

Mode: all

INPut<1|2>:ATTenuation:AUTO ON | OFF

This command automatically couples the input attenuation to the reference level (state ON) or switches the input attenuation to manual entry (state OFF). The minimum input attenuation set with the coupling switched on is 10 dB (with electronic attenuator option: 5 dB).

Example: "INP:ATT:AUTO ON" Couples the attenuation set on the attenuator to the reference level.

Characteristics: *RST value: ON
SCPI: conforming

Mode: all

INPut<1|2>:ATTenuation:PROTection:RESet

The FSU is equipped with an overload protection mechanism. This mechanism becomes active as soon as the power at the input mixer exceeds a value of 27 dBm. It ensures that the connection between RF input and input mixer is cut off.
The command resets the attenuator into the state that it had before the overload condition was detected. It re-connects the RF input with the input mixer.

Note:
This command comes into effect only if the reason for the overload condition has been eliminated. Otherwise the connection between RF input and input mixer is left open.

Example: "INP:ATT:PROT:PRES"

Characteristics: *RST value: --
SCPI: device-specific

Mode: all

This command is an event and has therefore no query form and no *RST value.

INPut:COUPling AC | DC

This command switches the input coupling of the RF input between AC and DC.

Example: "INP:COUP DC"

Characteristics: *RST value: AC
SCPI: conforming

Mode: A

INPut<1|2>:EATT 0 to 30dB

This command programs the attenuation of the electronic input attenuator. The attenuation can be varied in 5 dB steps from 0 to 30 dB. Other entries are rounded to the next lower integer value. If the attenuation is programmed directly, the coupling to the reference level is switched off.

If the defined reference level cannot be set with the given RF attenuation, this level is adapted to the maximum possible value.

The electronic attenuator is swiched off in the default state.

Example: `"INP:EATT:STAT ON"` Switches the electronic attenuator into the signal path.

`"INP:EATT 15dB"` Sets the attenuation of the electronic attenuator to 15 dB and switches off the coupling to the reference level.

Characteristics: *RST value: 0 dB (state is set to OFF)
SCPI: device-specific

Mode: all

The command is only available with the electronic attenuator option B25.

INPut<1|2>:EATT:AUTO ON | OFF

This command automatically couples the electronic input attenuation to the reference level and the attenuation of the mechanical attenuator (state ON) or switches the input attenuation to manual entry (state OFF).

Example: `"INP:EATT:STAT ON"` Switches the electronic attenuator into the signal path.

Example: `"INP:EATT:AUTO ON"` Couples the attenuation of the electronic attenuator to the reference level.

Characteristics: *RST value: ON
SCPI: device-specific

Mode: all

The command is only available with the electronic attenuator option B25.

INPut<1|2>:EATT:STATe ON | OFF

This command switches the electronic input attenuation into the signal path (state ON) or removes it from the signal path (state OFF).

Example: "INP:EATT:STAT ON" Switches the electronic attenuator into the signal path.

Characteristics: *RST value: OFF
SCPI: device-specific

Mode: all

The command is only available with the option electronic attenuator B25.

INPut<1|2>:IMPedance 50 | 75

This command sets the nominal input impedance of the instrument. The set impedance is taken into account in all level indications of results..

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

Example: "INP:IMP 75"

Characteristics: *RST value: 50 Ω
SCPI: conforming

Mode: all

INPut<1|2>:GAIN:STATe ON | OFF

This command switches on the preamplifier for the instrument. The switchable gain is fixed to 20 dB.

Example: "INP:GAIN ON"

Characteristics: *RST value: OFF
SCPI: conforming

Modes: A, MS

The command is only available with the option electronic attenuator B25.

INPut<1|2>:MIXer[:POWer] <numeric value>

This command defines the desired power at the input mixer of the analyzer. On any change to the reference level the RF attenuation will be adjusted in a way that makes the difference between reference level and RF attenuation come as close to the desired mixer level as possible.

Example: "INP:MIX -30"

Characteristics: *RST value: - 25 dBm
SCPI: device-specific

Mode: A

INPut<1|2>:MIXer:AUTO ON | OFF

This command enables/disables the automatic setup of the mixer level.

Example: "INP:MIX:AUTO ON"

Characteristics: *RST value: ON
SCPI: device-specific

Mode: A

INSTrument Subsystem

COMMAND	PARAMETERS	UNIT	COMMENT
INSTrument			
[:SELect]	SANalyzer		
:NSELect	<numeric_value>		
:COUPle	NONE | RLEVel | CF_B | CF_A		no query

INSTrument[:SELect] SANalyzer| MSGM

This command switches between the operating modes by means of text parameters.

Note for GSM MS Analyzer:
If the Analyzer is set to external trigger source when entering the option GSM MS Analyzer (with `INST:SEL MGSM`), the GSM Trigger 'Extern' is selected. Otherwise the default GSM Trigger 'IF POWER' is set

Parameter:

	SANalyzer:	Spectrum analysis
	MGSM:	GSM MS analyzer
Example:	`"INST SAN"`	Switches the instrument to *SPECTRUM.*
Characteristics:	*RST value: SCPI:	SANalyzer conforming
Mode:	all	

Changeover to MGSM is only possible with GSM MS Analyzer FS-K5 option installed.

INSTrument:NSELect 1

This command switches between the operating modes by means of numbers.

Parameter:	1:	Spectrum analysis
	5:	GSM MS analyzer
Example:	`"INST:NSEL 1"`	Switches the instrument to *SPECTRUM.*
Characteristics:	*RST value: SCPI:	1 conforming
Mode:	all	

Changeover to 5 is only possible with GSM MS Analyzer FS-K5 option installed.

INSTrument:COUPle NONE | RLEVel | CF_B | CF_A

In operating mode *SPECTRUM* this command selects the parameter coupling between the two measurement windows screen A and B.

Parameter:	NONE	No coupling. The two measurement windows are operated like two independent "virtual" devices.
	RLEVel	The reference levels of the two measurement windows are coupled.
	CF_B	The center frequency of screen B is coupled to the frequency of marker 1 in screen A.
	CF_A	The center frequency of screen A is coupled to the frequency of marker 1 in screen B.

Example: `"INST:COUP NONE"` Switches off the coupling of measurement windows. This leads to two independent "virtual" devices.

Characteristics: *RST value: NONE
SCPI: device specific

Mode: A

MMEMory Subsystem

The MMEMory (mass memory) subsystem provides commands which allow for access to the storage media of the instrument and for storing and loading various instrument settings.

The various drives can be addressed via the "mass storage unit specifier" <msus> using the conventional DOS syntax. The internal hard disk is addressed by "D:", the floppy-disk drive by "A:".

Note: *For reasons of compatibility with the FSE instruments, addressing the hard disk by "C:" is also accepted. Since hard disk "C:" is reserved for instrument software, all read and write operations are rerouted to hard disk "D:" in normal operation (service level0).*

The file names <file_name> are indicated as string parameters with the commands being enclosed in quotation marks. They also comply with DOS conventions.

DOS file names consist of max. 8 ASCII characters and an extension of up to three characters separated from the file name by a dot "." Both, the dot and the extension are optional. The dot is not part of the file name. DOS file names do not distinguish between uppercase and lowercase notation. All letters and digits are permitted as well as the special characters "_", "^", "$", "~", "!", "#", "%", "&", "-", "{", "}", "(", ")", "@" and "'". Reserved file names are CLOCK$, CON, AUX, COM1 to COM4, LPT1 to LPT3, NUL and PRN.

The two characters "*" and "?" have the function of so-called "wildcards", i.e., they are variables for selection of several files. The question mark "?" replaces exactly one character, the asterisk means any of the remaining characters in the file name. "*.*" thus means all files in a directory.

COMMAND	PARAMETERS	UNIT	COMMENT
MMEMory			
:CATalog?	<string>		
:CDIRectory	<directory_name>	--	
:COPY	<file_name>,<file_name>	--	no query
:DATA	<file_name>[,<block>]	--	
:DELete	<file_name>	--	no query
:INITialize	<msus>	--	no query
:LOAD			
:STATe	1,<file_name>	--	no query
:AUTO	1,<file_name>	--	no query
:MDIRectory	<directory_name>	--	no query
:MOVE	<file_name>,<file_name>	--	no query e
:MSIS	<msus>	--	
:NAME	<file_name>	--	
:RDIRectory	<directory_name>	--	no query
:STORe<1|2>			
:STATe	1,<file_name>	--	no query
:TRACe	<numeric_value>, <file_name>		
:CLEar			
:STATe	1,<file_name>	--	no query
:ALL			k no query
:SELect			
[:ITEM]			
:HWSettings	<Boolean>		
:TRACe			
[:ACTive]	<Boolean>		
:LINes			
:ALL	<Boolean>		
:SCData	<Boolean>		Tracking generator option
:ALL	--		no query
:NONE	--		no query
:DEFault	--		no query
:COMMent	<string>		

MMEMory:CATalog? <path>

This command reads the indicated directory. According to DOS convention, wild card characters can be entered in order to query eg a list of all files of a certain type.

The path name should be in conformance with DOS conventions and may also include the drive name.

Parameter: <path>::= DOS Path name

Example:

"MMEM:CAT? 'D:\USER\DATA' — Returns the contents of the D:\USER\DATA directory

"MMEM:CAT? 'D:\USER\DATA*.LOG' — Returns all files in D:\USER\DATA with extension ".LOG"

"MMEM:CAT? 'D:\USER\DATA\SPOOL?.WMF' — Returns all files in D:\USER\DATA whose names start with SPOOL, have 6 letters and the extension ".WMF".

Response value: List of file names in the form of strings separated by commas, ie
'SPOOL1.WMF','SPOOL2.WMF','SPOOL3.WMF'

Characteristics: *RST value: -
SCPI: conformal

Operating mode: all

MMEMory:CDIRectory <directory_name>

This command changes the current directory.

In addition to the path name, the indication of the directory may contain the drive name. The path name complies with the DOS conventions.

Parameter: <directory_name>::= DOS path name

Example: "MMEM:CDIR 'D:\USER\DATA'" Returns the list of files in directory D:\USER\DATA.

Characteristics: *RST value: -
SCPI: conforming

Mode: all

MMEMory:COPY <file_source>,<file_destination>

This command copies the files indicated in <file_source> to the destination directory indicated with <file_destination> or to the destination file indicated by <file_destination> when <file_source> is just a file.

The indication of the file name may include the path and the drive name. The file names and path information must be in accordance with the DOS conventions.

Parameter: <file_source>,<file_destination> ::= <file_name>
<file_name> ::= DOS file name

Example: "MMEM:COPY 'D:\USER\DATA\SETUP.CFG','A:'"

Characteristics: *RST value: -
SCPI conforming

Mode: all

This command is an event and is therefore not assigned an *RST value and has no query.

MMEMory:DATA <file_name>[,<block data>]

This command writes the block data contained in <block> into the file characterized by <file_name>. The IEC/IEEE-bus delimiter must be set to EOI to obtain error-free data transfer.

The associated query command reads the indicated file from the mass memory and transfers it to the control computer via the IEC/IEEE bus. It should be noted that the buffer memory of the control computer should be large enough to store the file. The setting of the IEC/IEEE-bus delimiter is irrelevant in this case.

The command is useful for reading stored device settings or trace data from the instrument or for transferring them to the instrument.

Syntax:

MMEMory:DATA <file_name>,<block data>	Data transfer from control computer to instrument.
MMEMory:DATA? <file_name>	Data transfer from instrument to control computer.

<file_name> selects the file to be transferred.

The binary data block <block> has the following structure:

- it always begins with the character '#',
- followed by a digit for the length of the length information,
- followed by the indicated number of digits as length information (number of bytes) for the binary data themselves,
- finally the binary data with the indicated number of bytes

Example: "MMEM:DATA 'TEST01.HCP', #217This is the file"
means:
#2: the next 2 characters are the length indication
17: number of subsequent binary data bytes
This is the file: 17 bytes stored as binary data in the file TEST01.HCP.

"MMEM:DATA? 'TEST01.HCP'" Transfers the file TEST01.HCP from the instrument to the control computer.

Characteristics: *RST value: -
SCPI: conforming

Mode: all

MMEMory:DELete <file_name>

This command deletes the indicated files.

The indication of the file name contains the path and, optionally, the drive name. Indication of the path complies with DOS conventions.

Parameter: <file_name> ::= DOS file name

Example: "`MMEM:DEL 'TEST01.HCP'`" The file TEST01.HCP is deleted.

Characteristics: *RST value: -
SCPI: conforming

Mode: all

This command is an event and is therefore not assigned an *RST value and has no query.

MMEMory:INITialize 'A:'

This command formats the disk in drive A. Formatting deletes all data stored on the floppy disk.

Parameter: <msus> ::= 'A:'
Only drive name A: is accepted.

Example: "`MMEM:INIT 'A:'`"

Characteristics: *RST value: -
SCPI: conforming

Mode: all

This command is an event and is therefore not assigned an *RST value and has no query.

MMEMory:LOAD:STATe 1,<file_name>

This command loads device settings from files.The contents of the file are loaded and set as the new device state. The device automatically recognizes the files that are required for the whole setup from the list of file extensions:

Contents	Extension
Current setting of measurement hardware and associated title, if indicated	.SET
Activated limit lines	.LIN
Current configuration of general device parameters	.CFG
Configuration for the hardcopy output	.HCS
User-defined color setting	.COL
All defined limit lines	.LIA
Measured data trace 1 to trace 3 screen A	.TR1 to 3
Measured data trace 1 to trace 3 screen B	.TR4 to 6
Tracking generator settings (only with Option Ext. Generator Control B10)	.TCi
Setting for source calibration (only with Option Ext. Generator Control B10)	.TS1 .TS2
Correction data for source calibration (only with Tracking Generator Option B9 or Ext. Generator Control B10) Correction data for source calibration (only with Option Ext. Generator Control B10)	.TC1 .TC2

The file name includes indication of the path and may also include the drive name. The path name complies with DOS conventions.

Parameter: <file_name> ::= DOS file name without extension, extensions see table

Example: "MMEM:LOAD:STAT 1,'A:TEST'"

Characteristics: *RST value: -
SCPI: conforming

Mode: all

This command is an event and is therefore not assigned an *RST value and has no query.

MMEMory:LOAD:AUTO 1,<file_name>

This command defines which device setting is automatically loaded after the device is switched on. The contents of the file are read after switching on the device and used to define the new device state. The file name includes indication of the path and may also include the drive. The path name complies with DOS conventions.

Note:
*The data set defined as auto recall set will also be restored by a *RST-command.*

Parameter: <file_name> ::= DOS file name without extension;
FACTORY denotes the data set previously in the instrument

Example: "MMEM:LOAD:AUTO 1,'D:\USER\DATA\TEST'"

Characteristics: *RST value: FACTORY
SCPI: device-specific

Mode: all

This command is an event and is therefore not assigned an *RST value and has no query.

MMEMory:MDIRectory <directory_name>

This command creates a new directory. The file name includes indication of the path and may also include the drive name. The path name complies with DOS conventions.

Parameter: <directory_name>::= DOS path name

Example: "MMEM:MDIR 'D:\USER\DATA'"

Characteristics: *RST value: -
SCPI: device-specific

Mode: all

This command is an event and is therefore not assigned an *RST value and has no query.

MMEMory:MOVE <file_source>,<file_destination>

This command renames existing files, if <file_destination> contains no path indication. Otherwise the file is moved to the indicated path and stored under the file name specified there, if any.

The file name includes indication of the path and may also include the drive. The path name complies with DOS conventions.

Parameter: <file_source>,<file_destination> ::= <file_name>
<file_name> ::= DOS file name

Example: `"MMEM:MOVE 'D:\TEST01.CFG','SETUP.CFG'"`
Renames TEST01.CFG in SETUP.CFG in directory D:\.

`"MMEM:MOVE 'D:\TEST01.CFG','D:\USER\DATA'"`
Moves TEST01.CFG from D:\ to D:\USER\DATA.

`"MMEM:MOVE 'D:\TEST01.CFG','D:\USER\DATA\SETUP.CFG'"`
Moves TEST01.CFG from D:\ to D:\USER\DATA and renames the file in SETUP.CFG.

Characteristics: *RST value: -
SCPI: conforming

Mode: all

This command is an event and is therefore not assigned an *RST value and has no query.

MMEMory:MSIS <device>

This command changes to the drive indicated.The drive may be the internal hard disk D: or the floppy-disk drive A:.

Example: `"MMEM:MSIS 'A:'"`

Characteristics: *RST value: "D:'
SCPI: conforming

Mode: all

MMEMory:NAME <file_name>

This command defines a destination file for the printout started with the command `HCOPy:IMMediate`. In this case the printer output must be routed to destination *FILE* using the command "`HCOP:DEST 'MMEM'` ".

The file name includes indication of the path and may also include the drive name. The file name and path information comply with DOS conventions.

Parameter: <file_name> ::= DOS filename

Example:

`"HCOP:DEV:LANG BMP"`	Selection of data format.
`"HCOP:DEST 'MMEM' "`	Selection of the output device
`"MMEM:NAME 'PRINT1.BMP'"`	Selection of file name.
`"HCOP:IMM"`	Start of the printout.

Characteristics: *RST value: -
SCPI: conforming

Mode: all

This command is an event and is therefore not assigned an *RST value and has no query.

MMEMory:RDIRectory <directory_name>

This command deletes the indicated directory. The directory name includes indication of the path and may also include the drive name. The path name complies with DOS conventions.

Parameter: <directory_name>::= DOS path name

Example: "MMEM:RDIR 'D:\TEST'"

Characteristics: *RST value: -
SCPI: device-specific

Mode: all

This command is an event and is therefore not assigned an *RST value and has no query.

MMEMory:STORe<1|2>:STATe 1,<file_name>

This command stores the current device settings in a series of files which have the indicated file name, but different extensions. The file name includes indication of the path and may also include the drive name. The path name complies with DOS conventions. The numeric suffix in STORe<1|2> is irrelevant with this command.

A list of the extensions used is contained under `MMEMory:LOAD:STATe`.

Parameter: <file_name> := DOS file name without extension

Example: "MMEM:STOR:STAT 1,'TEST'"

Characteristics: *RST value: -
SCPI: conforming

Mode: all

This command is an event and is therefore not assigned an *RST value and has no query.

MMEMory:STORe<1|2>:TRACe 1 to 3,<file_name>

This command stores the selected trace (1 to 3) in the measurement window indicated by STORe<1|2> (screen A or B) in a file with ASCII format. The file format is described in chapter 4 in the TRACE menu under the *ASCII-FILE EXPORT* softkey.

The decimal separator (decimal point or comma) for floating-point numerals contained in the file is defined with the command `FORMat:DEXPort:DSEParator`.

The file name includes indication of the path and the drive name. Indication of the path complies with DOS conventions.

Parameter: 1 to 3 := selected measurement curve Trace 1 to 3
<file_name> := DOS file name

Example: "MMEM:STOR2:TRAC 3,'A:\TEST.ASC'"
Stores trace 3 from screen B in the file TEST.ASC on a disk.

Characteristics: *RST value: -
SCPI: device-specific

Mode: all

This command is an event and is therefore not assigned an *RST value and has no query.

MMEMory:CLEar:STATe 1,<file_name>

This command deletes the instrument setting selected by <file_name>. All associated files on the mass memory storage are cleared. A list of the extensions used is included under `MMEMory:LOAD:STATe`.

The file name includes indication of the path and may also include the drive. The path name complies with DOS conventions.

Parameter: <file_name> ::= DOS file name without extension

Example: "`MMEM:CLE:STAT 1,'TEST'`"

Characteristics: *RST value: -
SCPI: device-specific

Mode: all

This command is an event and is therefore not assigned an *RST value and has no query.

MMEMory:CLEar:ALL

This command deletes all device settings in the current directory.The current directory can be selected with `MMEM:CDIR`. The default directory is D:.

Example: "`MMEM:CLE:ALL`"

Characteristics: *RST value: -
SCPI: device-specific

Mode: all

This command is an event and is therefore not assigned an *RST value and has no query.

MMEMory:SELect[:ITEM]:HWSettings ON | OFF

This command includes the hardware settings in the list of data subsets of a device setting to be stored/loaded. The hardware settings include:

- current configuration of general device parameters (general setup)
- current setting of the measurement hardware including markers
- activated limit lines:
  A data set may include 8 limit lines at maximum in each measurement window. This number includes the activated limit lines and, if available, the de-activated limit lines last used. Therefore the combination of the non-activated restored limit lines depends on the sequence of use with the command `MMEM:LOAD`.
- user-defined color setting
- configuration for the hardcopy output
- Tracking generator settings
  (only in conjunction with option External Generator Control B10)
- Correction data for source calibration
  (only in conjunction with option External Generator Control B10)

Example: "`MMEM:SEL:HWS ON`"

Characteristics: *RST value: ON
SCPI: device-specific

Mode: all

MMEMory:SELect[:ITEM]:TRACE ON | OFF

This command adds the active traces to the list of data subsets of a save/recall device setting. Active traces are all traces whose state is not blank.

Example: "MMEM:SEL:TRAC ON"

Characteristics: *RST value: OFF, ie no traces will be stored
SCPI: device-specific

Mode: all

MMEMory:SELect[:ITEM]:LINes:ALL ON | OFF

This command adds all limit lines (activated and de-activated) to the list of device settings to be stored/loaded.

Example: "MMEM:SEL:LIN:ALL ON"

Characteristics: *RST value: ON
SCPI: device-specific

Mode: all

MMEMory:SELect[:ITEM]:SCData ON | OFF

This command adds the tracking generator calibration data to the list of device settings to be stored/loaded.

Example: "MMEM:SEL:SCD ON" Inserts the tracking generator correction data in the list of data subsets

Characteristics: *RST value: OFF
SCPI: device-specific

Modes: all

This command is only available in conjunction with option external generator control B10.

MMEMory:SELect[:ITEM]:ALL

This command includes all data subsets in the list device settings to be stored/loaded.

Example: "MMEM:SEL:ALL"

Characteristics: *RST value: --
SCPI: device-specific

Mode: all

This command is an event and therefore has no *RST value assigned.

MMEMory:SELect[:ITEM]:NONE

This command deletes all data subsets from the list of device settings to be stored/loaded.

Example: "MMEM:SEL:NONE"

Characteristics: *RST value: --
SCPI: device-specific

Mode: all

This command is an event and therefore has no *RST value assigned.

MMEMory:SELect[:ITEM]:DEFault

This command sets the default list of device settings to be stored/loaded.The latter includes:

- current configuration of general device parameters (general setup)
- current setting of the measurement hardware including markers
- activated limit lines
- user-defined color setting
- configuration for the hardcopy output
- Tracking generator settings
  (only in conjunction with option External Generator Control B10)
- Correction data for source calibration
  (only in conjunction with option External Generator Control B10)

Trace data and non-used limit lines are not included.

Example: "MMEM:SEL:DEFault"

Characteristics: *RST value: --
SCPI: device-specific

Mode: all

This command is an event and therefore has no *RST value assigned.

MMEMory:COMMent <string>

This command defines a comment (max. 60 characters) for a device setting to be stored.

Example: "MMEM:COMM 'Setup for GSM measurement'"

Characteristics: *RST value: blank comment
SCPI: device-specific

Mode: all

READ - Subsytem

The READ-subsystem contains commands for starting complex measurement tasks such as those provided by options GSM MS Analyzer (FSE-K5), and for querying the results subsequently. The READ-subsystem is closely linked to the functions of the CONFigure- and FETCh-subsystems, where the measurement sequences are configured or the results are queried without restarting a new measurement.

READ:BURSt - Subsystem

This subsystem provides the commands for starting measurements in the GSM MS Analyzer mode (option FS-K5), which are performed on individual bursts (phase/frequency error and power vs. time), and for reading out the results subsequently

COMMAND	PARAMETERS	UNIT	COMMENT
READ			Option FS-K5
:BURSt			
:PERRor			
:RMS			
:AVERage?	--	deg	query only
:MAXimum?	--	deg	query only
:PEAK			
:AVERage?	--	deg	query only
:MAXimum?	--	deg	query only
:FERRor			
:AVERage?	--	Hz	query only
:MAXimum?	--	Hz	query only
:PTEMplate			
:REFerence			
[:IMMediate?]	--	--	query only
:REFerence	--		
[:IMMediate?]	--	--	query only

READ:BURSt:PERRor:RMS:AVERage?

This command starts the measurement of the phase and frequency error of the mobile and reads out the average of the RMS-measurement of the phase error taken over the selected number of bursts.
The analyzer is set to single sweep if the measurement is selected.
Further results of the phase/frequency error measurement can be then queried without restart of the measurement via the `:FETCh:BURSt`-subsystem.
An ongoing measurement can be aborted via the command `ABORt`.
This command is only available with GSM MS Analyzer FS-K5 option and when measurement of the phase/frequency error is selected (see `:CONFigure:BURSt:PFERror`).

Example:

"INST MGSM"	Switches the instrument to GSM MS mode
"CONF:BURS:PFER"	Selects the phase-frequency error measurement
"SWE:COUN 20"	Sets the sweep counter/no. of bursts
"READ:BURS:PERR:RMS:AVER?"	Executes the measuremen and read out the result

Characteristics: *RST-Wert: --
SCPI: device-specific

Mode: MS

This command is an event and is therefore not assigned a query and has no *RST value.

READ:BURSt:PERRor:RMS:MAXimum?

This command starts the measurement of the phase and frequency error of the mobile and reads out the maximum of the RMS-measurement of the phase error taken over the selected number of bursts.
The analyzer is set to single sweep if the measurement is selected.
Further results of the phase/frequency error measurement can be then queried without restart of the measurement via the `:FETCh:BURSt`-subsystem.
An ongoing measurement can be aborted via the command `ABORt`.
This command is only available with GSM MS Analyzer FS-K5 option and when measurement of the phase/frequency error is selected (see `:CONFigure:BURSt:PFERror`).

Example:	`"INST MGSM"`	Switches the instrument to GSM MS mode
	`"CONF:BURS:PFER"`	Selects the phase-frequency error measurement
	`"SWE:COUN 20"`	Sets the sweep counter/no. of bursts
	`"READ:BURS:PERR:RMS:MAX?"`	Executes the measuremen and read out the result

Characteristics: *RST-Wert: --
SCPI: device-specific

Mode: MS

This command is an event and is therefore not assigned a query and has no *RST value.

READ:BURSt:PERRor:PEAK:AVERage?

This command starts the measurement of the phase and frequency error of the mobile and reads out the average of the peak measurement of the phase error taken over the selected number of bursts.
The analyzer is set to single sweep if the measurement is selected.
Further results of the phase/frequency error measurement can be then queried without restart of the measurement via the `:FETCh:BURSt`-subsystem.
An ongoing measurement can be aborted via the command `ABORt`.
This command is only available with GSM MS Analyzer FS-K5 option and when measurement of the phase/frequency error is selected (see `:CONFigure:BURSt:PFERror`).

Example:	`"INST MGSM"`	Switches the instrument to GSM MS mode
	`"CONF:BURS:PFER"`	Selects the phase-frequency error measurement
	`"SWE:COUN 20"`	Sets the sweep counter/no. of bursts
	`"READ:BURS:PERR:PEAK:AVER?"`	Executes the measuremen and read out the result

Characteristics: *RST-Wert: --
SCPI: device-specific

Mode: MS

This command is an event and is therefore not assigned a query and has no *RST value.

READ:BURSt:PERRor:PEAK:MAXimum?

This command starts the measurement of the phase and frequency error of the mobile and reads out the maximum of the peak measurement of the phase error taken over the selected number of bursts.
The analyzer is set to single sweep if the measurement is selected.
Further results of the phase/frequency error measurement can be then queried without restart of the measurement via the `:FETCh:BURSt`-subsystem.
An ongoing measurement can be aborted via the command `ABORt`.
This command is only available with GSM MS Analyzer FS-K5 option and when measurement of the phase/frequency error is selected (see `:CONFigure:BURSt:PFERror`).

Example:	"INST MGSM"	Switches the instrument to GSM MS mode
	"CONF:BURS:PFER"	Selects the phase-frequency error measurement
	"SWE:COUN 20"	Sets the sweep counter/no. of bursts
	"READ:BURS:PERR:PEAK:MAX?"	Executes the measuremen and read out the result

Characteristics: *RST-Wert: --
SCPI: device-specific

Mode: MS

This command is an event and is therefore not assigned a query and has no *RST value.

READ:BURSt:FERRor:AVERage?

This command starts the measurement of the phase and frequency error of the mobile and reads out the average of the frequency error taken over the selected number of bursts.
The analyzer is set to single sweep if the measurement is selected.
Further results of the phase/frequency error measurement can be then queried without restart of the measurement via the `:FETCh:BURSt`-subsystem.
An ongoing measurement can be aborted via the command `ABORt`.
This command is only available with GSM MS Analyzer FS-K5 option and when measurement of the phase/frequency error is selected (see `:CONFigure:BURSt:PFERror`).

Example:	"INST MGSM"	Switches the instrument to GSM MS mode
	"CONF:BURS:PFER"	Selects the phase-frequency error measurement
	"SWE:COUN 20"	Sets the sweep counter/no. of bursts
	"READ:BURS:FERR:AVER?"	Executes the measuremen and read out the result

Characteristics: *RST-Wert: --
SCPI: device-specific

Mode: MS

This command is an event and is therefore not assigned a query and has no *RST value.

READ:BURSt:FERRor:MAXimum?

This command starts the measurement of the phase and frequency error of the mobile and reads out the maximum of the frequency error taken over the selected number of bursts.
The analyzer is set to single sweep if the measurement is selected.
Further results of the phase/frequency error measurement can be then queried without restart of the measurement via the `:FETCh:BURSt`-subsystem.
An ongoing measurement can be aborted via the command `ABORt`.
This command is only available with GSM MS Analyzer FS-K5 option and when measurement of the phase/frequency error is selected (see `:CONFigure:BURSt:PFERror`).

Example:	"INST MGSM"	Switches the instrument to GSM MS mode
	"CONF:BURS:PFER"	Selects the phase-frequency error measurement
	"SWE:COUN 20"	Sets the sweep counter/no. of bursts
	"READ:BURS:FERR:MAX?"	Executes the measuremen and read out the result

Characteristics: *RST-Wert: --
SCPI: device-specific

Mode: MS

This command is an event and is therefore not assigned a query and has no *RST value.

READ:BURSt:PTEMplate:REFerence[:IMMediate]?

This command starts the premeasurement of power vs. time and read out the results.

The result is output as a list of partial result strings separated by ',' in the following (ASCII) format:

<Level1>,<Level2>,<RBW>

<Level1>: measured level

<Level2>: level corrected by means of the bandwidth

<RBW>: bandwidth

This command is only available with GSM MS Analyzer FS-K5 option and when measurement of the power vs. time is selected (see `:CONFigure:BURSt:PTEMplate`).

Example:	"INST MGSM"	Switches the instrument to GSM MS mode
	"CONF:BURS:PTEM"	Selects the power vs. time measurement
	"READ:BURS:PTEM:REF?"	Executes premeasurement of power vs. time
	"FETC:BURS:PTEM:REF?"	Read out result

Ergebnis: 43.2,43.2,1000000

Characteristics: *RST-Wert: --
SCPI: device-specific

Mode: MS

This command is an event and is therefore not assigned a query and has no *RST value.

READ:BURSt:REFerence[:IMMediate]?

This command starts the premeasurement of power vs. time and returns the measured level in dBm. This command is only available with GSM MS Analyzer FS-K5 option and when measurement of the power vs. time is selected (see `:CONFigure:BURSt:PTEMplate`).

Note:

This command was taken over from FSE-K10 for reasons of compatibility.
It is recommended to use the command READ:BURSt:PTEMplate:REFerence[IMMediate]? instead of. The command READ:BURSt:PTEMplate:REFerence[IMMediate]? uses the conform output of all reference reqeust commands.
See detailed description at command READ:BURSt:PTEMplate:REFerence[IMMediate]?

Example:

`"INST MGSM"`	Switches the instrument to GSM MS mode
`"CONF:BURS:PTEM"`	Selects the power vs. time measurement
`"READ:BURS:REF?"`	Executes premeasurement of power vs. time and returns result

Characteristics: *RST-Wert: --
SCPI: device-specific

Mode: MS

This command is an event and is therefore not assigned a query and has no *RST value.

READ:SPECtrum - Subsystem

This subsystem provides the commands for starting measurements in the GSM MS (option FS-K5) Analyzer mode, which are used to measure the power of the spectral components due to modulation and switching (modulation spectrum, transient spectrum), and for reading out the results subsequently.

COMMAND	PARAMETERS	UNIT	COMMENT
READ			Option FS-K5
:SPECtrum			
:MODulation			
[:ALL?]	--	--	query only
:REFerence			
[:IMMediate?]	--	--	query only
:SWITching			
[:ALL?]	--	--	query only

READ:SPECtrum:MODulation[:ALL]?

This command starts the measurement of the modulation spectrum of the mobile and reads out the result. The measurement is performed in the frequency range ARFCN ± 1.8 MHz.

The result is read out as a list of partial ASCII result strings separated by ',' in the following format:

<Index>,<Freq1>,<Freq2>,<Level>,<Limit>, <Abs/Rel>,<Status> [,
<Index>,<Freq1>,<Freq2>,<Level>,<Limit>, <Abs/Rel>,<Status>]...

where the part set in '[...]' characterizes a partial result string which can be repeated n times.

<Index>: 0, if the partial result string characterizes a measurement range.
current number <>0, if the partial result string characterizes a single limit excess.

<Freq1>: Start frequency of the measurement range or frequency where the limit is exceeded.

<Freq2>: Stop frequency of the measurement range or frequency where the measured range is exceeded. The value of <Freq2> is equal to the value of <Freq1>, if either the measurement is performed in the time domain or the partial result string contains a limit excess.

<Level>: Measured maximum level of the partial range or measured level at the test point.

<Limit>: Limit in the partial range or at the test point.

<Abs/Rel>: ABS <Level> and <Limit> are in absolute units (dBm)
REL <Level> and <Limit> are in relative units (dB)

<Status>: Result of the limit check in character data form:
PASSED no limit exceeded
FAILED limit exceeded
MARGIN margin exceeded

The frequencies <Freq1> and <Freq2> are always absolute and not referred to the carrier frequency.

An ongoing measurement can be aborted via the command `ABORt`.
This command is only available with GSM MS Analyzer FS-K5 option and when modulation spectrum measurement is selected (see `:CONFigure:SPECtrum:MODulation`).

Example:	"INST MGSM"	Switches the instrument to GSM MS mode
	"CONF:SPEC:MOD"	Selects the spectrum due to modulation measurement
	"READ:SPEC:MOD:REF?"	Executes premeasurement
	"READ:SPEC:MOD?"	Executes list-measurement

Result:
```
0,890E6,915E6,-87.4,-108.0,ABS,FAILED,
1,893.2E6,893.2E6,-83.2,-108.0,ABS,FAILED,
2,895.7E6,895.7E6,-87.4,-108.0,ABS,FAILED
```

Characteristics: *RST-Wert: --
SCPI: device-specific

Mode: MS

This command is an event and is therefore not assigned a query and has no *RST value.

READ:SPECtrum:MODulation:REFerence[:IMMediate]?

This command starts the premeasurement of the modulation due to spectrum measurement and reads out the result.

The result is output as a list of partial result strings separated by ',' in the following (ASCII) format:

<Level1>,<Level2>,<RBW>

<Level1>:	measured level
<Level2>:	level corrected by means of the bandwidth
<RBW>:	bandwidth

This command is only available with GSM MS Analyzer FS-K5 option and when measurement of the modulation due to spectrum is selected (see `:CONFigure:SPECtrum:MODulation`).

Example:	"INST MGSM"	Switches the instrument to GSM MS mode
	"CONF:SPEC:MOD"	Selects the spectrum due to modulation measurement
	"READ:SPEC:MOD:REF?"	Executes premeasurement
Ergebnis:	43.2,43.2,1000000	

Characteristics: *RST-Wert: --
SCPI: device-specific

Mode: MS

This command is an event and is therefore not assigned a query and has no *RST value.

READ:SPECtrum:SWITching[:ALL]?

This command starts the measurement of the transient spectrum of the base station or mobile and reads out the result.

The result is read out as a list of partial ASCII result strings separated by ',' in the format used for `READ:SPECtrum:MODulation[:ALL]?`

An ongoing measurement can be aborted via the command `ABORt`.
This command is only available with GSM MS Analyzer FS-K5 option and when the spectrum due to switching measurement is selected (see `:CONFigure:SPECtrum:SWITChing`).

Example:	"INST MGSM"	Switches the instrument to GSM MS mode
	"CONF:SPEC:SWIT"	Selects the spectrum due to switching measurement
	"READ:SPEC:SWIT?"	Executes list-measurement

Result:

```
0,833.4E6,833.4E6,37.4,-36.0,ABS,MARGIN,
1,834.0E6,834.0E6,-35.2,-36.0,ABS,FAILED,
2,834.6E6,834.6E6,-74.3,-75.0,REL,FAILED
0,835.0E6,835.0E6,-65,0,-60.0,REL,PASSED
```

Characteristics: *RST-Wert: --
SCPI: device-specific

Mode: MS

This command is an event and is therefore not assigned a query and has no *RST value.

SENSe Subsystem

The SENSe subsystem is organized in several subsystems. The commands of these subsystems directly control device-specific settings, they do not refer to the signal characteristics of the measurement signal.
The SENSe subsystem controls the essential parameters of the analyzer. In accordance with the SCPI standard, the keyword "SENSe" is optional for this reason, which means that it is not necessary to include the SENSe node in command sequences.
The measurement windows are selected by SENSe1 and SENSe2:

SENSe1 = Modification of screen A settings
SENSe2 = Modification of screen B settings.

Screen A is automatically selected if 1 or 2 is missing.

SENSe:AVERage Subsystem

The SENSe:AVERage subsystem calculates the average of the acquired data. A new test result is obtained from several successive measurements.
There are two types of average calculation: logarithmic and linear. In case of logarithmic average calculation (denoted with VIDeo), the average value of the measured logarithmic power is calculated and in case of linear average calculation, the linear power is averaged before the logarithm is applied.
The measurement windows are selected by SENSe1 (screen A) and SENSe2 (screen B).

COMMAND	PARAMETERS	UNIT	COMMENT
[SENSe<1|2>]			
:AVERage			
:COUNt	<numeric_value>	--	
[:STATe<1 to 3>]	<Boolean>	--	
:TYPE	VIDeo | LINear	--	

[SENSe<1|2>:]AVERage:COUNt 0 to 32767

This command defines the number of measurements which contribute to the average value.

It should be noted that continuous averaging will be performed after the indicated number has been reached in continuous sweep mode.

In single sweep mode, the sweep is stopped as soon as the indicated number of measurements (sweeps) is reached. Synchronization to the end of the indicated number of measurements is only possible in single sweep mode.

The command `[SENSe<1|2>:]AVERage:COUNt` is the same as command `[SENSe<1|2>:]SWEep:COUNt`. In both cases, the number of measurements is defined whether the average calculation is active or not.

The number of measurements is valid for all traces in the indicated measurement window.

Example:	"SWE:CONT OFF"	Switching to single-sweep mode.
	"AVER:COUN 16"	Sets the number of measurements to 16.
	"AVER:STAT ON"	Switches on the calculation of average.
	"INIT;*WAI"	Starts the measurement and waits for the end of the 16 sweeps.

Characteristics: *RST value: 0
SCPI: conforming

Mode: all

[SENSe<1|2>:]AVERage[:STATe<1 to 3>] ON | OFF

This command switches on or off the average calculation for the selected trace (STATe<1 to 3>) in the selected measurement window.

Example:	"AVER OFF"	Switches off the average calculation for trace 1 in screen A.
	"SENS2:AVER:STAT3 ON"	Switches on the average calculation for trace 3 in screen B.

Characteristics: *RST value: OFF
SCPI: conforming

Mode: all

[SENSe<1|2>:]AVERage:TYPE VIDeo | LINear

This command selects the type of average function.If VIDeo is selected, the logaritmic power is averaged and, if LINear is selected, the power values are averaged before they are converted to logarithmic values.

The type of average calculation is equally set for all traces in one measurement window.

Example: "AVER:TYPE LIN" Switches screen A to linear average calculation.

Characteristics: *RST value: VIDeo
SCPI: device-specific

Mode: A, MS

SENSe:BANDwidth Subsystem

This subsystem controls the setting of the instrument's filter bandwidths. Both groups of commands (BANDwidth and BWIDth) perform the same functions. The measurement windows are selected by SENSe1 (screen A) and SENSe2 (screen B).

COMMAND	PARAMETERS	UNIT	COMMENT
[SENSe<1|2>]			
:BANDwidth			
[:RESolution]	<numeric_value>	HZ	
:AUTO	<Boolean>	--	
:RATio	<numeric_value>	--	
:TYPE	NORMal | FFT | CFILter | RRC	--	
:VIDeo	<numeric_value>	HZ	
:AUTO	<Boolean>	--	
:RATio	<numeric_value>	--	
:BWIDth			
[:RESolution]	<numeric_value>	HZ	
:AUTO	<Boolean>	--	
:RATio	<numeric_value>	--	
:TYPE	NORMal | FFT | CFILter | RRC	--	
:VIDeo	<numeric_value>	HZ	
:AUTO	<Boolean>	--	
:RATio	<numeric_value>	--	

[SENSe<1|2>:]BANDwidth|BWIDth[:RESolution] 10 Hz to 50 MHz

This command defines the analyzer's resolution bandwidth.

Analog resolution filters of 10 Hz to 20 MHz in 1, 2, 3, 5, 10 steps are available. Additionoally there is a 50 MHz resolution bandwidth. These filters are implemented as 5-circuit LC filters in the range from 300 kHz to 10 MHz and as digital filters with analog characteristic in the range of 10 Hz to 100 kHz.

In addition, the EMI bandwidths 200 Hz, 9 kHz and 120 kHz are available (6 dB bandwidths each). These bandwidths can only be obtained by entering numeric values and not with the commands `INCrement` and `DECrement`.

FFT filters from 1 Hz to 30 kHz (3 dB bandwidth each) are also available in the frequency domain (span > 0) for fast measurements on periodic signals. The instrument automatically switches to analog filters above 30 kHz.

A number of especially steep-edged channel filters can be selected from firmware version 1.10 or higher provided that parameters `CFILter` or `RRC` are selected using the `BAND:TYPE` command. The possible combinations of filter type and filter bandwidth are listed in the table "List of available channel filters" of chapter 4, section "Setting Bandwidths and Sweep Time– Key *BW*".

If the resolution bandwidth is modified, the coupling to the span is automatically switched off.

Note:
This function is not available during GSM measurements phase-frequency error/power vs. time. During these measurements the bandwith is selected due to GSM standard.

Example: `"BAND 1MHz"` sets the resolution bandwidth to 1 MHz

Characteristics: *RST value: - (AUTO is set to ON)
SCPI: conforming

Mode: all

[SENSe<1|2>:]BANDwidth|BWIDth[:RESolution]:AUTO ON | OFF

This command either automatically couples the resolution bandwidth of the instrument to the span or cancels the coupling.

The automatic coupling adapts the resolution bandwidth to the currently set frequency span according to the relationship between frequency span and resolution bandwidth. The 6 dB bandwidths 200 Hz, 9 kHz and 120 kHz and the channel filters available from Version 1.10 are not set by the automatic coupling.

The ratio resolution bandwidth/span can be modified with the command `[SENSe<1|2>:]BANDwidth[:RESolution]:RATio`.

Note:
This function is not available during GSM measurements phase-frequency error/power vs. time.

Example:	`"BAND:AUTO OFF"`	Switches off the coupling of the resolution bandwidth to the span.	
Characteristics:	*RST value:	ON	
	SCPI:	conforming	
Mode:	A, MS		

[SENSe<1|2>:]BANDwidth|BWIDth[:RESolution]:RATio 0.0001 to 1

This command defines the ratio resolution bandwidth (Hz) / span (Hz). The ratio to be entered is reciprocal to the ratio span/RBW used in manual control.

Example:	`"BAND:RAT 0.1"`	
Characteristics:	*RST value:	0.02 with BAND:TYPE NORMal or RBW > 30 kHz 0.01 with BAND:TYPE FFT for RBW $\leq$ 30 kHz
	SCPI:	conforming
Mode:	A, MS	

[SENSe<1|2>:]BANDwidth|BWIDth[:RESolution]:TYPE NORMal | FFT | CFILter | RRC

This command switches the filter type for the resolution bandwidth between "normal" analog or FIR filters in 1, 3, 10 steps and the FFT filtering for bandwidths <100 kHz.

The advantage of FFT filtering is the higher measurement speed compared to digital filters with analog filter characteristic. However, FFT filters are only suitable for periodic signals, and they are only available for span > 0 Hz.

Since firmware version 1.10 steep-edged channel filters and filters with RRC (Root Raised Cosine) characteristic are available. The possible combinations of filter type and filter bandwidth are listed in the table "List of available channel filters" in chapter 4, section "Setting Bandwidths and Sweep Time– Key *BW*".

Note:
When changing the filter type, the next larger filter bandwidth is selected if the same filter bandwidth is not available for the new filter type.

This function is not available during GSM measurements phase-frequency error/power vs. time.

Example:	`"BAND:TYPE NORM"`	
Characteristics:	*RST value:	NORMal
	SCPI:	device-specific
Operating mode:	A, MS	

[SENSe<1|2>:]BANDwidth|BWIDth:VIDeo 1Hz to 10MHz

This command defines the instrument's video bandwidth. Bandwidths from 10 Hz to 10 MHz in 1, 2, 3, 5, 10 steps are available. The command is not available if FFT filtering is switched on and the set bandwidth is ≤ 30 kHz or if the quasi-peak detector is switched on.

Note:
This function is not available during GSM measurements phase-frequency error/power vs. time.

Example: "BAND:VID 10kHz"

Characteristics: *RST value: - (AUTO is set to ON)
SCPI: conforming

Mode: A, MS

[SENSe<1|2>:]BANDwidth|BWIDth:VIDeo:AUTO ON | OFF

This command either automatically couples the instrument's video bandwidth to the resolution bandwidth or cancels the coupling.

The ratio video bandwidth/resolution bandwidth can be modified with the command [SENSe<1|2>:]BANDwidth:VIDeo:RATio.

Note:
This function is not available during GSM measurements phase-frequency error/power vs. time.

Example: "BAND:VID:AUTO OFF"

Characteristics: *RST value: ON
SCPI: conforming

Mode: A, MS

[SENSe<1|2>:]BANDwidth|BWIDth:VIDeo:RATio 0.01 to 1000

This command defines the ratio video bandwidth (Hz) / resolution bandwidth (Hz).The ratio to be entered is reciprocal to the ratio RBW/VBW used in manual control.

Note:
This function is not available during GSM measurements phase-frequency error/power vs. time.

Example: "BAND:VID:RAT 3" Sets the coupling of video bandwidth to video bandwidth = 3*resolution bandwidth

Characteristics: *RST value: 3
SCPI: conforming

Mode: A, MS

SENSe:CORRection Subsystem

This subystem controls calibration and normalization during operation with the external generator control option (B10). The measurement windows are selected by SENSe1 (screen A) and SENSe2 (screen B).

Note:
The functions of this subsystem are not available during GSM measurements.

COMMAND	PARAMETERS	UNIT	COMMENT
[SENSe<1|2>]			
:CORRection			Tracking Generator option
:METHod	TRANsmission | REFLexion		
:COLLect			
[:ACQuire]	THRough | OPEN		no query
[:STATe]	<Boolean>		
:RECall			no query

[SENSe<1|2>:]CORRection[:STATe] ON | OFF

This command activates/deactivates the normalization of the measurement results in the selected window provided that the tracking generator is active. The command is available only after aquisition of a reference trace for the selected type of measurement (transmission/reflection, see command `[SENSe<1|2>:]CORRection:COLLect[:ACQire]`).

Example: `"CORR ON "` activates normalization in screen A.

Characteristics: *RST value: OFF
SCPI: conforming

Mode: A

This command is only valid in conjunction with the ext. generator control option (B10).

[SENSe<1|2>:]CORRection:METHod TRANsmission | REFLexion

This command selects the type of measurement with active tracking generator (transmission/reflexion).

Example: `"CORR:METH TRAN "` sets the type of measurement in screen A to "transmission".

Characteristics: *RST value: TRANsmission
SCPI: device specific

Mode: A

This command is only valid in conjunction with the ext. generator control option (B10).

[SENSe<1|2>:]CORRection:COLLect[:ACQuire] THRough | OPEN

This command selects the kind of measurement for the reference values of the normalization (response calibration).

THRough	"TRANsmission" mode:	calibration with direct connection between tracking generator and device input.
	"REFLexion" mode:	calibration with short circuit at the input
OPEN	only valid in "REFLexion" mode:calibration with open input	

This command is an event and is therefore not assigned an *RST value and has no query.
It is only valid in conjunction with the ext. generator control option (B10).

Example:	`"CORR:COLL THR"`	selects single sweep operation
	`"CORR:COLL THR;*WAI"`	starts the measurement of reference data using direct connection between generator and device input and waits for the sweep end.

Characteristics: *RST value: --
SCPI: conforming

Mode: A

[SENSe<1|2>:]CORRection:RECall

This command restores the instrument setting that was valid for the measurement of the reference data, provided that the tracking generator is active.

Example: `"CORR:REC"`

Characteristics: *RST value: -
SCPI: conforming

Mode: A

This command is an event and is therefore not assigned an *RST value and has no query.
It is only valid in conjunction with the ext. generator control option (B10).

SENSe:DETector Subsystem

The SENSe:DETector subsystem controls the acquisition of measurement data via the selection of the detector for the corresponding trace. The measurement windows are selected by SENSe1 (screen A) and SENSe2 (screen B).

COMMAND	PARAMETERS	UNIT	COMMENT
[SENSe<1|2>]			
:DETector<1 to 3>			
[:FUNCtion]	APEak | NEGative| POSitive | SAMPle| RMS | AVERage | QPEak		
:AUTO	<Boolean>		

[SENSe<1|2>:]DETector<1..3>[:FUNCtion] APEak | NEGative | POSitive | SAMPle | RMS | AVERage | QPEak

This command switches on the detector for the data acquisition in the selected trace and the indicated measurement window.

- The APEak detector (AutoPeak) displays the positive and also the negative peak value of the noise floor. If a signal is detected, only the positive peak value is displayed.
- The POSitive or NEGative detector only displays the positive or the negative peak value.
- With the Sample detector the value measured at the sampling time is displayed, whereas the RMS value of the power measured at each test point is displayed with the RMS detector.
- The AVERage detector displays the power average value at each test point.
- The QPEak detector performs a signal evaluation for EMC measurements.

If QPEak is selected, the video filter is automatically switched off. The couplings between span and RBW as well as between RBW and sweep time are also switched off and restored on selecting another detector. A long sweep time should be selected so that the quasi-peak detector can fully settle at each test point.

The trace is indicated as numeric suffix in `DETector`.

Note:
APEak and QPEak are not available during GSM measurements phase-frequency error/power vs. time.

Example: `"DET POS"` Sets the detector in screen A to "positive peak".

Characteristics: *RST value: APEak
SCPI: conforming

Mode: A, MS

[SENSe<1|2>:]DETector<1 to 3>[:FUNCtion]:AUTO ON | OFF

This command either couples the detector in the selected measurement window to the current trace setting or turns coupling off. The trace is selected by the numeric suffix at DETector.

Example: `"DET:AUTO OFF"`

Characteristics: *RST value: ON
SCPI: conforming

Mode: A, MS

SENSe:FREQuency Subsystem

The SENSe:FREQuency subsystem defines the frequency-axis of the active display. The frequency-axis can either be defined via the start/stop frequency or via the center frequency and span. The measurement windows are selected by SENSe1 (screen A) and SENSe2 (screen B).

COMMAND	PARAMETERS	UNIT	COMMENT
[SENSe<1|2>]			
:FREQuency			
:CENTer	<numeric_value>	HZ	
:STEP	<numeric_value>	HZ	
:LINK	SPAN|RBW|OFF	--	
:FACTor	<numeric_value>	PCT	
:SPAN	<numeric_value>	HZ	
:FULL	--	--	
:STARt	<numeric_value>	HZ	
:STOP	<numeric_value>	HZ	
:MODE	CW|FIXed|SWEep		
:OFFSet	<numeric_value>	HZ	

[SENSe<1|2>:]FREQuency:CENTer 0 to f_{max}

This command defines the center frequency of the analyzer or the measuring frequency for span = 0.

Example: `"FREQ:CENT 100MHz"`

Characteristics: *RST value: f_{max} /2 with f_{max} = maximum frequency of the analyzer
SCPI: conforming

Mode: all

[SENSe<1|2>:]FREQuency:CENTer:STEP 0 to f_{max}

This command defines the step width of the center frequency.

Example: `"FREQ:CENT:STEP 120MHz"`

Characteristics: *RST value: - (AUTO 0.1 × SPAN is switched on)
SCPI: conforming

Mode: all

[SENSe<1|2>:]FREQuency:CENTer:STEP:LINK SPAN | RBW | OFF

This command couples the step width of the center frequency to span (span >0) or to the resolution bandwidth (span = 0) or cancels the couplings.

Parameters:
SPAN = Coupling to frequency display range (for span > 0)
RBW = Coupling to resolution bandwidth (for span = 0)
OFF = manual input, no coupling.

Note:
This function is not available during GSM measurements phase-frequency error/power vs. time.

Example: `"FREQ:CENT:STEP:LINK SPAN"`

Characteristics: *RST value: SPAN
SCPI: device-specific

Mode: A, MS

[SENSe<1|2>:]FREQuency:CENTer:STEP:LINK:FACTor 1 to 100 PCT

This command couples the step width of the center frequency with a factor to the span (span >0) or to the resolution bandwidth (span = 0).

Note:
This function is not available during GSM measurements phase-frequency error/power vs. time.

Example: "FREQ:CENT:STEP:LINK:FACT 20PCT"

Characteristics: *RST value: - (AUTO 0.1 × SPAN is switched on)
SCPI: device-specific

Mode: A, MS

[SENSe<1|2>:]FREQuency:SPAN 0 to f_{max}

This command defines the frequency span of the analyzer.

Note:
This function is not available during GSM measurements phase-frequency error/power vs. time.

Example: "FREQ:SPAN 10MHz"

Characteristics: *RST value: f_{max} with f_{max} = maximum frequency of the analyzer
SCPI: conforming

Mode: A, MS

[SENSe<1|2>:]FREQuency:SPAN:FULL

This command sets the frequency span of the analyzer to its maximum.

Note:
This function is not available during GSM measurements phase-frequency error/power vs. time/ carrier power.

Example: "FREQ:SPAN:FULL"

Characteristics: *RST value: -
SCPI: conforming

Mode: A, MS

[SENSe<1|2>:]FREQuency:STARt 0 to f_{max}

This command defines the start frequency of the analyzer. This command is only available in the frequency domain (span >0).

Note:
This function is not available during GSM measurements phase-frequency error/power vs. time/ carrier power.

Example: "FREQ:STAR 20MHz"

Characteristics: *RST value: 0
SCPI: conforming

Mode: A-F, MS

[SENSe<1|2>:]FREQuency:STOP 0 to f_{max}

This command defines the stop frequency of the analyzer.This command is only available in the frequency domain (span >0).

Note:
This function is not available during GSM measurements phase-frequency error/power vs. time/carrier power.

Example: "FREQ:STOP 2000MHz"

Characteristics: *RST value: f_{max}
SCPI: conforming

Mode A-F, MS

[SENSe<1|2>:]FREQuency:MODE CW | FIXed | SWEep

This command switches between frequency domain (SWEep) and time domain (CW | FIXed) in the analyzer mode.

For CW and FIXed, the frequency setting is via command `FREQuency:CENTer`. In the SWEep mode, the setting is via commands `FREQuency:STARt`, `STOP`, `CENTer` and `SPAN`.

Note:
This function is not available with the GSM measurements Phase-Frequency Error/Power vs. Time/Carrier Power/SPU.

Example: "FREQ:MODE SWE"

Characteristics: *RST value: SWEep
SCPI: conforming

Mode: A, MS

[SENSe<1|2>:]FREQuency:OFFSet <numeric_value>

This command defines the frequency offset of the instrument.

Example: "FREQ:OFFS 1GHZ"

Characteristics: *RST value: 0 Hz
SCPI: conforming

Mode: A, MS

SENSe:LIST Subsystem

The commands of this subsystem are used for measuring the power at a list of frequency points with different device settings. The measurement is always performed in the time domain (span = 0 Hz).

A new trigger event is required for each test point (exception: Trigger FREE RUN).

The results are output as a list in the order of the entered frequency points. The number of results per test point depends on the number of concurrently active measurements (peak/RMS/average).

Selection of concurrently active measurements and setting of parameters that are constant for the whole measurement is via a configuration command (SENSe:LIST:POWer:SET). This also includes the setting for trigger and gate parameters.

The following setting parameters can be selected independently for each frequency point:

- Analyzer frequency
- Reference level
- RF attenuation
- RF attenuation of attenuator (only with option B25)
- Resolution filter
- Resolution bandwidth
- Video bandwidth
- Measurement time
- Detector

The number of frequencies is limited to 100 entries.

The commands of this subsystem can be used in two different ways:

1. Instrument setup, measurement and querying of the results in a single command: With this method, there is the least delay between the measurement and the result output. However, it requires the control computer to wait for the response from the instrument.
2. Instrument setup and querying of the result list at the end of the measurement: With this method, the control computer may be used for other activities while the measurement is being performed. However, more time is needed for synchronization via service request.

Note:
Settings that are not directly included in commands of this subsystem can be configured by sending the corresponding commands prior to the SENSe:LIST-commands.
Please note that changes to the trigger level have to be executed in time domain (span = 0 Hz) in order to take effect for the SENSe:LIST-commands.

COMMAND	PARAMETER	UNIT	COMMENT
[SENSe<1|2>]			
:LIST			
:POWer			
:RESult?			Query only
[:SEQuence]	<numeric_value>, <numeric_value>, <numeric_value>, <numeric_value> | OFF, NORMal | CFILter | RRC, <numeric_value>, <numeric_value>, <numeric_value>, <numeric_value> ...	HZ, DBM, DB, DB, --, HZ, HZ, S, PCT|DBM	
:SET	<Boolean>, <Boolean>, <Boolean>, IMMediate | EXTernal | VIDeo | IFPower, POSitive|NEGative, <numeric_value>, <numeric_value>	--, --, --, --, --, S, S	
:STATe	OFF		

[SENSe<1|2>:]LIST:POWer[:SEQuence] <analyzer freq>,<ref level>,<rf att>,<el att>, <filter type>,<rbw>,<vbw>,<meas time>,<trigger level>,...

This command configures the list of settings (max. 100 entries) for the multiple power measurement and starts a measurement sequence. When synchronizing the command with *OPC, a service request is generated as soon as all frequency points are processed and the defined number of individual measurements (# of meas) is reached.

To reduce the setting time, all indicated parameters are set up simultaneously at each test point.

The query form of the command processes the list and immediately returns the list of results. The number of results per test point depends on the setting of the "SENSe:LIST:POWer:SET" command.

Parameter:

Note:
The following parameters are the settings for an individual frequency point. They are repeated for every other frequency point.

<analyzer freq>: Receive frequency for the signal to be measured (= center frequency in manual operation)

Range of values: 0 Hz to max. analyzer frequency, depending on the instrument model.

<ref level>: Reference level

Range of values: +30 dBm to -75 dBm in 5 dB steps

<rf att>: RF input attenuation

Range of values:	0 dB to 70 dB	in 10 dB steps
	0 dB to 75 dB	in 5 dB steps with El. Attenuator Option B25
Range of values:	0 dB to 75 dB	in 5 dB steps

<el att>:	RF input attenuation of electronic attenuator		
	Range of values:	0 dB to 30 dB	in 10 dB steps
		OFF	electronic attenuator not in signal path
	If option B25 is missing, OFF is to be used.		
<filter type>:	NORMal:	normal resolution filter	
	CFILter:	channel filter. These are especially steep-edged filters, which are used for example in Fast ACP measurement to ensure the band-limiting of a transmission channel in the time domain.	
	RRC:	Root Raised Cosine filter. This special filter form is used to determine the channel power for some mobile radio standards.	
<rbw>:	Resolution bandwidth		
	Range of values:	10 Hz to 20 MHz, 50 MHz	in 1, 2, 3, 5, 10 steps for <filter type> = NORMal.
		See filter table	for <filter type> = CFILter and <filter type> = RRC. Possible combinations of filter type and filter bandwidth see table "List of available channel filters" in section "Setting Bandwidths and Sweep Time – Key *BW*".
<vbw>:	Video bandwidth		
	Range of values:	1 Hz to 10 MHz	in 1, 2, 3, 5, 10 steps. The value is ignored for <filter type> = CFILter or RRC
<meas time>:	Measurement time		
	Range of values:	1us to 30s	
<trigger level>:	Reserved. Must be set to 0.		

Returned values:

The query command returns a list of comma-separated values (CSV) which contains the power measurement results in floating-point format. The unit depends on the setting with `CALC:UNIT`.

Command

```
"SENSe:LIST:POWer?  935.2MHz,-20dBm,10dB,OFF,NORM,1MHz,3MHz,434us,0,
                   935.4MHz,-20dBm,10dB,10dB,NORM,30kHz,100kHz,434us,0,
                   935.6MHz,-20dBm,10dB,20dB,NORM,30kHz,100kHz,434us,0"
```

thus returns the following list, for example:

-28.3,-30.6,-38.1

If the command sequence is extended to

```
"SENSe:LIST:POWer:SET ON,ON,ON,IMM,POS,0,0"
"SENSe:LIST:POWer?  935.2MHz,-20dBm,10dB,OFF,NORM,1MHz,3MHz,434us,0,
                   935.4MHz,-20dBm,10dB,10dB,NORM,30kHz,100kHz,434us,0,
                   935.6MHz,-20dBm,10dB,20dB,NORM,30kHz,100kHz,434us,0"
```

the result list is extended to 3 results per frequency point (peak, RMS and average):
-28.3, -29.6, 1.5, -30.6, -31.9, 0.9, -38.1, -40.0, 2.3

Note:
This function is not available during GSM measurements phase-frequency error/power vs. time.

Examples:

```
"SENSe:LIST:POWer   935.2MHz,-20dBm,10dB,OFF,NORM,1MHz,3MHz,434us,0,
                   935.4MHz,-20dBm,10dB,10dB,CFIL,30kHz,100kHz,434us,0,
                   935.6MHz,-20dBm,10dB,20dB,CFIL,30kHz,100kHz,434us,0"
```

performs a measurement sequence with the following settings:

Step	Freq. [MHz]	Ref Level	RF Att	el Att	Filtertyp	RBW	VBW	Meas Time	TRG Level (reserved)
1	935.2	-20 dBm	10 dB	OFF	Normal	1 MHz	3 MHz	434 us	0
2	935.4	-20 dBm	10 dB	10dB	Channel	30 kHz	100 kHz	434 us	0
3	935.6	-20 dBm	10 dB	20dB	Channel	30 kHz	100 kHz	434 us	0

```
"SENSe:LIST:POWer?  935.2MHz,-20dBm,10dB,OFF,NORM,1MHz,3MHz,434us,0,
                   935.4MHz,-20dBm,10dB,10dB,CFIL,30kHz,100kHz,434us,0,
                   935.6MHz,-20dBm,10dB,20dB,CFIL,30kHz,100kHz,434us,0"
```

performs the same measurement and returns the result list immediately after the last frequency point.

Notes: *The measurement is performed in the time domain and therefore the span is set to 0 Hz. If the time domain is abandoned, the function is automatically switched off.*

The measurement is not compatible with other measurements, especially as far as marker, adjacent channel power measurement or statistics are concerned. The corresponding commands thus automatically deactivate the function.

The function is only available in REMOTE operation. It is deactivated when switching the instrument back to LOCAL.

Characteristics: *RST value: --
SCPI: device-specific

Mode: A-F, A-T, MS

[SENSe<1|2>:]LIST:POWer:SET <PEAK meas>,<RMS meas>,<AVG meas>, <trigger mode>,<trigger slope>,<trigger offset>,<gate length>

This command defines the constant settings for the list during multiple power measurement.

Parameters <PEAK meas>, <RMS meas> and <AVG meas> define, which measurements are to be performed at the same time at the frequency point. Correspondingly, one, two or three results per frequency point are returned for the SENS:LIST:POW? command. If all three parameters are set to OFF, the command generates an execution error.

Parameter:

<PEAK meas>: ON activates the measurement of the peak power (peak detector).
OFF deactivates the measurement of the peak power.

<RMS meas>: ON activates the measurement of the RMS power (RMS detector).
OFF deactivates the measurement of the RMS power.

<AVG meas>: ON activates the measurement of the average power (average detector).
OFF deactivates the measurement of the average power.

<trigger mode>: Selection of the trigger source used for the list measurement.
Possible values:
IMMediate | VIDeo | EXTernal | IFPower

<trigger slope>: Used trigger slope.
Possible values:
POSitive | NEGative

<trigger offset>: Offset between the detection of the trigger signal and the start of the measurement at the next frequency point.
Range of values: 0 s, 125 ns to 100s

<gate length>: Gate length with Gated Sweep.
Range of values: 0 s, 125 ns to 100s

Note:

- *The value 0 s deactivates the use of GATED TRIGGER; other values activate the GATED TRIGGER function.*
- *Values <> 0 s are only possible if <trigger mode> is different from IMMediate. Otherwise, an execution error is triggered.*

Returned values:

The query command returns a list of comma-separated values (CSV) of the settings, ie

```
ON,ON,ON,IMM,POS,0,0
```

if the configuration has been set with the command

```
"SENSe:LIST:POWer:SET ON,ON,ON,IMM,POS,0,0"
```

Note:
This function is not available during GSM measurements phase-frequency error/power vs. time.

Examples:

```
"SENSe:LIST:POWer:SET ON,OFF,OFF,EXT,POS,10US,434US"
"SENSe:LIST:POWer:SET ON,ON,ON,VID,NEG,10US,0"
```

Characteristics: *RST values: `ON,OFF,OFF,IMM,POS,0S,0S`
SCPI: device-specific

[SENSe<1|2>:]LIST:POWer:RESult?

This command queries the result of a previous list measurement as configured and initiated with `SENSe:LIST:POWer[:SEQuence]`. The measured results are output in a list of floating point values separated by commas. The unit of the results depends on the setting made with the CALC:UNIT command.

This command may be used to obtain measurement results in an asynchronous way, using the service request mechanism for synchronization with the end of the measurement.

If no measurement results are available, the command will return a query error.

Note:
This function is not available during GSM measurements phase-frequency error/power vs. time.

Example:

```
'Configuration of the status reporting system for the generation of an SRQ
on operation complete

*ESE 1

*SRE 32

'Configuring and starting the measurement
"SENSe:LIST:POWer 935.2MHz,-20dBm,10dB,OFF,NORM,1MHz,3MHz,434us,0,
                  935.4MHz,-20dBm,10dB,10dB,NORM,30kHz,100kHz,434us,0,
                  935.6MHz,-20dBm,10dB,20dB,NORM,30kHz,100kHz,434us,0;
                  *OPC"

'Further actions of the control computer during measurement

...

'Response to service request

On SRQ:

SENSe:LIST:POWer:RESult?
```

Characteristics: *RST value: --
SCPI: device-specific

Mode: A-F, A-T, MS

[SENSe<1|2>:]LIST:POWer:STATe OFF

This command deactivates the list measurement.

Note:
This function is not available during GSM measurements phase-frequency error/power vs. time.

Example:

```
SENSe:LIST:POWer:STATe OFF
```

Characteristics: *RST value: --
SCPI: device-specific

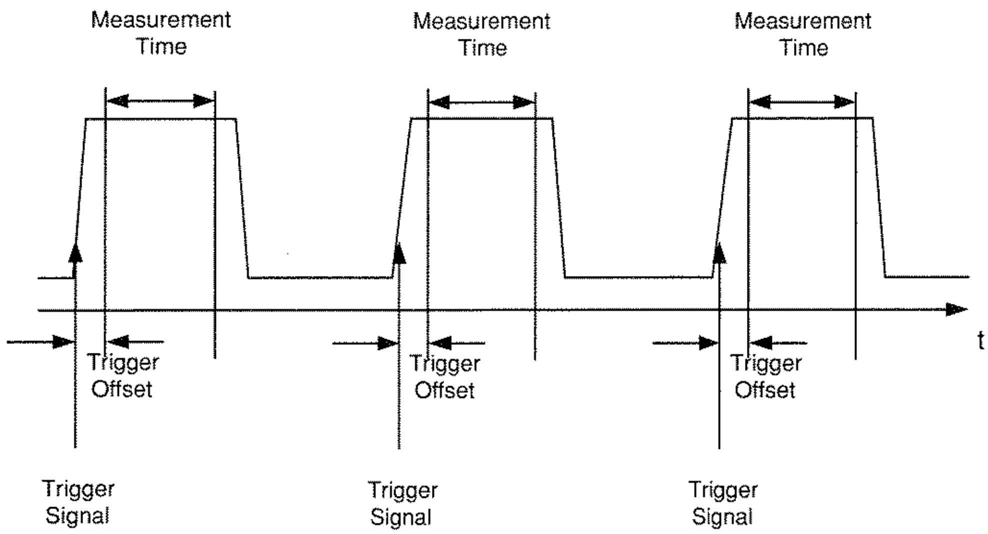
Mode: A-F, A-T, MS

SENSe:MPOWer – Subsystem

The commands of this subsystem are used to determine the mean burst power or peak burst power for a given number of signal bursts, and for outputting the results in a list. Since all the settings required for a measurement are combined in a single command, the measurement speed is considerably higher than when using individual commands.

For measuring the signal bursts, the GATED SWEEP function is used in the time domain. The gate is controlled either by an external trigger signal or by the video signal. An individual trigger event is required for each burst to be measured. If an external trigger signal is used, the threshold is fixed to TTL level, while with a video signal the threshold can be set as desired.

The following graphics shows the relation between trigger time, trigger offset (for delayed gate opening) and measurement time.



Depending on the settings made, the measurements are performed with the RMS detector for RMS power or the PEAK detector for peak power. For all these measurements, TRACE 1 of the selected system is used.

The setting parameters for this measurement are:

- analyzer frequency
- resolution bandwidth
- measurement time used for a single burst
- trigger source
- trigger level
- trigger offset
- type of power measurement (PEAK, MEAN)
- number of bursts to be measured

The commands of this subsystem can be used in two different ways:

1. Setting up the instrument and at the same time querying the result list: This method ensures the smallest delay between measurement and the output of the measured values, but requires the control computer to wait actively for the response of the instrument.
2. Setting up the instrument and querying the result list after synchronisation to the end of measurement:
   With this method the control computer can be used for other activities while the analyzer is performing the measurement at the cost of additional time needed for synchronisation via service request.

COMMAND	PARAMETER	UNIT	COMMENT
[SENSe<1|2>]			
:MPOWer			
[:SEQuence]	<numeric_value>, <numeric_value>, <numeric_value>, EXTernal | VIDeo, <numeric_value>, <numeric_value>, MEAN | PEAK, <numeric_value>	HZ, HZ, S, --, PCT, S, --, --	
:RESult			
[:LIST]?			Query only
:MIN?			Query only

[SENSe<1|2>:]MPOWer[:SEQuence] <analyzer freq>,<rbw>,<meas time>,<trigger source>, <trigger level>,<trigger offset>,<type of meas>,<# of meas>

This command configures the instrument setup for multiple burst power measurement and starts a measurement sequence. When synchronizing the command with *OPC, a service request is generated as soon as the defined number of individual measurements (# of meas) is reached.

To reduce the setting time, the setup is performed simultaneously for all selected parameters.

The command in the form of a query makes the instrument settings, performs the defined number of measurements and outputs the measurement results list.

Parameters:

<analyzer freq>: Receive frequency for the burst signals to be measured (= center frequency in manual operation)

Range: 0 Hz to max. analyzer frequency, depending on instrument model

<rbw>: resolution bandwidth for the measurement

Range: 10 Hz to 10 MHz in steps of 1, 3, 10

<meas time>: Time span during which measurement samples are sampled for RMS / peak measurement The type of measurement is selected by <type of meas>.

Range: 1us to 30s

<trigger source>: trigger signal source. Possible settings:

EXTernal The trigger signal is fed from the "Ext. Trigger/Gate" input on the rear of the unit.

VIDeo The internal video signal is used as trigger signal.

<trigger level>: Signal level at which the trigger becomes active. For <trigger source> = VIDeo this is the level of the video signal as a percentage of the diagram height. If <trigger source> = EXTernal is selected, the value entered here is ignored, as in this case the trigger input uses TTL levels.

Range: 0 – 100PCT (<trigger source> = VIDeo)

<trigger offset>: Offset between the detection of the trigger signal and the start of the measurement.

Range: 125 ns to 100s

<type of meas>: Determines whether mean power (RMS) or peak power (PEAK) is to be measured. The detector is selected accordingly.

Possible values:MEAN, PEAK

<# of meas>: Number of individual bursts to be measured.
Range: 1 to 501

Note:
This function is not available during GSM measurements phase-frequency error/power vs. time.

Return values:

The query command returns a list separated by commas (comma separated values = CSV), which contains the power measurement results in floating-point format. The unit used for the return values is always dBm.

The command `"SENSe:MPOWer? 935.2MHz,1MHz,434us,VIDEO,50PCT,5us,MEAN,20"` may, for instance, cause the following list to be returned:

18.3,18.6,18.1,18.0,17.9,18.3,18.6,18.1,18.0,17.9,18.3,18.6,18.1,18.0,17.9,18.3,18.6,18.1,18.0,17.9

Examples: `"SENSe:MPOWer 935.2MHz,1MHz,434us,VIDEO,50PCT,5us,MEAN,20"`
performs a measurement sequence with the following settings:

Frequency	= 935.2 MHz,
Resolution bandwidth	= 1 MHz
Measurement time	= 434 µs
Trigger source	= VIDEO
Trigger threshold	= 50%
Trigger offset	= 5 µs
Type of measurement	= MEAN power
No. of measurements	= 20

`"SENSe:MPOWer? 935.2MHz,1MHz,434us,VIDEO,50PCT,5us,MEAN,20"`

performs the same measurement and in addition returns the results list immediately after completion of the last measurement.

Notes: *The measurement function always uses trace 1 in the selected screen, and activates the selected screen.*
Repeated use of the command without changes to its parameters (ie using the same settings again) will speed up the measurement since the previous hardware settings will be cached and therefore additional hardware settling times will be avoided. This also holds true if only part of the parameters (e.g. only the trigger delay) are changed, as in this case the rest of the parameters will be cached.

This measurement is not compatible with other measurements, especially as far as marker functions, adjacent-channel measurement or statistics are concerned. The corresponding functions are therefore automatically switched off. In return incompatible commands will automatically deactivate the multi burst power function.

The function is only available in the REMOTE operation. It is deactivated on switching back to LOCAL.

Characteristics: *RST value: --
SCPI: instrument-specific

Mode: A-F, A-T, MS

SENSe:MPOWer:RESult[:LIST]?

This command queries the results of a multiple burst power measurement as configured and initiated with `SENSe:MPOWer[:SEQuence]`. The results are output in a comma-separated list of floating point values. The unit used for the return values is always dBm.
This command may be used to obtain measurement results in an asynchronous way using the service request mechanism for synchronization with the end of the measurement.
If no measurement results are available, the command will return a query error.

Note: *This function is not available during GSM measurements phase-frequency error/power vs. time.*

Example:

```
'Configuration of status reporting systems for the
'generation of an SRQ on operation complete
*ESE 1
*SRE 32
'Configuring and starting the measurement
SENSe:MPOWer
935.2MHz,1MHz,434us,VIDEO,50PCT,5us,MEAN,20;*OPC
'Further actions of the control computer during measurement
...
'Response to service request
On SRQ:
SENSe:MPOWer:RESult?
```

Characteristics: *RST value: --
SCPI: instrument-specific

Mode: A-F, A-T, MS

SENSe:MPOWer:RESult:MIN?

This command queries the minimum power value in a multiple burst power measurement as configured and initiated with `SENSe:MPOWer[:SEQuence]`. The unit used for the return values is always dBm.

If no measurement result is available, the command will return a query error.

Note: *This function is not available during GSM measurements phase-frequency error/power vs. time.*

Example:

```
'Configuration of the status reporting system for the
'generation of an SRQ on operation complete
*ESE 1
*SRE 32
'Configuring and starting the measurement
SENSe:MPOWer
935.2MHz,1MHz,434us,VIDEO,50PCT,5us,MEAN,20;*OPC
'Further actions of the control computer during measurement
...
'Response to service request
On SRQ:
SENSe:MPOWer:RESult:MIN?
```

Characteristics: *RST value: --
SCPI: instrument-specific

Mode: A-F, A-T, MS

SENSe:POWer Subsystem

This subsystem controls the setting of the instrument's channel and adjacent channel power measurements. The measurement windows are selected by SENSe1 (screen A) and SENSe2 (screen B).

Note:

The functions of this subsystem are not available during GSM measurements.

COMMAND	PARAMETERS	UNIT	COMMENT
[SENSe<1|2>]			
:POWer			
:ACHannel			
:SPACing			
[:ACHannel]	<numeric_value>	HZ	
:ALTernate<1|2>	<numeric_value>	HZ	
:ACPairs	0 | 1 | 2 | 3		
:BANDwidth			
[:CHANnel]	<numeric_value>	HZ	
:ACHannel	<numeric_value>	HZ	
:ALTernate<1|2>	<numeric_value>	HZ	
:BWIDth			
[:CHANnel]	<numeric_value>	HZ	
:ACHannel	<numeric_value>	HZ	
:ALTernate<1|2>	<numeric_value>	HZ	
:MODE	ABSolute | RELative		
:REFerence			
:AUTO	ONCE		no query
:PRESet	ACPower | CPOWer | OBANdwidth | OBWidth		
:RLEVel			
:BANDwidth	<numeric_value>	PCT	
:BWIDth	<numeric_value>	PCT	
:HSPeed	<Boolean>		
:NCORrection	<Boolean>		
:TRACe	<numeric_value>	--	

[SENSe<1|2>:]POWer:ACHannel:SPACing:ACHannel 100 Hz to 2000 MHz

This command defines the channel spacing of the adjacent channel to the TX channel. At the same time, the spacing of alternate adjacent channels 1 and 2 is set to the double or triple of the entered value.

The command is only available in the frequency domain (span > 0).

Example: `"POW:ACH:SPAC:ACH 33kHz"` Sets the spacing between the carrier signal and
- the adjacent channel to 33 kHz
- the alternate adjacent channel 1 to 66 kHz
- the alternate adjacent channel 2 to 99 kHz

Characteristics: *RST value: 14 kHz
SCPI: device-specific

Mode: A-F

[SENSe<1|2>:]POWer:ACHannel:SPACing:ALTernate<1|2> 100 Hz to 2000 MHz

This command defines the spacing between the first (ALTernate1) or the second alternate adjacent channel (ALTernate2) and the TX channel.If the spacing to the alternate adjacent channel ALTernate1 is modified, the spacing to alternate adjacent channel 2 is set to 1.5 times the entered value.

This command is only available in the frequency domain (span > 0).

Example: `"POW:ACH:SPAC:ALT1 100kHz"` Sets the spacing between TX channel and alternate adjacent channel 1 to 100 kHz and between TX channel and alternate adjacent channel 2 to 150 kHz.

Characteristics: *RST value: 40 kHz (ALT1)
60 kHz (ALT2)
SCPI: device-specific

Mode: A-F

[SENSe<1|2>:]POWer:ACHannel:ACPairs 0 | 1.| 2 | 3

This command sets the number of adjacent channels (upper and lower channel in pairs).The figure 0 stands for pure channel power measurement.

The command is only available in the frequency domain (span > 0).

Example: `"POW:ACH:ACP 3"` Sets the number of adjacent channels to 3, ie the adjacent channel and alternate adjacent channels 1 and 2 are switched on.

Characteristics: *RST value: 1
SCPI: device-specific

Mode: A-F

[SENSe<1|2>:]POWer:ACHannel:BANDwidth|BWIDth[:CHANnel] 100 Hz to 1000 MHz

This command sets the channel bandwidth of the radio communication system.The bandwidths of adjacent channels are not influenced by this modification (in contrast to the FSE family).

With `SENS:POW:HSP ON` the steep-edged channel filters from the table "List of available channel filters" in Section "Setting Bandwidths and Sweep Time – Key *BW*" are available.

Example: `"POW:ACH:BWID 30kHz"` Sets the banwidth of the TX channel to 30 kHz.

Characteristics: *RST value: 14 kHz
SCPI: device-specific

Mode: A-F

[SENSe<1|2>:]POWer:ACHannel:BANDwidth|BWIDth:ACHannel 100 Hz to 1000 MHz

This command defines the channel bandwidth of the adjacent channel of the radio transmission system. If the bandwidth of the adjacent channel is changed, the bandwidths of all alternate adjacent channels are automatically set to the same value.

With `SENS:POW:HSP ON` the steep-edged channel filters from the table "List of available channel filters" in Section "Setting Bandwidths and Sweep Time – Key *BW*" are available.

Example: `"POW:ACH:BWID:ACH 30kHz"` Sets the bandwidth of all adjacent channels to 30 kHz.

Characteristics: *RST value: 14 kHz
SCPI: device-specific

Mode: A-F

[SENSe<1|2>:]POWer:ACHannel:BANDwidth|BWIDth:ALTernate<1|2> 100 Hz to 1000 MHz

This command defines the channel bandwidth of the first/second alternate adjacent channel of the radio transmission system. If the channel bandwidth of alternate adjacent channel 1 is changed, the bandwith of alternate adjacent channel 2 is automatically set to the same value.

With `SENS:POW:HSP ON` the steep-edged channel filters from the table "List of available channel filters" in Section "Setting Bandwidths and Sweep Time – Key *BW*" are available.

Example: `"POW:ACH:BWID:ALT2 30kHz"`

Characteristics: *RST value: 14 kHz
SCPI: device-specific

Mode: A-F

[SENSe<1|2>:]POWer:ACHannel:MODE ABSolute | RELative

This command toggles between absolute and relative adjacent channel measurement.

For the relative measurement the reference value is set to the currently measured channel power by command `SENSe:POWer:ACHannel:REFerence:AUTO ONCE`.

The command is only available in the frequency domain (span > 0).

Example: `"POW:ACH:MODE REL"`

Characteristics: *RST value: ABSolute
SCPI: device-specific

Mode: A-F

[SENSe<1|2>:]POWer:ACHannel:REFerence:AUTO ONCE

This command sets the reference value for the relative measurement to the currently measured channel power.

The command is only available in the frequency domain (span > 0).

Example: `"POW:ACH:REF:AUTO ONCE"`

Characteristics: *RST value: -
SCPI: device-specific

Mode: A-F

This command is an event and is therefore not assigned an *RST value and has no query.

[SENSe<1|2>:]POWer:ACHannel:PRESet ACPower | CPOWer | OBANdwidth|OBWidth

This command adapts the frequency span, the bandwidths and the detector to the number of channels, channel bandwidths and channel spacings of the active power measurement and switches on the adjacent channel power measurement, if required.

To ensure that the results are valid, a complete sweep including synchronization to the sweep end must be performed after the configuration. Synchronization is only possible in single sweep mode.

The results are queried with `CALCulate:MARKer:FUNCtion:POWer:RESult?`.

The command is only available in the frequency domain (span > 0).

Example:	`"POW:ACH:REF:PRES ACP"`	Sets the frequency range, bandwidths and detector suitable for ACP measurement in screen A.
	`"INIT:CONT OFF"`	Switches to single-sweep mode.
	`"INIT;*WAI"`	Starts a sweep and waits for the end.
	`"CALC:MARK:FUNC:POW:RES? ACP"`	Queries the result of the adjacent channel power measurement.

Characteristics: *RST value: -
SCPI: device-specific

Mode: A-F

[SENSe<1|2>:]POWer:ACHannel:PRESet:RLEVel

This command adapts the reference level to the measured channel power and – if required - switches on previously the adjacent channel power measurement. This ensures that the signal path of the instrument is not overloaded. Since the measurement bandwidth is significantly smaller than the signal bandwidth in channel power measurements, the signal path can be overloaded although the trace is still significantly below the reference level. If the measured channel power equals the reference level, the signal path is not overloaded.

The command is only available in the frequency domain (span > 0).

Note:
*Subsequent commands have to be synchronized with *WAI, *OPC or *OPC? to the end of the autorange process which would otherwise be aborted.*

Example:	`"POW:ACH:REF:PRES:RLEV;*WAI"`	Adapts the reference level to the measured channel power.

Characteristics: *RST value: -
SCPI: device-specific

Mode: A-F

[SENSe<1|2>:]POWer:BANDwidth|BWIDth 10 to 99.9PCT

This command defines the percentage of the power with respect to the total power. This value is the basis for the occupied bandwidth measurement (command: `POWer:ACHannel:PRESet OBW`).

The command is only available in the frequency domain (span > 0).

Example: `"POW:BWID 95PCT"`

Characteristics: *RST value: 99PCT
SCPI: device-specific

Mode: A-F

[SENSe<1|2>:]POWer:HSPeed ON | OFF

This command switches on or off the high-speed channel/adjacent channel power measurement. The measurement itself is performed in the time domain on the center frequencies of the individual channels. The command automatically switches to the time domain and back.

Depending on the selected mobile radio standard, weighting filters with $\sqrt{\cos}$ characteristic or very steep-sided channel filters are used for band limitation.

The command is only available in the frequency domain (span > 0).

Example: `"POW:HSP ON"`

Characteristics: *RST value: OFF
SCPI: device-specific

Mode: A-F

[SENSe<1|2>:]POWer:TRACe 1 to 3

This command assigns the channel/adjacent channel power measurement to the indicated trace in the selected measurement window. The corresponding trace must be active, ie its state must be different from blank.

Note: *The measurement of the occupied bandwidth (OBW) is performed on the trace on which marker 1 is positioned. To evaluate another trace, marker 1 must be positioned to another trace with `CALCulate:MARKer:TRACe`.*

Example:
`"POW:TRAC 2"` Assigns the measurement in screen A to trace 2.
`"SENS2:POW:TRAC 3"` Assigns the measurement in screen B to trace 3.

Characteristics: *RST value: -
SCPI: device-specific

SENSe:ROSCillator Subsystem

This subsystem controls the reference oscillator. The numeric suffix in SENSe is irrelevant for the commands of this subsystem.

COMMAND	PARAMETERS	UNIT	COMMENT
[SENSe<1|2>]			
:ROSCillator			
:SOURce	INTernal | EXTernal	--	
[:INTernal]			
:TUNe	<numeric_value>		
:SAVe			no query

[SENSe<1|2>:]ROSCillator:SOURce INTernal | EXTernal

This command controls selection of the reference oscillator.

If the external reference oscillator is selected, the reference signal must be connected to the rear panel of the instrument.

Example: "ROSC:SOUR EXT"

Characteristics: *RST value: –
SCPI: conforming

Mode: all

[SENSe<1|2>:]ROSCillator[:INTernal]:TUNe 0 to 4095

This command defines the value for the tuning of the internal reference oscillator.

The reference oscillator should be tuned only if an error has been detected in the frequency accuracy check. After rebooting the instrument, the factory-set reference frequency or the previously saved reference frequency is restored.

Note: *This command is only available at service level 1.*

Example: "ROSC:TUN 128"

Characteristics: *RST value: –
SCPI: device-specific

Mode: all

[SENSe<1|2>:]ROSCillator[:INTernal]:TUNe:SAVe

This command saves the new value for the tuning of the internal reference oscillator. The factory-set value in the EEPROM is overwritten.

Note: *This command is only available at service level 1.*

Example: "ROSC:TUN:SAV"

Characteristics: *RST value: –
SCPI: device-specific

Mode: all

SENSe:SWEep Subsystem

This subsystem controls the sweep parameters. The measurement windows are selected by SENSe1 (screen A) and SENSe2 (screen B).

COMMAND	PARAMETERS	UNIT	COMMENT
[SENSe<1|2>]			
:SWEep			
:TIME	<numeric_value>	S	
:AUTO	<Boolean>	--	
:COUNt	<numeric_value>	--	
:EGATe	<Boolean>	--	
:TYPE	LEVel|EDGE	--	
:POLarity	POSitive|NEGative	--	
:HOLDoff	<numeric_value>	S	
:LENGth	<numeric_value>	S	
:SOURce	EXTernal | IFPower		

[SENSe<1|2>:]SWEep:TIME 2,5ms to 16000s (frequency domain) | 1µs... 16000s (time domain)

This command defines the sweep time. The available time values are different in the frequency domain (2.5 ms to 16000s with span > 0) and in the time domain (1µs to 16000s with span = 0).

If `SWEep:TIME` is directly programmed, automatic coupling to resolution bandwidth and video bandwidth is switched off.

Note:
This function is not available during GSM measurements phase-frequency error/power vs. time/ carrier power.

Example: `"SWE:TIME 10s"`

Characteristics: *RST value - (AUTO is set to ON)
SCPI: conforming

Mode: A, MS

[SENSe<1|2>:]SWEep:TIME:AUTO ON | OFF

This command controls the automatic coupling of the sweep time to the frequency span and bandwidth settings.

If `SWEep:TIME` is directly programmed, automatic coupling is switched off.

Note:
This function is not available during GSM measurements phase-frequency error/power vs. time/ carrier power.

Example: `"SWE:TIME:AUTO ON"` Switches on the coupling to frequency span and bandwidths.

Characteristics: *RST value: ON
SCPI: conforming

Mode: A, MS

[SENSe<1|2>:]SWEep:COUNt 0 to 32767

This command defines the number of sweeps started with single sweep, which are used for calculating the average or maximum value. In average mode, the value 0 defines a continuous averaging of measurement data over 10 sweeps.

Example:

"SWE:COUN 64"	Sets the number of sweeps to 64.
"INIT:CONT OFF"	Switches to single-sweep mode.
"INIT;*WAI"	Starts a sweep and waits for its end.

Characteristics: *RST value: 0
SCPI: conforming

Mode: A, MS

[SENSe<1|2>:]SWEep:EGATe ON | OFF

This command switches on/off the sweep control by an external gate signal. If the external gate is selected the trigger source is automatically switched to EXTernal as well.

In case of measurement with external gate, the measured values are recorded as long as the gate is opened. There are two possibilities:

1. The gate is edge-triggered (`"SWEep:EGATe:TYPE EDGE"`):
   After detection of the set gate signal edge, the gate remains open until the gate delay (`SWEep:EGATe:HOLDoff`) has expired.
2. The gate is level-triggered (`"SWEep:EGATe:TYPE LEVel"`):
   After detection of the gate signal, the gate remains open until the gate signal disappears.

A delay between applying the gate signal and the start of recording measured values can be defined with `SWEep:EGATe:HOLDoff`.

During a sweep the gate can be opened and closed several times. The synchronization mechanisms with *OPC, *OPC? and *WAI remain completely unaffected.

The sweep end is detected when the required number of measurement points (625 in analyzer mode) has been recorded.

Note:
This function is not available during GSM measurements phase-frequency error/power vs. time/ carrier power/spectrum due to switching/spurious emissions .

Example:

"SWE:EGAT ON"	Switches on the external gate mode.
"SWE:EGAT:TYPE EDGE"	Switches on the edge-triggered mode.
"SWE:EGAT:HOLD 100US"	Sets the gate delay to 100 μs.
"SWE:EGAT:LEN 500US"	Sets the gate opening time to 500 μs.
"INIT;*WAI"	Starts a sweep and waits for its end.

Characteristics: *RST value: OFF
SCPI: device-specific

Mode: A, MS

[SENSe<1|2>:]SWEep:EGATe:TYPE LEVel | EDGE

This command sets the type of triggering (level or edge) by the external gate signal.

The gate opening time cannot be defined with the parameter `EGATe:LENGth` in case of level triggering. The gate is closed when the gate signal disappears.

Note:
This function is not available during GSM measurements phase-frequency error/power vs. time/ carrier power/spectrum due to switching/spurious emissions .

Example: "SWE:EGAT:TYPE EDGE"

Characteristics: *RST value: EDGE
SCPI: device-specific

Mode: A, MS

[SENSe<1|2>:]SWEep:EGATe:POLarity POSitive | NEGative

This command determines the polarity of the external gate signal. The setting is valid both for the edge of an edge-triggered signal and the level of a level-triggered signal.

Note:
This function is not available during GSM measurements phase-frequency error/power vs. time/ carrier power/spectrum due to switching/spurious emissions .

Example: "SWE:EGAT:POL POS"

Characteristics: *RST value: POSitive
SCPI: device-specific

Mode: A, MS

[SENSe<1|2>:]SWEep:EGATe:HOLDoff 125 ns to 100 s

This command defines the delay time between the external gate signal and the continuation of the sweep.

Note:
This function is not available during GSM measurements phase-frequency error/power vs. time/ carrier power/spectrum due to switching/spurious emissions .

Example: "SWE:EGAT:HOLD 100us"

Characteristics: *RST value: 0s
SCPI: device-specific

Mode: A, MS

[SENSe<1|2>:]SWEep:EGATe:LENGth 0 to 100 s

In case of edge triggering, this command determines the time interval during which the instrument sweeps.

Note:
This function is not available during GSM measurements phase-frequency error/power vs. time/ carrier power/spectrum due to switching/spurious emissions .

Example: "SWE:EGAT:LENG 10ms"

Characteristics: *RST value: 0s
SCPI: device-specific

Mode: A, MS

[SENSe<1|2>:]SWEep:EGATe:SOURce EXTernal | IFPower

This command toggles between external gate signal and IF power signal as a signal source for the gate mode. If an IF power signal is used, the gate is opened as soon as a signal at > -20 dBm is detected within the IF path bandwidth (10 MHz).

This function is not available during GSM measurements. The trigger source selection has to be done with the command TRIGger<1|2>[:SEQuence]:SYNChronize:ADJust..

Example:	`"SWE:EGAT:SOUR IFP"`	Switches the gate source to IF power.
Characteristics:	*RST value:	IFPower
	SCPI:	device-specific
Mode:	A	

SOURce Subsystem

The SOURce subsystem controls the output signals of the analyzer if the option External Generator Control (FSP-B10) is installed. The measurement window is selected by SOURce1 (screen A) and SOURce2 (screen B).

SOURce:EXTernal Subsystem

The SOURce:EXTernal subsystem controls the operation of the unit with option Ext. Generator Control (B10). The commands are only valid for the selected window, with SOURce1 changing the setting in screen A and SOURce2 the setting in screen B.

The selection of the external generator 1 or 2 is via EXTernal<1|2>.

Note:
The commands of the SOURce:EXTernal subsystem assume that the addressed generator was correctly configured with the commands of subsystem
`SYSTem:COMMunicate:GPIB:RDEVice:GENerator.`

If no external generator is selected, if the IECBUS address is not correct or the generator is not ready for operation, an execution error will be generated.

COMMAND	PARAMETER	UNIT	COMMENT
SOURce<1|2>			
:EXTernal<1|2>			Ext. generator option
[:STATe]	<Boolean>		
:FREQuency			
:OFFSet	<numeric_value>	HZ	
[:FACTor]			
:NUMerator	<numeric_value>		
:DENominator	<numeric_value>		
:SWEep			
[:STATe]	<Boolean>		
:POWer			
[:LEVel]	<numeric_value>	DBM	

SOURce<1|2>:EXTernal<1|2>[:STATe] ON | OFF

This command activates or deactivates the external generator selected with `SOUR:EXT<1|2>:FREQ:SWE ON` in the selected window.

The suffix behind EXTernal is irrelevant for this command.

This command is only available in connection with option Ext. Generator Control B10.

Example:

`"SYST:COMM:RDEV:GEN1:TYPE 'SMP02'"`
selects SMP02 as generator 1.

`"SYST:COMM:RDEV:GEN1:LINK TTL"`
selects IECBUS + TTL link as interface.

`"SYST:COMM:RDEV:GEN1:ADDR 28"`
sets the generator address to 28.

`"SOUR:EXT1:FREQ:SWE ON"`
activates the frequency sweep for generator 1.

`"SOUR:EXT ON"` activates the external generator

Characteristics: *RST value: OFF
SCPI: device-specific

Operating mode: all

SOURce<1|2>:EXTernal<1|2>:FREQuency[:FACTor]:DENominator <numeric_value>

This command defines the denominator of the factor with which the analyzer frequency is multiplied in order to obtain the transmit frequency of the selected generator 1 or 2 in the selected window.

Note:
Select the multiplication factor in a way that the frequency range of the generator is not exceeded by the following formula

$$F_{Generator} = F_{Analyzer} * \frac{Numerator}{Denominator} + F_{Offset}$$

if applied to the start and stop frequency of the analyzer.

This command is only valid in combination with option Ext. Generator Control B10.

Example: "SOUR:EXT:FREQ:NUM 4"
"SOUR:EXT:FREQ:DEN 3" sets a multiplication factor of 4/3, ie the transmit frequency of the generator is 4/3 times the analyzer frequency.

Characteristics: *RST value: 1
SCPI: device-specific

Operating mode: all

SOURce<1|2>:EXTernal<1|2>:FREQuency[:FACTor]:NUMerator <numeric_value>

This command defines the numerator of the factor with which the analyzer frequency is multiplied to obtain the transmit frequency of the selected generator 1 or 2 in the selected window.

Note:
Select the multiplication factor so that the frequency range of the generator is not exceeded if the following formula

$$F_{Generator} = F_{Analyzer} * \frac{Numerator}{Denominator} + F_{Offset}$$

is applied to the start and stop frequency of the analyzer.

This command is only valid in combination with option Ext. Generator Control B10.

Example: "SOUR:EXT:FREQ:NUM 4"
"SOUR:EXT:FREQ:DEN 3" sets a multiplication factor of 4/3, ie the transmit frequency of the generator is 4/3 times the analyzer frequency.

Characteristics: *RST value: 1
SCPI: device-specific

Operating mode: all

SOURce<1|2>:EXTernal<1|2>:FREQuency:OFFSet <numeric_value>

This command defines the frequency offset of the selected generator 1 or 2 with reference to the receive frequency in the selected window.

Note:
Select the frequency offset of the generator so that the frequency range of the generator is not exceeded with the following formula

$$F_{Generator} = F_{Analyzer} * \frac{Numerator}{Denominator} + F_{Offset}$$

applied to the start and stop frequency of the analyzer.

This command is only valid in combination with option Ext. Generator Control B10.

Example:	`"SOUR:EXT:FREQ:OFFS 1GHZ"`	sets a frequency offset of the generator transmit frequency compared to the analyzer receive frequency of 1 GHz.

Characteristics: *RST value: 0 Hz
SCPI: device-specific

Operating mode: all

SOURce<1|2>:EXTernal<1|2>:FREQuency:SWEep[:STATe] ON | OFF

This command activates or deactivates the frequency sweep for generator 1 or 2 in the selected window.

This command is only valid in combination with option Ext. Generator Control B10.

Example:	`"SOUR:EXT1:FREQ:SWE ON"`	activates the frequency sweep for ext. generator 1.

Characteristics: *RST value: OFF
SCPI: device-specific

Operating mode: all

SOURce<1|2>:EXTernal<1|2>:POWer[:LEVel] <numeric_value>

This command sets the output power of the selected generator 1 or 2 in the selected window.

This command is only valid in combination with option Ext. Generator Control B10.

Example:	`"SOUR:EXT:POW -30dBm"`	sets the generator level to –30 dBm

Characteristics: *RST value: -20 dBm
SCPI: device-specific

Operating mode: all

STATus Subsystem

The STATus subsystem contains the commands for the status reporting system (see Section 3.8, Status Reporting System"). *RST does not influence the status registers.

COMMAND	PARAMETERS	UNIT	COMMENT
STATus			
:OPERation			
[:EVENt]?	--	--	
:CONDition?	--	--	
:ENABle	0 to 65535	--	
:PTRansition	0 to 65535	--	
:NTRansition	0 to 65535	--	
:PRESet	--	--	
:QUEStionable			
[:EVENt]?	--	--	
:CONDition?	--	--	
:ENABle	0 to 65535	--	
:PTRansition	0 to 65535	--	
:NTRansition	0 to 65535	--	
:POWer			
[:EVENt]?	--	--	
:CONDition?	--	--	
:ENABle	0 to 65535	--	
:PTRansition	0 to 65535	--	
:NTRansition	0 to 65535	--	
:LIMit<1|2>			
[:EVENt]?	--	--	
:CONDition?	--	--	
:ENABle	0 to 65535	--	
:PTRansition	0 to 65535	--	
:NTRansition	0 to 65535	--	
:LMARgin<1|2>			
[:EVENt]?	--	--	
:CONDition?	--	--	
:ENABle	0 to 65535	--	
:PTRansition	0 to 65535	--	
:NTRansition	0 to 65535	--	
:ACPLimit			
[:EVENt]?	--	--	
:CONDition?	--	--	
:ENABle	0 to 65535	--	
:PTRansition	0 to 65535	--	
:NTRansition	0 to 65535	--	
:FREQuency	--	--	
[:EVENt]?	0 to 65535	--	
:CONDition?	0 to 65535	--	
:ENABle	0 to 65535	--	
:PTRansition	--	--	
:NTRansition	--	--	
:QUEue?	--	--	
[:NEXT]?	--	--	

STATus:OPERation[:EVENt]?

This command queries the contents of the EVENt section of the STATus:OPERation register. The contents of the EVENt section are deleted after readout.

Example: "STAT:OPER?"

Characteristics: *RST value: –
SCPI: conforming

Mode: all

STATus:OPERation:CONDition?

This command queries the CONDition section of the STATus:OPERation register. Readout does not delete the contents of the CONDition section. The value returned reflects the current hardware status.

Example: "STAT:OPER:COND?"

Characteristics: *RST value: –
SCPI: conforming

Mode: all

STATus:OPERation:ENABle 0 to 65535

This command sets the bits of the ENABle section of the STATus:OPERation register. The ENABle register selectively enables the individual events of the associated EVENt section for the summary bit in the status byte.

Example: "STAT:OPER:ENAB 65535"

Characteristics: *RST value: –
SCPI: conforming

Mode: all

STATus:OPERation:PTRansition 0 to 65535

This command sets the edge detectors of all bits of the STATus:OPERation register from 0 to 1 for the transitions of the CONDition bit.

Example: "STAT:OPER:PTR 65535"

Characteristics: *RST value: –
SCPI: conforming

Mode: all

STATus:OPERation:NTRansition 0 to 65535

This command sets the edge detectors of all bits of the STATus:OPERation register from 1 to 0 for the transitions of the CONDition bit.

Example: "STAT:OPER:NTR 65535"

Characteristics: *RST value: –
SCPI: conforming

Mode: all

STATus:PRESet

This command resets the edge detectors and ENABle parts of all registers to a defined value. All PTRansition parts are set to FFFFh, ie all transitions from 0 to 1 are detected. All NTRansition parts are set to 0, ie a transition from 1 to 0 in a CONDition bit is not detected. The ENABle part of the STATus:OPERation and STATus:QUEStionable registers are set to 0, ie all events in these registers are not passed on.

Example: "STAT:PRES"

Characteristics: *RST value: –
SCPI: conforming

Mode: all

STATus:QUEStionable[:EVENt]?

This command queries the contents of the EVENt section of the STATus:QUEStionable register. The contents of the EVENt section are deleted after the readout.

Example: "STAT:QUES?"

Characteristics: *RST value: –
SCPI: conforming

Mode: all

STATus:QUEStionable:CONDition?

This command queries the CONDition section of the STATus:QUEStionable register. Readout does not delete the contents of the CONDition section.

Example: "STAT:QUES:COND?"

Characteristics: *RST value: –
SCPI: conforming

Mode: all

STATus:QUEStionable:ENABle 0 to 65535

This command sets the bits of the ENABle section of the STATus-QUEStionable register.The ENABle register selectively enables the individual events of the associated EVENt section for the summary bit in the status byte.

Example: "STAT:QUES:ENAB 65535"

Characteristics: *RST value: –
SCPI: conforming

Mode: all

STATus:QUEStionable:PTRansition 0 to 65535

This command sets the edge detectors of all bits of the STATus:QUEStionable register from 0 to 1 for the transitions of the CONDition bit.

Example: "STAT:QUES:PTR 65535"

Characteristics: *RST value: –
SCPI: conforming

Mode: all

STATus:QUEStionable:NTRansition 0 to 65535

This command sets the edge detectors of all bits of the STATus:OPERation register from 1 to 0 for the transitions of the CONDition bit.

Example: "STAT:QUES:NTR 65535"

Characteristics: *RST value: –
SCPI: conforming

Mode: all

STATus:QUEStionable:POWer[:EVENt]?

This command queries the contents of the EVENt section of the STATus:QUEStionable:POWer register. Readout deletes the contents of the EVENt section.

Example: "STAT:QUES?"

Characteristics: *RST value: –
SCPI: conforming

Mode: all

STATus:QUEStionable:POWer:CONDition?

This command queries the contents of the CONDition section of the STATus:QUEStionable:POWer register. Readout does not delete the contents of the CONDition section.

Example: "STAT:QUES:COND?"

Characteristics: *RST value: –
SCPI: conforming

Mode: all

STATus:QUEStionable:POWer:ENABle 0 to 65535

This command sets the bits of the ENABle section of the STATus:QUEStionable:POWer register. The ENABle register selectively enables the individual events of the associated EVENt section for the summary bit.

Example: "STAT:QUES:ENAB 65535"

Characteristics: *RST value: –
SCPI: conforming

Mode: all

STATus:QUEStionable:POWer:PTRansition 0 to 65535

This command sets the edge detectors of all bits of the STATus:QUEStionable:POWer register from 0 to 1 for the transitions of the CONDition bit.

Example: "STAT:QUES:PTR 65535"

Characteristics: *RST value: –
SCPI: conforming

Mode: all

STATus:QUEStionable:POWer:NTRansition 0 to 65535

This command sets the edge detectors of all bits of the STATus:QUEStionable:POWer register from 1 to 0 for the transitions of the CONDition bit.

Example: "STAT:QUES:NTR 65535"

Characteristics: *RST value: –
SCPI: conforming

Mode: all

STATus:QUEStionable:LIMit<1|2> [:EVENt]?

This command queries the contents of the EVENt section of the STATus:QUEStionable:LIMit register. Readout deletes the contents of the EVENt section.

Example: "STAT:QUES?"

Characteristics: *RST value: –
SCPI: device-specific

Mode: all

STATus:QUEStionable:LIMit<1|2>:CONDition?

This command queries the contents of the CONDition section of the STATus:QUEStionable:LIMit register.

Readout does not delete the contents of the CONDition section.

Example: "STAT:QUES:LIM:COND?"

Characteristics: *RST value: –
SCPI: device-specific

Mode: all

STATus:QUEStionable:LIMit<1|2>:ENABle 0 to 65535

This command sets the bits of the ENABle section of the STATus:QUEStionable register.The ENABle register selectively enables the individual events of the associated EVENt section for the summary bit.

Example: "STAT:QUES:ENAB 65535"

Characteristics: *RST value: –
SCPI: device-specific

Mode: all

STATus:QUEStionable:LIMit<1|2>:PTRansition 0 to 65535

This command sets the edge detectors of all bits of the STATus:QUEStionable:LIMit register from 0 to 1 for the transitions of the CONDition bit.

Example: "STAT:QUES:PTR 65535"

Characteristics: *RST value: –
SCPI: device-specific

Mode: all

STATus:QUEStionable:LIMit<1|2>:NTRansition 0 to 65535

This command sets the edge detectors of all bits of the STATus:QUEStionable:LIMit register from 1 to 0 for the transitions of the CONDition bit.

Example: "STAT:QUES:NTR 65535"

Characteristics: *RST value: –
SCPI: device-specific

Mode: all

STATus:QUEStionable:LMARgin<1|2> [:EVENt]?

This command queries the contents of the EVENt section of the STATus:QUEStionable:LMARgin register. Readout deletes the contents of the EVENt section.

Example: "STAT:QUES:LMAR?"

Characteristics: *RST value: –
SCPI: device-specific

Mode: all

STATus:QUEStionable:LMARgin<1|2>:CONDition?

This command queries the contents of the CONDition section of the STATus:QUEStionable:LMARgin register. Readout does not delete the contents of the CONDition section.

Example: "STAT:QUES:LMAR:COND?"

Characteristics: *RST value: –
SCPI: device-specific

Mode: all

STATus:QUEStionable:LMARgin<1|2>:ENABle 0 to 65535

This command sets the bits of the ENABle section of the STATus:QUEStionable:LMARgin register. The ENABle register selectively enables the individual events of the associated EVENt section for the summary bit.

Example: "STAT:QUES:LMAR:ENAB 65535"

Characteristics: *RST value: –
SCPI: device-specific

Mode: all

STATus:QUEStionable:LMARgin<1|2>:PTRansition 0 to 65535

This command sets the edge detectors of all bits of the STATus:QUEStionable:LMARgin register from 0 to 1 for the transitions of the CONDition bit.

Example: "STAT:QUES:LMAR:PTR 65535"

Characteristics: *RST value: –
SCPI: device-specific

Mode: all

STATus:QUEStionable:LMARgin<1|2>:NTRansition 0 to 65535

This command sets the edge detectors of all bits of the STATus:QUEStionable:LMARgin register from 1 to 0 for the transitions of the CONDition bit.

Example: "STAT:QUES:LMAR:NTR 65535"

Characteristics: *RST value: –
SCPI: device-specific

Mode: all

STATus:QUEStionable:ACPLimit[:EVENt]?

This command queries the contents of the EVENt section of the STATus:QUEStionable:ACPLimit register. Readout deletes the contents of the EVENt section.

Example: "STAT:QUES:ACPL?"

Characteristics: *RST value: –
SCPI: device-specific

Mode: all

STATus:QUEStionable:ACPLimit:CONDition?

This command queries the contents of the CONDition section of the STATus:QUEStionable:ACPLimit register. Readout does not delete the contents of the CONDition section.

Example: "STAT:QUES:ACPL:COND?"

Characteristics: *RST value: –
SCPI: device-specific

Mode: all

STATus:QUEStionable:ACPLimit:ENABle 0 to 65535

This command sets the bits of the ENABle section of the STATus:QUEStionable:ACPLimit register. The ENABle register selectively enables the individual events of the associated EVENt section for the summary bit.

Example: "STAT:QUES:ACPL:ENAB 65535"

Characteristics: *RST value: –
SCPI: device-specific

Mode: all

STATus:QUEStionable:ACPLimit:PTRansition 0 to 65535

This command sets the edge detectors of all bits of the STATus:QUEStionable: ACPLimit register from 0 to 1 for the transitions of the CONDition bit.

Example: "STAT:QUES:ACPL:PTR 65535"

Characteristics: *RST value: –
SCPI: device-specific

Mode: all

STATus:QUEStionable:ACPLimit:NTRansition 0 to 65535

This command sets the edge detectors of all bits of the STATus:QUEStionable: ACPLimit register from 1 to 0 for the transitions of the CONDition bit.

Example: "STAT:QUES:ACPL:NTR 65535"

Characteristics: *RST value: –
SCPI: device-specific

Mode: all

STATus:QUEStionable:FREQuency[:EVENt]?

This command queries the contents of the EVENt section of the STATus:QUEStionable: FREQuency register.

Example: "STAT:QUES:FREQ?"

Characteristics: *RST value: –
SCPI: device-specific

Mode: all

Readout deletes the contents of the EVENt section.

STATus:QUEStionable:FREQuency:CONDition?

This command queries the contents of the CONDition section of the STATus:QUEStionable:FREQuency register. Readout does not delete the contents of the CONDition section.

Example: "STAT:QUES:FREQ:COND?"

Characteristics: *RST value: –
SCPI: device-specific

Mode: all

STATus:QUEStionable:FREQuency:ENABle 0 to 65535

This command sets the bits of the ENABle section of the STATus:QUEStionable:FREQuency register. The ENABle register selectively enables the individual events of the associated EVENt section for the summary bit.

Example: "STAT:QUES:FREQ:ENAB 65535"

Characteristics: *RST value: –
SCPI: device-specific

Mode: all

STATus:QUEStionable:FREQuency:PTRansition 0 to 65535

This command sets the edge detectors of all bits of the STATus:QUEStionable:FREQuency register from 0 to 1 for the transitions of the CONDition bit.

Example: `"STAT:QUES:FREQ:PTR 65535"`

Characteristics: *RST value: –
SCPI: device-specific

Mode: all

STATus:QUEStionable:FREQuency:NTRansition 0 to 65535

This command sets the edge detectors of all bits of the STATus:QUEStionable:FREQuency register from 1 to 0 for the transitions of the CONDition bit.

Example: `"STAT:QUES:FREQ:NTR 65535"`

Characteristics: *RST value: –
SCPI: device-specific

Mode: all

STATus:QUEue[:NEXT]?

This command returns the earliest entry to the error queue and deletes it.

Positive error numbers indicate device-specific errors, negative error numbers are error messages defined by SCPI (cf. Chapter 9). If the error queue is empty, the error number 0, "no error", is returned. This command is identical with the command `SYSTem:ERRor`.

Example: `"STAT:QUE?"`

Characteristics: *RST value: –
SCPI: conforming

Mode: all

SYSTem Subsystem

This subsystem contains a series of commands for general functions.

COMMAND	PARAMETERS	UNIT	COMMENT
SYSTem			
:COMMunicate			
:GPIB			
[:SELF]			
:ADDRess	0...30	--	
:RTERminator	LFEoi | EOI		
:RDEVice			
:GENerator<1|2>			Option ext. Generator
:ADDRess	0...30		Option ext. Generator
:RDEVice			
:GENerator<1|2>			
:LINK	GPIB | TTL		tracking generator option
:TYPE	<name>		tracking generator option
:SERial			
:CONTrol			
:DTR	IBFull | OFF		
:RTS	IBFull | OFF		
[:RECeive]			
:BAUD	<numeric_value>	--	
:BITS	7 | 8	--	
:PARity			
[:TYPE]	EVEN | ODD | NONE		
:SBITs	1 | 2	--	
:PACE	XON | NONE		
:PRINter			
:ENUMerate			
[:NEXT?]			query only
:FIRSt?			query only
:SELect<1|2>	<printer_name>		
:DATE	<num>, <num>, <num>	--	
:DISPlay			
:FPANel	<Boolean>		
:UPDate	<Boolean>		
:ERRor?	--	--	query only
:PASSword			
[:CENable]	<string>		no querye
:PRESet	--	--	no query
:SET	<block>		
:SPEaker			audio demodulator option
:VOLume	<numeric_value>	--	
:TIME	0...23, 0...59, 0...59	--	
:VERSion?	--	--	query only

SYSTem:COMMunicate:GPIB[:SELF]:ADDRess 0 to 30

This command changes the IEC/IEEE-bus address of the unit.

Example: "SYST:COMM:GPIB:ADDR 18"

Characteristics: *RST value: - (no influence on this parameter)
SCPI: conforming

Mode: all

SYSTem:COMMunicate:GPIB[:SELF]:RTERminator LFEOI | EOI

This command changes the GPIB receive terminator.

According to the standard the terminator in ASCII is <LF> and/or <EOI>. For binary data transfers (eg trace data) from the control computer to the instrument, the binary code (0AH) used for <LF> might be included in the binary data block, and therefore should not be interpreted as a terminator in this particular case. This can be avoided by changing the receive terminator to EOI.

Output of binary data from the instrument to the control computer does not require such a terminator change.

Example: "SYST:COMM:GPIB:RTER EOI"

Characteristics: *RST value: LFEOI
SCPI: device-specific

Mode: all

SYSTem:COMMunicate:GPIB:RDEVice:GENerator<1|2>:ADDRess 0 to 30

This command changes the IEC/IEEE-bus address of the device selected as external generator 1 or 2.

Note:
If two generators are connected at the same time to IECBUS 2 their addresses must be different.

The command is only available with option Ext. Generator Control B10.

Example: "SYST:COMM:GPIB:RDEV:GEN1:ADDR 19" Changes the IECBUS address of generator 1 to 19

Characteristics: *RST value: 28
SCPI: device-specific

Operating mode: all

SYSTem:COMMunicate:RDEVice:GENerator<1|2>:LINK GPIB | TTL

This command selects the interface type of the external generator 1 or 2.
The following types are available

- IECBUS alone (= GPIB, for all the generators of other manufacturers and some Rohde & Schwarz units)

or

- IECBUS and TTL interface for synchronization (= TTL, for most of the Rohde & Schwarz generators, see table in command SYSTem:COMMunicate:RDEVice:GENerator:TYPE).

The difference between the two operating modes is the execution speed. While, during IECBUS operation, each settable frequency is transmitted separately to the generator, a whole frequency list can be programmed in one go if the TTL interface is also used. Frequency switching can then be performed per TTL handshake which results in considerable speed advantages.

Note:
Only one of the two generators can be operated via the TTL interface at a time. The other generator must be configured for IECBUS (GPIB).

The command is only available with option Ext. Generator Control B10.

Example: "SYST:COMM:RDEV:GEN:LINK TTL" selects IECBUS + TTL interface for generator operation

Characteristics: *RST value: GPIB
SCPI: device-specific

Operating mode: all

SYSTem:COMMunicate:RDEVice:GENerator<1|2>:TYPE <name>

This command selects the type of external generator 1 or 2. The following table shows the available generator types including the associated interface:

Generator	Interface Type	Generator Min Freq	Generator Max Freq	Generator Min Power dBm	Generator Max Power dBm
SME02	TTL	5 kHz	1.5 GHz	-144	+16
SME03	TTL	5 kHz	3.0 GHz	-144	+16
SME06	TTL	5 kHz	6.0 GHz	-144	+16
SMG	GPIB	100 kHz	1.0 GHz	-137	+13
SMGL	GPIB	9 kHz	1.0 GHz	-118	+30
SMGU	GPIB	100 kHz	2.16 GHz	-140	+13
SMH	GPIB	100 kHz	2.0 GHz	-140	+13
SMHU	GPIB	100 kHz	4.32 GHz	-140	+13
SMIQ02B	TTL	300 kHz	2.2 GHz	-144	+13
SMIQ02E	GPIB	300 kHz	2.2 GHz	-144	+13
SMIQ03B	TTL	300 kHz	3.3 GHz	-144	+13
SMIQ03E	GPIB	300 kHz	3.3 GHz	-144	+13
SMIQ04B	TTL	300 kHz	4.4 GHz	-144	+10
SMIQ06B	TTL	300 kHz	6.4 GHz	-144	+10
SML01	GPIB	9 kHz	1.1 GHz	-140	+13
SMR20	GPIB	1 GHz	20 GHz	-130 [2)]	+11 [2)]
SMR20B11 [1)]	GPIB	10 MHz	20 GHz	-130 [2)]	+13 [2)]
SMR27	GPIB	1 GHz	27 GHz	-130 [2)]	+11 [2)]
SMR27B11 [1)]	GPIB	10 MHz	27 GHz	-130 [2)]	+12 [2)]
SMR30	GPIB	1 GHz	30 GHz	-130 [2)]	+11 [2)]
SMR30B11 [1)]	GPIB	10 MHz	30 GHz	-130 [2)]	+12 [2)]
SMR40	GPIB	1 GHz	40 GHz	-130 [2)]	+9 [2)]
SMR40B11 [1)]	GPIB	10 MHz	40 GHz	-130 [2)]	+12 [2)]
SMP02	TTL	10 MHz	20 GHz	-130 [3)]	+17 [3)]
SMP03	TTL	10 MHz	27 GHz	-130 [3)]	+13 [3)]
SMP04	TTL	10 MHz	40 GHz	-130 [3)]	+12 [3)]
SMP22	TTL	10 MHz	20 GHz	-130 [3)]	+20 [3)]
SMT02	GPIB	5.0 kHz	1.5 GHz	-144	+13
SMT03	GPIB	5.0 kHz	3.0 GHz	-144	+13
SMT06	GPIB	5.0 kHz	6.0 GHz	-144	+13

1) Requires mounting of option SMR-B11.

2) Maximum/Minimum Power depends on the presence of option SMR-B15/-B17 and of the selected frequency range. For details please consult the SMR datasheet.

3) Maximum/Minimum Power depends on the presence of option SMP-B15/-B17 and of the selected frequency range. For details please consult the SMP datasheet.

Generator	Interface Type	Generator Min Freq	Generator Max Freq	Generator Min Power dBm	Generator Max Power dBm
SMX	GPIB	100 kHz	1.0 GHz	-137	+13
SMY01	GPIB	9 kHz	1.04 GHz	-140	+13
SMY02	GPIB	9 kHz	2.08 GHz	-140	+13
HP8340A	GPIB	10 MHz	26.5 GHz	-110	10
HP ESG-A Series 1000A, 2000A, 3000A, 4000A	GPIB	250 kHz	4 GHz	-136	20
HP ESG-D SERIES E4432B	GPIB	250 kHz	3 GHz	-136	+10

Notes:
Generators with TTL interface can also be operated via IECBUS (= GPIB) alone.

With NONE selected, the corresponding generator 1 or 2 is deactivated.

The command is only available with option Ext. Generator Control B10.

Example: `"SYST:COMM:RDEV:GEN2:TYPE 'SME02'"` selects SME02 as generator 2.

Characteristics: *RST value: NONE
SCPI: device-specific

SYSTem:COMMunicate:SERial:CONTrol:DTR IBFull | OFF
SYSTem:COMMunicate:SERial:CONTrol:RTS IBFull | OFF

These commands switch the hardware handshake procedure for the serial interface off (OFF) or on (IBFull).

The two commands are equivalent.

Examples:
```
"SYST:COMM:SER:CONT:DTR OFF"
"SYST:COMM:SER:CONT:RTS IBF"
```

Characteristics: *RST value: OFF
SCPI: conforming

Mode: all

SYSTem:COMMunicate:SERial[:RECeive]:BAUD 110 | 300 | 600 | 1200 | 2400 | 9600 | 19200

This command sets the transmission speed for the serial interface (COM).

Example: `"SYST:COMM:SER:BAUD 2400"`

Characteristics: *RST value: 9600
SCPI: conforming

Mode: all

SYSTem:COMMunicate:SERial[:RECeive]:BITS 7 | 8

This command defines the number of data bits per data word for the serial interface (COM).

Example: "SYST:COMM:SER:BITS 7"

Characteristics: *RST value: 8
SCPI: conforming

Mode: all

SYSTem:COMMunicate:SERial[:RECeive]:PARity[:TYPE] EVEN | ODD | NONE

This command defines the parity check for the serial interface (COM).

Possible values are:
EVEN even parity
ODD odd parity
NONE no parity check.

Example: "SYST:COMM:SER:PAR EVEN"

Characteristics: *RST value: NONE
SCPI: conforming

Mode: all

SYSTem:COMMunicate:SERial[:RECeive]:SBITs 1|2

This command defines the number of stop bits per data word for the serial interface (COM).

Example: "SYST:COMM:SER:SBITs 2"

Characteristics: *RST value: 1
SCPI: conforming

Mode: all

SYSTem:COMMunicate:SERial[:RECeive]:PACE XON | NONE

This command switches on or off the software handshake for the serial interface.

Example: "SYST:COMM:SER:PACE XON"

Characteristics: *RST value: NONE
SCPI: conforming

Mode: all

SYSTem:COMMunicate:PRINter:ENUMerate:FIRSt?

This command queries the name of the first printer (in the list of printers) available under Windows NT.

The names of other installed printers can be queried with command `SYSTem:COMMunicate:PRINter:ENUMerate:NEXT?`.

If no printer is configured an empty string is output.

Example: "SYST:COMM:PRIN:ENUM:FIRS?"

Characteristics: *RST value: NONE
SCPI: device-specific

Mode: all

SYSTem:COMMunicate:PRINter:ENUMerate:NEXT?

This command queries the name of the next printer installed under Windows NT.

The command
`SYSTem:COMMunicate:PRINter:ENUMerate:FIRSt?`
should be sent previously to return to the beginning of the printer list and query the name of the first printer.

The names of other printers can then be queried with NEXT?. After all available printer names have been output, an empty string enclosed by quotation marks (") is output for the next query. Further queries are answered by a Query Error.

Example: "SYST:COMM:PRIN:ENUM:NEXT?"

Characteristics: *RST value: NONE
SCPI: device-specific

Mode: all

SYSTem:COMMunicate:PRINter:SELect <1|2> <printer_name>

This command selects one of the printers configured under Windows NT including the associated output destination.

The specified printer name must be a string as returned by the commands
`SYSTem:COMMunicate :PRINter:ENUMerate:FIRSt?` or
`SYSTem:COMMunicate :PRINter:ENUMerate:NEXT?`

Note: *Command `HCOPy:DESTination` is used to select an output medium other than the default one.*

Example: "SYST:COMM:PRIN:SEL 'LASER on LPT1'"

Characteristics: *RST value: NONE
SCPI: device-specific

Mode: all

SYSTem:DATE 1980 to 2099, 1 to 12, 1 to 31

This command is used to enter the date for the internal calendar.

The sequence of entry is year, month, day.

Example: `" SYST:DATE 2000,6,1"`

Characteristics: *RST value: –
SCPI: conforming

Mode: all

SYSTem:DISPlay:FPANel ON | OFF

This command activates or deactivates the display of the front panel keys on the screen.

With the display activated, the instrument can be operated on the screen using the mouse by pressing the corresponding buttons. This may be useful if the instrument is operated in a detached station by means of a remote program such as PCANYWHERE.

Notes: *With the display of the front panel keys activated, the screen resolution of the unit is set to 1024x768. Thus, only a section of the whole screen is visible on the internal LCD display, which will be moved by mouse moves.*

For a full display of the user interface, an external monitor has to be connected to the rear panel.

When the front panel display is deactivated, the original screen resolution is restored.

Example: `"SYST:DISP:FPAN ON"`

Characteristics: *RST value: OFF
SCPI: device-specific

Operating mode: all

SYSTem:DISPlay:UPDate ON | OFF

This command switches on or off the update of all display elements during remote control.

Note: *The best performance is obtained when the display output is switched off during remote control.*

Example: `" SYST:DISP:UPD ON`

Characteristics: *RST value: OFF
SCPI: device specific

Mode: all

SYSTem:ERRor?

This command queries the earliest entry in the error queue, and deletes it after the readout.

Positive error numbers indicate device-specific errors, negative error numbers are error messages defined by SCPI (cf. Chapter 9). If the error queue is empty, the error number 0, "no error", is returned. This command is identical with the command `STATus:QUEue:NEXT?`. This command is a query and is therefore not assigned an *RST value.

Example: `"SYST:ERR?"`

Characteristics: *RST value: –
SCPI: conforming

Mode: all

SYSTem:ERRor:LIST?

This command reads all system messages and returns a list of comma separated strings. Each string corresponds to an entry in the table SYSTEM MESSAGES.

If the error list is empty, an empty string "" will be returned.

This command is a query and is therefore not assigned an *RST value.

Example: `"SYST:ERR:LIST?"`

Characteristics: *RST value: –
SCPI: device specific

Mode: all

SYSTem:ERRor:CLEar:ALL

This command deletes all entries in the table SYSTEM MESSAGES.

This command is an event and is therefore not assigned a query or an *RST value.

Example: `"SYST:ERR:CLE:ALL?"`

Characteristics: *RST value: –
SCPI: device specific

Mode: all

SYSTem:PASSword[:CENable] <string>

This command enables access to the service functions by means of the password.

Example: `"SYST:PASS 'XXXX'"`

Characteristics: *RST value: –
SCPI: conforming

Mode: all

This command is an event and is therefore not assigned an *RST value and has no query.

SYSTem:PRESet

This command initiates an instrument reset.

The effect of this command corresponds to that of the *PRESET* key with manual control or to the *RST command.

Example: `"SYST:PRES"`

Characteristics: *RST value: –
SCPI: conforming

Mode: all

SYSTem:SET <block>

The query `SYSTem:SET?` causes the data of the current instrument setting to be transmitted to the control computer in binary format (SAVE function). The data can be read back into the instrument (RECALL function) by means of command `SYSTem:SET` <block>. Whilst the data records are stored on the instrument harddisk with SAVE/RECALL (`MMEMory:STORe` bzw. `MMEMory:LOAD)`, it is possible to store the data in an external computer by means of `SYSTem:SET`.

The receive terminator has to be set to EOI to ensure reliable transfer of data (setting `SYST:COMM:GPIB:RTER EOI`).

Example: `"SYST:SET "`

Characteristics: *RST value: –
SCPI: conforming

Mode: all

SYSTem:SPEaker:VOLume 0 to 1

This command sets the volume of the built-in loudspeaker for demodulated signals. Minimum volume is set by 0 and maximum volume by 1.

The value 0 is the lowest volume, the value 1 the highest volume.

Example: `"SYST:SPE:VOL 0.5"`

Characteristics: *RST value: 0
SCPI: device-specific

Mode: all

SYSTem:TIME 0 to 23, 0 to 59, 0 to 59

This command sets the internal clock. The sequence of entry is hour, minute, second.

Example: `"SYST:TIME 12,30,30"`

Characteristics: *RST value: –
SCPI: conforming

Mode: all

SYSTem:VERSion?

This command queries the number of the SCPI version, which is relevant for the instrument.

Example: `"SYST:VERS?"`

Characteristics: *RST value: –
SCPI: conforming

Mode: all

This command is a query and is therefore not assigned an *RST value.

TRACe Subsystem

The TRACe subsystem controls access to the instrument's internal trace memory.

COMMAND	PARAMETERS	UNIT	COMMENT
TRACe<1|2>			
[:DATA]	TRACE1|TRACE2|TRACE3,<block>|<numeric_value>...	-	
:COPY	TRACE1|TRACE2|TRACE3, TRACE1|TRACE2|TRACE3	-	
:IQ			
:DATA?			nur Abfrage
:MEMory?	<numeric_value>, <numeric_value>	-- , --	nur Abfrage
:SET	NORMal, <numeric_value>, <numeric_value>, IMMediate | EXTernal, POSitive, <numeric_value>, <numeric_value>	--, HZ, HZ, --, --, --, --	
:SRATe	<numeric_value>	HZ	
[:STATe]	<Boolean>		
:ONLine			
[:STATe]	<Boolean>		

General Trace Commands

TRACe[:DATA] TRACE1| TRACE2| TRACE3, <block> | <numeric_value>

This command transfers trace data from the control computer to the instrument, the query reads trace data out of the instrument. The associated measurement window is selected with the numeric suffix of TRACe<1|2>.

Example: `"TRAC TRACE1,"+A$` `(A$: data list in the current format)`
`"TRAC? TRACE1"`

Characteristics: *RST value: -
SCPI: conforming

Mode: all

The trace data are transferred in the current format (corresponding to the command FORMat ASCii|REAL). The device-internal trace memory is addressed using the trace names 'TRACE1' to 'TRACE3'.
The transfer of trace data from the control computer to the instrument takes place by indicating the trace name and then the data to be transferred. In ASCII format, these data are values separated by commas. If the transfer takes place using the format real (REAL,32), the data are transferred in block format.

The parameter of the query is the trace name TRACE1 to TRACE3, it indicates which trace memory will be read out.

Saving and recalling trace data together with the device settings to/from the device-internal hard disk or to/from a floppy is controlled via the commands "`MMEMory:STORe:STATe`" and "`MMEMory:LOAD:STATe`" respectively. Trace data are selected with "`MMEMory:SELect[:ITEM]:ALL`" or ""`MMEMory:SELect[:ITEM]:TRACe`". Trace data in ASCII format (ASCCII FILE EXPORT) are exported with the command "`MMEM:STORe:TRACe`".

The transfer format for the trace data depends on the instrument setting:

Analyzer mode (span > 0 and zero span):

625 results are output in the unit selected for display.

Note: *With AUTO PEAK detector, only positive peak values can be read out.*
Trace data can be written into the instrument with logarithmic display only in dBm, with linear display only in volts.

FORMAT REAL,32 is to be used as format for binary transmission.

TRACe:COPY TRACe:COPY TRACE1| TRACE2| TRACE3| TRACE4 ,
TRACE1| TRACE2| TRACE3| TRACE4

This command copies data from one trace to another. The second operand describes the source, the first operand the destination of the data to be copied.The associated measurement window is selected with the numeric suffix of TRACe<1|2>.

Example: `"TRAC:COPY TRACE1,TRACE2"`

Characteristics: *RST value:
SCPI: conforming

Mode: all

This command is an event and therefore has no query and no *RST value assigned.

TRACe:IQ-Subsystem

The commands of this subsystem are used for collection and output of measured IQ data. A special memory is therefore available in the instrument with 128k words for the I and Q data. The measurement is always performed in the time domain (span = 0 Hz) at the selected center frequency. The number of samples to be collected can be set. The sample rate can be set in the range from 15.625 kHz to 32 MHz. Prior to being stored in memory or output via GPIB, the measurement data are corrected in terms of frequency response.

Note:
The functions of this subsystem are not available during GSM measurements.
Depending on the sample rate, the following maximum bandwidths can be obtained during the measurement.

Sample rate	**Max. bandwidth**	**Notes**
32 MHz	9.6 MHz	
16 MHz	7.72 MHz	
8 MHz	4.8 MHz	Signals outside the given bandwidth are folded back into the useful band due to the anti-aliasing filter.
4 MHz	2.8 MHz	
2 MHz	1.6 MHz	max. Bandwidth = 0.8 * Sample Rate for Sample Rate ≤ 2 MHz
1 MHz	800 kHz	
500 kHz	400 kHz	
250 kHz	200 kHz	
125 kHz	100 kHz	
62.5 kHz	50 kHz	
31.25 kHz	25 kHz	
15.625 kHz	12.5 kHz	

Due to the sampling concept (21.4 MHz IF, 32 MHz Sampling rate), the image frequency is suppressed only by the 10 MHz analog IF filter. When applying an input signal at the edge of the 10 MHz band (+5 MHz from center), the image frequency appears 800 kHz above the input signal.
The image frequency in MHz is calculated as follows:

$$f_{image} = 2 \cdot (f_{center} + 5.4\,\mathrm{MHz}) - f_{signal}$$

where
f_{image} = image frequency in MHz
f_{center} = center frequency in MHz
f_{signal} = frequency of the signal to be measured in MHz

For correct operation the RF input signal shall be limited in bandwidth. Signals more than 5.4 MHz above the center frequency will be mirrored into the ± 5 MHz pass band.

For additional bandwidth limitation of the measurement data the analog filters (RBW ≥ 300 kHz) are available.

The trigger mode can be selected between FREE RUN and EXTERNAL. With external trigger the number of samples to be measured before the trigger point can be selected (this value has to be set to 0 for free run trigger mode).

The measurement results will be output as a list of values, with the Q-values following immediately after the list of I-values in the output buffer. The FORMAT command can be used to select between binary output (32 Bit IEEE 754 floating point values) and output in ASCII format.

The commands of this subsystem can be used in two ways:

1. Measurement and result query with one command:
   This method causes the least delay between measurement and output of the result data, but iit requires the control computer to wait actively for the response data.
2. Setting up the instrument, start of the measurement via "`INIT`" and query of the result list at the end of the measurement:
   With this method the control computer can be used for other activities during the measurement. In this case the additional time needed for synchronisation via service request must be taken into account.

TRACe<1|2>:IQ:DATA?

This command starts a measurement with the settings defined via `TRACe:IQ:SET` and returns the list of measurement results immediately after they are corrected in terms of frequency response. The number of measurement results depends on the settings defined with `TRACe:IQ:SET`, the output format depends on the settings of the `FORMat` – subsystem.

Note:

The command requires that all response data are read out completely before the instrument accepts further commands.

Parameter: none

Example:

```
'Enable acquisition of I/Q data
"TRAC:IQ:STAT ON"
'Measurement configuration:
'Filtertype:  Normal
'RBW:         10 MHz
'Sample Rate: 32 MHz
'Trigger Source:     External
'Trigger Slope:      Positive
'Pretrigger Samples: 0
'# of Samples:4096

"TRAC:IQ:SET  NORM,10MHz,32MHz,EXT,POS,0,4096"
'Select format of response data
"FORMat       REAL,32"
'Start measurement and read results:
"TRAC:IQ:DATA?"
```

Return values:

The result values are scaled linear in unit *Volt* and correspond to the voltage at the RF input of the instrument.

ASCII-Format (FORMat ASCII):

In this case the command returns a comma separated list of the measured voltage values in floating point format (Comma Separated Values = CSV). The number of values returned is 2 * number of samples, the first half being the I-values, the second half the Q-values.

Binary-Format (FORMat REAL,32):

In this case the command returns binary data (Definite Length Block Data according to IEEE 488.2), with the lists of I- and Q-data being arranged one after the other in 32 Bit IEEE 754 floating point data. The scheme of the response string is as follows:

#41024<I-value1><I-value2>...<I-value128><Q-value1><Q-value2>...<Q-value128>

with

#4	digits of the subsequent number of data bytes (4 in the example)
1024	number of subsequent data bytes (*# of DataBytes*, 1024 in the example)
<I-value x>	4-Byte-Floating Point I-value
<Q-value y>	4-Byte-Floating Point Q-value

The number of I- and Q-data can be calculated as follows:

$$\#\,of\;\;I-Data \;=\; \#\,of\;\;Q-Data \;=\; \frac{\#\,of\;\;DataBytes}{8}$$

The offset of Q-data in the output buffer can be calculated as follows:

$$Q-Data-Offset \;=\; \frac{(\#\,of\;\;DataBytes)}{2} + LengthIndicatorDigits$$

with LengthIndicatorDigits being the number of digits of the length indicator including the '#'. In the example above (#41024...) this results in a value of 6 for LengthIndicatorDigits and the offset for the Q-data will result in 512 + 6 = 518.

Characteristics: *RST-Value: --

Note:
*Using the command with the *RST-values for command TRAC:IQ:SET the following minimum buffer sizes for the response data are recommended:*
ASCII format:10 kBytes
Binary format:2 kBytes

SCPI: device specific

Mode: A-T

TRACe<1|2>:IQ:DATA:MEMory? <offset samples>,<# of samples>

This command permits the readout of previously acquired (and frequency response corrected) I/Q data from the memory, with indication of the offset related to the start of measurement and with indication of the number of measurement values. Therefore a previously acquired data set can be read out in smaller portions. The maximum amount of available data depends on the settings of command `TRACe:IQ:SET`, the output format on the settings in the `FORMat` – subsystem.

Note:
The command requires that all response data are read out completely before the instrument accepts further commands.

If there are not I/Q data available in memory because the corresponding measurement had not been started, the command will cause a Query Error.

Parameter:

<offset samples> Offset of the values to be read related to the start of the acquired data.

Value range: 0 to <# of samples> - 1,

with <# of samples> being the value indicated with command TRACe:IQ:SET.

<# of samples> Number of measurement values to be read.

Value range: 1 to <# of samples> - <offset samples>

with <# of samples> being the value indicated with command TRACe:IQ:SET.

Examples:

```
'Enable acquisition of I/Q data
"TRAC:IQ:STAT ON"
'Configure measurement:
'Filtertyp:    Normal
'RBW:          10 MHz
'Sample Rate:  32 MHz
'Trigger Source:     External
'Trigger Slope:      Positive
'Pretrigger Samples: 100
'# of Samples:4096

"TRAC:IQ:SET NORM,10MHz,32MHz,EXT,POS,100,4096"
'Start measurement and wait for sync
"INIT;*WAI"
'Determine output format
"FORMat                        REAL,32"
'Read results:
"TRAC:IQ:DATA:MEM? 0,2048"      'Reads 2048 I/Q data starting at the
                                'beginning of data acquisition
"TRAC:IQ:DATA:MEM? 2048,1024"  'Reads 1024 I/Q data from half of the
                                'recorded data
"TRAC:IQ:DATA:MEM? 100,512"     'Reads 512 I/Q data starting at the
                                'trigger point(<Pretrigger Samples> was
                                100)
```

Return values:

The result values are scaled linear in unit *Volt* and correspond to the voltage at the RF input of the instrument.

The format of the output buffer corresponds to the command `TRACe:IQ:DATA?`

Characteristics: *RST-value: --
SCPI: device specific

Mode: A-T

TRACe<1|2>:IQ:SET <filter type>,<rbw>,<sample rate>,<trigger source>,<trigger slope>, <pretrigger samples>,<# of samples>

This command defines the settings of the analyzer hardware for the measurement of I/Q data. This allows setting the bandwidth of the analog filters in front of the A/D converter as well as setting the sample rate, trigger conditions and the record length.

Note:
If this command is omitted, the current analyzer settings will be used for the corresponding parameters.

Parameter:

<filter type>: NORMAL selects the analog analyzer resolution filters as filter type. This is currently the only available filter type.

<rbw>: Bandwidth of the analog filters in front of the A/D converter.

Value range: 300 kHz – 10 MHz in steps of 1, 3, 10 for <filter type> = NORMal<sample rate>: Sampling rate for the data acquisition.

Value range: 15.625 kHz, 31.25 kHz, 62.5 kHz,
125 kHz, 250 kHz, 500 kHz,
1 MHz, 2 MHz, 4 MHz, 8 MHz, 16 MHz,
32 MHz for <filter type> = NORMal

<trigger mode>: Selection of the trigger source used for the measurement.

Values: IMMediate | EXTernal

<trigger slope>: Used trigger slope.

Values: POSitive (currently the only value supported)

<pretrigger samples>: Number of measurement values to be recorded before the trigger point.

Value range: 0 to 65023 (= 64*1024 – 512 - 1)

Note:
For <trigger mode> = IMMediate the value must be 0.

<# of samples>: Number of measurement values to record.

Value range:1 to 130560 (= 128*1024 – 512)

Examples:

"TRAC:IQ:SET NORM,10MHz,32MHz,EXT,POS,0,2048"	Reads 2048 I/Q-values starting at the trigger point. Filtertype: NORMAL (analog) RBW: 10 MHz Sample Rate: 32 MHz Trigger: External Slope: Positive
"TRAC:IQ:SET NORM,1MHz,4MHz,EXT,POS,1024,512"	Reads 512 I/Q-values from 1024 measurement points before the trigger point. Filtertype: NORMAL (analog) RBW: 1 MHz Sample Rate: 4 MHz Trigger: External Slope: Positive

Characteristics: *RST-values: `NORM,3MHz,32MHz,IMM,POS,0,128`

Note:
For using these default settings with command TRAC:IQ:DATA? the following minimum buffer sizes for the response data are recommended:
ASCII format:10 kBytes
Binary format:2 kBytes

SCPI: device specific

Mode: A-T

TRACe<1|2>:IQ:SRATe 15.625kHz...32MHz

This command sets the sampling rate for the I/Q data acquisition. Thus the sample rate can be modified without affecting the other settings.

Value range: 15.625 kHz, 31.25 kHz, 62.5 kHz,
125 kHz, 250 kHz, 500 kHz,
1 MHz, 2 MHz, 4 MHz, 8 MHz, 16 MHz, 32 MHz

Example: "TRAC:IQ:SRAT 4MHZ"

Characteristics: *RST-value: 32 MHz
SCPI: device specific

Mode: A-T

TRACe<1|2>:IQ[:STATe] ON|OFF

This command switches the I/Q data acquisition on or off.

Note:
The I/Q data acquisition is not compatible with other measurement functions. Therefore all other measurement functions will be switched off as soon as the I/Q measurement function is switched on. Additionally a trace display is not possible in this operating mode. Therefore all traces are set to "BLANK". Finally split screen operation will automatically be stopped.

Example:

`TRAC:IQ ON` Switches on I/Q data acquisition

Characteristics: *RST-value: OFF
SCPI: device specific

Mode: A-T

TRACe<1|2>:IQ:ONLine[:STATe] ON|OFF {inhalt "TRACe<1|2>:IQ:ONLine[:STATe] ON|OFF" \l 8 \f c}

This command enables/disable the online output of I/Q measurement data via the optional LVDS interface (B17) on the rear panel of the instrument. As a precondition the I/Q data acquisition must be switched on in advance via command `TRAC:IQ ON`. The settings required for the I/Q data acquisition are configured using the command `TRAC:IQ:SET`.

Single shot measurements (default setting) or continuous measurement data output can be selected using `INIT:CONT OFF` or `INIT:CONT ON` respectively. Single shot measurements are started with `TRAC:IQ:DATA?` or `INIT`.

The format of the output data is described in detail in chapter "Option FSU-B17 – IQ Online Interface" in the manual operation part of this manual.

Please note the following restrictions for sampling rates > 2 MHz:

- The internal correction of the frequency response of the decimation filters is not available for sampling rates > 2 MHz.
- For single shot measurements additional measurement data are acquired that exceed the settings of the `TRAC:IQ:SET` command. The number of samples (each I and Q) acquired before the trigger event and after the specified number of samples is indicated in the following table:

Sampling rate	**Additional samples before the trigger event**	**Additional samples after the specified # of samples**
≤ 2 MHz	0	0
4 MHz	15	31
8 MHz	14	29
16 MHz	68	137
32 MHz	70	141

Note:
The I/Q data acquisition is not compatible with other measurement functions. Therefore all other measurement functions will be switched off as soon as the I/Q measurement function is switched on. Additionally a trace display is not possible in this operating mode. Therefore all traces are set to "BLANK". Finally split screen operation will automatically be stopped.

Example:

`TRAC:IQ ON`	Switches the I/Q data acquisition on.
`TRAC:IQ:ONL ON`	Switches the online output of the I/Q data on.
`INIT:CONT ON`	Selects continuous measurement data output.

Characteristics: *RST value: OFF
SCPI: device-specific

Mode: A-T

TRIGger Subsystem

The TRIGger subsystem is used to synchronize instrument actions with events. It is thus possible to control and synchronize the start of a sweep. An external trigger signal can be applied to the connector at the rear panel of the instrument. A distinction is made between TRIGger1 (screen A) and TRIGger2 (screen B).

<table>
<tr><th>COMMAND</th><th>PARAMETERS</th><th>UNIT</th><th>COMMENT</th></tr>
<tr><td>TRIGger<1|2></td><td></td><td></td><td></td></tr>
<tr><td>[:SEQuence]</td><td></td><td></td><td></td></tr>
<tr><td>:SOURce</td><td>IMMediate | EXTernal | VIDeo |</td><td></td><td>TV, RFPOWer only with Option FSP-B6</td></tr>
<tr><td>:LEVel</td><td>IFPower | RFPower | TV</td><td></td><td>TV- and RF-Trigger</td></tr>
<tr><td>:VIDeo</td><td></td><td></td><td></td></tr>
<tr><td>:HOLDoff</td><td><numeric_value></td><td>PCT</td><td></td></tr>
<tr><td>:SLOPe</td><td><numeric_value></td><td>S</td><td></td></tr>
<tr><td>:SYNChronize</td><td>POSitive|NEGative</td><td>--</td><td></td></tr>
<tr><td>:ADJust</td><td></td><td></td><td>Option FS-K5</td></tr>
<tr><td>:EXTernal</td><td></td><td></td><td></td></tr>
<tr><td>:IFPower</td><td><numeric_value></td><td>s</td><td></td></tr>
<tr><td></td><td><numeric_value></td><td>s</td><td></td></tr>
</table>

TRIGger<1|2>[:SEQuence]:SOURce IMMediate | EXTernal | VIDeo | IFPower

This command selects the trigger source for the start of a sweep.

Note:

> *This function is not available during GSM measurements. The trigger source selection has to be done with the command TRIGger<1|2>[:SEQuence]:SYNChronize:ADJust..*

Parameter:

IMMediate = automatic triggering the next measurement at the end of the previous one.The value IMMediate corresponds to the FREE RUN setting.

EXTernal = the next measurement is triggered by the signal at the external trigger input.

VIDeo = the next measurement is triggered by the detection of a signal at the video filter output.

IFPower = the next measurement is triggered by the detection of a signal at the instrument IF (10 MHz bandwidth)

Example: `"TRIG:SOUR EXT"` selects the external trigger input as source of the trigger signal

Characteristics: *RST value: IMMediate
SCPI: conforming

Mode: all, except GSM

TRIGger<1|2>[:SEQuence]:LEVel:VIDeo 0 to 100PCT

This command sets the level of the video trigger source.

Example: "TRIG:LEV:VID 50PCT"

Characteristics: *RST value: 50 PCT
SCPI: device-specific

Mode: all

TRIGger<1|2>[:SEQuence]:HOLDoff -100 to 100s

This command defines the length of the trigger delay.

A negative delay time (pretrigger) can be set in the time domain (span < 0 Hz) only.

Example: "TRIG:HOLD 500us"

Characteristics: *RST value: 0s
SCPI: conforming

Mode: all

TRIGger<1|2>[:SEQuence]:SLOPe POSitive | NEGative

This command selects the slope of the trigger signal. The selected trigger slope applies to all trigger signal sources .

Example: "TRIG:SLOP NEG"

Characteristics: *RST value: POSitive
SCPI: conforming

Mode: all

TRIGger<1|2>[:SEQuence]:SYNChronize:ADJust:EXTernal -460µs...100s

This command has two functions:
Firstly this command selects the GSM trigger 'Extern'. The external trigger source is used for all GSM measurements which work together with an external trigger.
(see table of used triggers in FS-K5 manual).
Secondly this command defines the correction value for the time offset between the external trigger and the begin slot which should be investigated.
This correction value is necessary in order to conserve the exact time relation between the trigger event and the midamble of the slot in question in cases where there is no midamble triggering.
This command is only available with option GSM MS Analyzer FS-K5.

Hint:
If the Analyzer is set to external trigger source when entering the option GSM MS Analyzer (with INST:SEL MGSM*), the GSM Trigger 'Extern' is selected. Otherwise the default GSM Trigger 'IF POWER' is set.*

Example:	"INST MGSM"	Switches the instrument to GSM MS mode
	"TRIG:SYNC:ADJ:EXT 200us"	Selects the GSM Trigger 'Extern' and 200 µs between external trigger and start of the slot

Characteristics: *RST value: 0s
SCPI: device-specific

Mode: MS

TRIGger<1|2>[:SEQuence]:SYNChronize:ADJust:IFPower -460µs...100s

This command has two functions:
Firstly this command selects the GSM trigger 'IF power'. The IF power trigger source is used for all GSM measurements which work together with an IF power trigger.
(see table of used triggers in FS-K5 manual).
Secondly this command defines the correction value for the time offset between the IF power trigger and the begin of slot which should be investigated.

This correction value is necessary in order to conserve the exact time relation between the trigger event and the midamble of the slot in question in cases where there is no midamble triggering.
This command is only available with option GSM MS Analyzer FS-K5.

Hint:
If the Analyzer is set to external trigger source when entering the option GSM MS Analyzer (with `INST:SEL MGSM`), the GSM Trigger 'Extern' is selected. Otherwise the default GSM Trigger 'IF POWER' is set.

Example:	`"INST MGSM"`	Switches the instrument to GSM MS mode
	`"TRIG:SYNC:ADJ:IFP 200us"`	Select the GSM Trigger 'IF power' and 200 µs between IF power trigger and start of the slot

Characteristics:	*RST value:	0s
	SCPI:	device-specific

Mode: MS

UNIT Subsystem

The UNIT subsystem is used to switch the basic unit of setting parameters. A distinction is made between UNIT1 (screen A) and UNIT2 (screen B).

COMMAND	PARAMETERS	UNIT	COMMENT
UNIT<1|2>			
:POWer	DBM | V | A | W | DBPW | WATT | DBUV | DBMV | VOLT | DBUA | AMPere		

UNIT<1|2>:POWer DBM | DBPW | WATT | DBUV | DBMV | VOLT | DBUA | AMPere | V | A | W

This command selects the default unit for the selected measurement window.

Note:
This function is not available during active GSM measurements.
During GSM measurements the unit is either dBm (power measurements) or deg (phase error measurements).

Example: `"UNIT:POW DBUV"` Sets the power unit for screen A to dBm.

Characteristics: *RST value: DBM
SCPI: conforming

Mode: A

Supported GPIB Commands of the HP 8590 Series

The FSU analyzer family has the capability to support a subset of the HP 8590 GPIB command set. Due to the differences in system architecture and features this can only be a limited support that comes to its limits where the corresponding parameters differ in their value ranges or default values or where hardware dependencies have to be taken into account. Nevertheless in many cases the subset supported by the FSU will make the adaption of existing GPIB programs for use with the FSU easier.

Supported Command Subset

Function Category	Function	HP 8590 Command	Supported Subset	Known differences
Amplitude				
	Attenuation	AT	AT <numeric_value> DB AT DN AT UP AT AUTO AT?	AT DN/UP: Stepsizes if option FSU-B25 is present. AT AUTO: Dependency calculation
	Amplitude Units	AUNITS	AUNITS DBM | DBMV | DBUV AUNITS?	
	Input Impedance	INZ	INZ 75 INZ 50 INZ?	
	Amplitude Scale Log	LG	LG <numeric_value> DB LG?	
	Amplitude Scale Lin	LN	LN	
	Reference Level	RL	RL <numeric_value> DB|DM RL DN RL UP RL?	Stepsize and default value
	Reference Level Position	RLPOS	RLPOS <numeric_value> RLPOS DN RLPOS UP RLPOS?	On the FSU this function affects the Reference Level Position also if tracking generator normalization is inactive.
	Reference Level Offset	ROFFSET	ROFFSET <numeric_value> DB ROFFSET?	
Auxiliary Control				
	AF Demodulator	DEMOD	DEMOD ON|OFF|AM|FM	
	Normalized Reference Level	NRL	NRL <numeric_value> DB NRL?	requires Option FSU-B10
	Source Normalization	SRCNORM	SRCNORM ON|OFF SRCNORM 1|0	requires Option FSU-B10
	Source Power Offset	SRCPOFS	SRCPOFS <numeric_value> DB SRCPOFS DN SRCPOFS UP SRCPOFS?	requires Option FSU-B10
	Source Power	SRCPWR	SRCPWR <numeric_value> DB SRCPWR DN SRCPWR UP SRCPWR ON SRCPWR OFF SRCPWR?	requires Option FSU-B10

Function Category	Function	HP 8590 Command	Supported Subset	Known differences
Bandwidth				
	Resolution Bandwidth	RB	RB <numeric_value> HZ|KHZ|MHZ|GHZ RB DN RB UP RB AUTO RB?	Value range. Formula for dependent parameters (video bandwidth, sweeptime).
	Video Bandwidth	VB	VB <numeric_value> HZ|KHZ|MHZ|GHZ VB DN VB UP VB AUTO VB?	Value range. Formula for dependent parameters (sweeptime).
	Video Bandwidth Ratio	VBR	VBR <numeric_value> VBR DN VBR UP VBR?	Default value.
Calibration				
	Start analyzer self alignment	CAL	CAL ALL CAL ON CAL OFF	The CAL commands do not automatically set the command complete bit (Bit 4) in the status byte. An additional DONE is required for that purpose.
Configuration				
	Time Display	TIMEDSP	TIMEDSP ON|OFF TIMEDSP 1|0 TIMEDSP?	
Display				
	Annotation	ANNOT	ANNOT ON|OFF ANNOT 1|0 ANNOT?	Only frequency axis annotation is affected.
	Threshold	TH	TH <numeric_value> DB|DM TH DN TH UP TH ON TH OFF TH AUTO TH?	Default value is different. Threshold line has no effect on trace data (TH AUTO is always active).
Frequency				
	Center Frequency	CF	CF <numeric_value> HZ|KHZ|MHZ|GHZ CF UP CF DN CF?	Default value. Range. Stepsize.
	Start Frequency	FA	FA <numeric_value> HZ|KHZ|MHZ|GHZ FA UP FA DN FA?	Range. Stepsize.
	Stop Frequency	FB	FB <numeric_value> HZ|KHZ|MHZ|GHZ FB UP FB DN FB?	Default value. Range. Stepsize.
	Frequency Offset	FOFFSET	FOFFSET <numeric_value> HZ|KHZ|MHZ|GHZ FOFFSET?	

Function Category	Function	HP 8590 Command	Supported Subset	Known differences
	CF Step Size	SS	SS <numeric_value> HZ|KHZ|MHZ|GHZ SS DN SS UP SS AUTO SS?	Stepsize.
Information				
	Clear all status bits	CLS	CLS	
	Service Request Bit mask	RQS	RQS	Bits supported: 1 (Units key pressed) 2 (End of Sweep) 3 (Device error) 4 (Command complete) 5 (Illegal command)
	Status byte query	STB	STB	Status bits will be mapped as stated under RQS *Note:* *Bit 2 and 4 will always be set together if "Command complete" or "End of Sweep" is detected. The FSU cannot distinguish between these two conditions. Additionally these bits cannot be used for synchronisation on the sweep end in continuous sweep mode.* The status byte obtained by a serial poll will always be conforming to IEEE 488.2 / SCPI.
Marker				
	Marker Frequency Query	MF	MF MF?	
	Set Marker Frequency	MKF	MKF <numeric_value> HZ|KHZ| MHZ|GHZ MKF?	
	Marker Amplitude	MKA	MKA?	
	Select the active marker	MKACT	MKACT 1 MKACT?	Only marker 1 is supported as the active marker.
	N dB Down	MKBW	MKBW <numeric_value> MKBW ON MKBW OFF	Different default value.
	Center Freq = Marker Freq	MKCF	MKCF	
	Delta Marker	MKD	MKD <numeric_value>HZ|KHZ| MHZ|GHZ MKD DN MKD UP MKD ON MKD OFF	Only Deltamarker 1 is supported. Different default value. Different stepsize.
	Frequency Counter	MKFC	MKFC ON|OFF MKFC 1|0	
	Frequency Counter Resolution	MKFCR	MKFCR <numeric_value> HZ|KHZ| MHZ|GHZ MKFCR DN MKFCR UP MKFCR?	

Function Category	Function	HP 8590 Command	Supported Subset	Known differences
	Marker -> Min	MKMIN	MKMIN	
	Normal Marker	MKN	MKN <numeric_value> HZ|KHZ|MHZ|GHZ MKN DN MKN UP MKN ON MKN OFF MKN?	
	Noise Measurement	MKNOISE	MKNOISE ON|OFF MKNOISE 1|0 MKNOISE?	
	Marker off	MKOFF	MKOFF MKOFF ALL	
	Marker Search	MKPK	MKPK MKPK HI MKPK NH MKPK NR MKPK NL	
	Peak Excursion	MKPX	MKPX <numeric_value> DB MKPX DN MKPX UP MKPX?	Different stepsize.
	Ref Level = Marker Level	MKRL	MKRL	
	CF Stepsize = Marker Freq	MKSS	MKSS	
	Marker to Trace	MKTRACE	MKTRACE TRA|TRB|TRC	
	Signal Track	MKTRACK	MKTRACK ON|OFF MKTRACK 1|0 MKTRACK?	
Preset				
	Instrument preset	IP	IP	Does not reset the status reporting information.*RST
Printer				
	Hardcopy	PRINT	PRINT	
Program Flow				
	Stop previous function	ABORT	ABORT	Does not automatically set the command complete bit (Bit 4) in the status byte. An additional DONE is required for that purpose.
Recall or Save				
	Recall analyzer state	RCLS	RCLS <numeric_value>	
	Save analyzer state	SAVES	SAVES <numeric_value>	

Function Category	Function	HP 8590 Command	Supported Subset	Known differences
Span				
	Full Span	FS	FS	Full span value.
	Frequency Span value	SP	SP <numeric_value> SP DN SP UP SP?	Default value. Stepsize. Formula for dependent values (Resolution Bandwidth, Video Bandwidth, Sweeptime)
Sweep				
	Continuous Sweep Mode	CONTS	CONTS	
	Single Sweep	SNGLS	SNGLS	
	Gated Sweep On/Off	GATE	GATE ON|OFF GATE 1|0	
	Gate Mode Edge/Level	GATECTL	GATECTL EDGE|LEVEL GATECTL?	
	Gate delay	GD	GD <numeric_value> US|MS|SC GD DN GD UP GD?	
	Gate length	GL	GL <numeric_value> US|MS|SC GL DN GL UP GL?	
	Gate polarity	GP	GP POS|NEG GP?	
	Sweep time value	ST	ST <numeric_value> US|MS|SC ST DN ST UP ST AUTO ST?	SWE:TIME Valid values. Range. Stepsize
Synchronization				
	Synchronization on end of all previous commands	DONE	DONE DONE?	
	Start and complete a Full Sweep	TS	TS	Only available in single sweep mode

Function Category	Function	HP 8590 Command	Supported Subset	Known differences
Trace				
	Trace difference w. display line	AMBPL	AMBPL ON|OFF AMBPL 1|0 AMBPL?	
	Trace Position (Display Line)	DL	DL <numeric_value> DB|DM DL DN DL UP DL ON DL OFF DL?	The display line function is only supported in terms of trace position on the screen and video trigger level. The general display line function does not exist on the FSU. ON/OFF are accepted, but ignored; the line is automatically switched on/off with AMBPL ON/OFF. Its default position is different.
	Trace Blank	BLANK	BLANK TRA|TRB|TRC	
	Trace Copy	MOV	MOV TRA|TRB|TRC,TRA|TRB|TRC	
	Trace Clear/Write	CLRW	CLRW TRA|TRB|TRC	
	Detector selection	DET	DET POS|SMP|NEG DET?	DET? returns SAMP instead of SMP on the FSU. DET not automatically set the command complete bit (Bit 4) in the status byte. An additional DONE is required for that purpose.
	Trace Max Hold	MXMH	MXMH TRA|TRB	
	Trace Min Hold	MINH	MINH TRC	
	Video Averaging	VAVG	VAVG TRA|TRB|TRC	
	Trace View	VIEW	VIEW TRA|TRB|TRC	
Trigger				
	Trigger Mode	TM	TM FREE|VID|EXT TM?	
	Start new sweep	TS	TS	

Differences in Status Reporting

The major difference in status reporting between the FSU and the HP 8590 analyzers is that the FSU has a hierarchical status reporting system conforming to IEEE 488.2/SCPI, whereas the HP 8590 series has a very simple status reporting system that consists simply of the bit patterns in the status byte.
As described above, for the RQS and STB command the bit mapping of the HP 8590 analyzers is supported as described in the table below. For the status byte returned by a serial poll the bit mapping is different on the FSU. In detail this means that all of the bits enabled by the RQS command will be mapped onto **bit 5** of the Service Request Status Byte of the FSU.
This mechanism makes sure that a Service Request is generated as soon as one of the conditions enabled becomes true.
What the Service Request Routine should do rather than evaluating the return value of a serial poll is to use the STB command in order to identify the reason for the service request. The bits returned by the STB command are mapped in the same way as for the RQS command.

Bit enabled by RQS	Bit set in the status byte on serial poll
1 (Units key pressed)	5 (Event Status Register Summary Bit)
2 (End of Sweep)	5 (Event Status Register Summary Bit)
3 (Device Error)	5 (Event Status Register Summary Bit)
4 (Command Complete)	5 (Event Status Register Summary Bit)
5 (Illegal Command)	5 (Event Status Register Summary Bit)

What needs to be noted is that the FSU will notify any key pressed on the frontpanel rather than only the unit keys if bit 1 is set by the RQS command.
Additionally there is a difference in the handling of bit 6. This bit reflects the status of the SRQ line of the GPIB bus on the HP 8590 analyzers. With the FSU this is not possible. Therefore this bit will be set as soon as any of the bits 1 to 5 is set, but it will not be cleared on a serial poll.

Differences in GPIB behavior between the FSU and the FSE families of instruments

The following list of commands contains the differences in syntax and behavior between the GPIB command set of the FSU and the FSE families of instruments. FSE alone in column "Devices" denotes the instrument families FSE, FSIQ, FSET and ESI, unless otherwise noted in column "Notes".

Devices	Command	Parameter	Notes
FSU + FSE	*CAL?		FSU: executes total calibration FSE: executes short calibration
FSU + FSE	*CLS		
FSU + FSE	*ESE		
FSU + FSE	*ESR?		
FSU + FSE	*IDN?		model indicator and version index is different for FSU and FSE
FSU + FSE	*IST?		
FSU + FSE	*OPC?		
FSU + FSE	*OPT?		list of available options is slightly different for FSU and FSE, but equally available options have equal names
FSU + FSE	*PCB		
FSU + FSE	*PRE		
FSU + FSE	*PSC		
FSU + FSE	*RST		instrument settings are slightly different for FSU and FSE due to different instrument specs
FSU + FSE	*SRE		
FSU + FSE	*STB?		
FSU + FSE	*TRG		FSU starts measurement in active screen FSE: starts measurement in both screens (split screen mode)
FSU + FSE	*TST?		
FSU + FSE	*WAI		
FSU + FSE	ABORt		
FSE	CALCulate:LIMit:CATalog?		not available in FSU
FSU	CALCulate:STATistics:APD[:STATe]	ON | OFF	new function for FSU
FSU	CALCulate:STATistics:CCDF[:STATe]	ON | OFF	new function for FSU
FSU	CALCulate:STATistics:NSAMples	100 to 1E9	new function for FSU
FSU	CALCulate:STATistics:PRESet		new function for FSU
FSU	CALCulate:STATistics:Result<1...3>?	MEAN|PEAK|CFACtor| ALL	new function for FSU
FSU	CALCulate:STATistics:SCALe:AUTO	ONCE	new function for FSU
FSU	CALCulate:STATistics:X:RANGe	-10dB to 200dB	new function for FSU
FSU	CALCulate:STATistics:X:RLEVel	-130dBm to 30dBm	new function for FSU
FSU	CALCulate:STATistics:Y:LOWer	-1E-9 to 0.1	new function for FSU
FSU	CALCulate:STATistics:Y:UPPer	-1E-8 to 1.0	new function for FSU
FSE	CALCulate<1|2>:CTHReshold	MIN to MAX	not available in FSU
FSE	CALCulate<1|2>:CTHReshold:STATe	ON | OFF	not available in FSU
FSU	CALCulate<1|2>:DELTamarker<1...4>:AOFF		markers 2...4 are either normal or delta markers; marker 1 always serves as the reference marker for all deltamarkers
FSE	CALCulate<1|2>:DELTamarker<1...4>:AOFF		there are 4markers and 4 deltamarkers; the most recently used marker serves as the reference marker for all deltamarkers

Devices	Command	Parameter	Notes
FSU + FSE	CALCulate<1|2>:DELTamarker<1...4>:FUNCtion:FIXed:RPOint:X	<numeric_value>	FSU: marker 1 can be moved independently from the reference point FSE: the marker and the reference point are linked to each other
FSU + FSE	CALCulate<1|2>:DELTamarker<1...4>:FUNCtion:FIXed:RPOint:Y	<numeric_value>	FSU: marker 1 can be moved independently from the reference point; FSE: the marker and the reference point are linked to each other
FSU + FSE	CALCulate<1|2>:DELTamarker<1...4>:FUNCtion:FIXed:RPOint:Y: OFFSet	<numeric_value>	
FSU + FSE	CALCulate<1|2>:DELTamarker<1...4>:FUNCtion:FIXed[:STATe]	ON | OFF	
FSU + FSE	CALCulate<1|2>:DELTamarker<1...4>:FUNCtion:PNOise:RESult?		
FSU + FSE	CALCulate<1|2>:DELTamarker<1...4>:FUNCtion:PNOise[:STATe]	ON | OFF	
FSE	CALCulate<1|2>:DELTamarker<1...4>:MAXimum:APEak		not available for FSU
FSU + FSE	CALCulate<1|2>:DELTamarker<1...4>:MAXimum:LEFT		
FSU + FSE	CALCulate<1|2>:DELTamarker<1...4>:MAXimum:NEXT		
FSU + FSE	CALCulate<1|2>:DELTamarker<1...4>:MAXimum:RIGHt		
FSU + FSE	CALCulate<1|2>:DELTamarker<1...4>:MAXimum[:PEAK]		
FSU + FSE	CALCulate<1|2>:DELTamarker<1...4>:MINimum:LEFT		
FSU + FSE	CALCulate<1|2>:DELTamarker<1...4>:MINimum:NEXT		
FSU + FSE	CALCulate<1|2>:DELTamarker<1...4>:MINimum:RIGHt		
FSU + FSE	CALCulate<1|2>:DELTamarker<1...4>:MINimum[:PEAK]		
FSU + FSE	CALCulate<1|2>:DELTamarker<1...4>:MODE	ABSolute | RELative	
FSE	CALCulate<1|2>:DELTamarker<1...4>:STEP:AUTO	ON | OFF	not available for FSU
FSE	CALCulate<1|2>:DELTamarker<1...4>:STEP[:INCRement]	<numeric_value>	not available for FSU
FSU + FSE	CALCulate<1|2>:DELTamarker<1...4>:TRACe	1 to 3	FSU: 3 traces are available per screen; FSE: 4 traces are available in full screen mode and 2 traces per screen in split screen mode
FSU + FSE	CALCulate<1|2>:DELTamarker<1...4>:X	0 to MAX (frequency | sweep time)	unit 'SYM' is not available for FSU
FSU + FSE	CALCulate<1|2>:DELTamarker<1...4>:X:RELative		
FSU + FSE	CALCulate<1|2>:DELTamarker<1...4>:Y?		
FSU + FSE	CALCulate<1|2>:DELTamarker<1...4>[:STATe]	ON | OFF	
FSE	CALCulate<1|2>:DLINe<1|2>	MIN to MAX	not available for FSU
FSE	CALCulate<1|2>:DLINe<1|2>:STATe	ON | OFF	not available for FSU
FSE	CALCulate<1|2>:FEED	'XTIM:DDEM:MEAS'| 'XTIM:DDEM:REF' | 'XTIM:DDEM:ERR:MPH' | 'XTIM:DDEM:ERR:VECT' | 'XTIM:DDEM:SYMB' | 'XTIM:AM' | 'XTIM:FM' | 'XTIM:PM' | 'XTIM:AMSummary' | 'XTIM:FMSummary' |'XTIM:PMSummary' | 'TCAP'	not available for FSU
FSET	CALCulate<1|2>:FEED	'XTIM:DDEM:MEAS' | 'XTIM:DDEM:REF' | 'XTIM:DDEM:ERR:MPH' | 'XTIM:DDEM:ERR:VECT' | 'XTIM:DDEM:SYMB' | 'TCAP'	not available for FSU
FSE	CALCulate<1|2>:FLINe<1|2>	0 to fmax	not available for FSU
FSE	CALCulate<1|2>:FLINe<1|2>:STATe	ON | OFF	not available for FSU
FSE	CALCulate<1|2>:FORMat	MAGNitude | PHASe | UPHase | RIMag | FREQuency | IEYE | QEYE | TEYE | FEYE | COMP | CONS	not available for FSU
FSE	CALCulate<1|2>:FSK:DEViation:REFerence	<numeric value>	not available for FSU

Devices	Command	Parameter	Notes
FSE	CALCulate<1|2>:LIMit<1...8>:ACPower:ACHannel	0 to 100 DB, 0 to 100 DB	compatible to CALCulate<1|2>:LIMit<1...8>: ACPower:ACHannel [:RELative] of FSU not available for FSET
FSU	CALCulate<1|2>:LIMit<1...8>:ACPower:ACHannel:ABSolute	-200 to 200 DBM, -200 to 200 DBM	new function for FSU
FSU	CALCulate<1|2>:LIMit<1...8>:ACPower:ACHannel:ABSolute:STATe	ON | OFF	new function for FSU
FSU + FSE	CALCulate<1|2>:LIMit<1...8>:ACPower:ACHannel:RESult?		
FSE	CALCulate<1|2>:LIMit<1...8>:ACPower:ACHannel:STATe	ON | OFF	compatible to CALCulate<1|2>:LIMit<1...8>: ACPower:ACHannel[:RELative]:STATe of FSU not available for FSET
FSU	CALCulate<1|2>:LIMit<1...8>:ACPower:ACHannel[:RELative]	0 to 100 DB, 0 to 100 DB	compatible to CALCulate<1|2>:LIMit<1...8>: ACPower:ACHannel of FSE
FSU	CALCulate<1|2>:LIMit<1...8>:ACPower:ACHannel[:RELative]:STATe	ON | OFF	compatible to CALCulate<1|2>:LIMit<1...8>: ACPower:ACHannel:STATe of FSE
FSE	CALCulate<1|2>:LIMit<1...8>:ACPower:ALTernate<1|2>	0 to 100 DB, 0 to 100 DB	compatible to CALCulate<1|2>:LIMit<1...8>: ACPower:ALTernate<1|2> [:RELative] of FSU not available for FSET
FSU	CALCulate<1|2>:LIMit<1...8>:ACPower:ALTernate<1|2>:ABSolute	-200 to 200 DBM, -200 to 200 DBM	new function for FSU
FSU	CALCulate<1|2>:LIMit<1...8>:ACPower:ALTernate<1|2>:ABSolute:STATe	ON | OFF	new function for FSU
FSU + FSE	CALCulate<1|2>:LIMit<1...8>:ACPower:ALTernate<1|2>:RESult?		
FSE	CALCulate<1|2>:LIMit<1...8>:ACPower:ALTernate<1|2>:STATe	ON | OFF	compatible to CALCulate<1|2>:LIMit<1...8>: ACPower:ALTernate<1|2> [:RELative]:STATe of FSU not available for FSET
FSU	CALCulate<1|2>:LIMit<1...8>:ACPower:ALTernate<1|2>[:RELative]	0 to 100 DB, 0 to 100 DB	compatible to CALCulate<1|2>:LIMit<1...8>: ACPower:ALTernate<1|2> of FSE
FSU	CALCulate<1|2>:LIMit<1...8>:ACPower:ALTernate<1|2>	ON | OFF	compatible to CALCulate<1|2>:LIMit<1...8>: ACPower:ALTernate<1|2>: STATe of FSE
FSU + FSE	CALCulate<1|2>:LIMit<1...8>:ACPower[:STATe]	ON | OFF	
FSE	CALCulate<1|2>:LIMit<1...8>:BURSt:POWer?		not available for FSU, FSET and ESI
FSE	CALCulate<1|2>:LIMit<1...8>:BURSt:PTEMplate?		not available for FSU, FSET and ESI
FSU + FSE	CALCulate<1|2>:LIMit<1...8>:CLEar[:IMMediate]		
FSU + FSE	CALCulate<1|2>:LIMit<1...8>:COMMent	<string>	
FSU + FSE	CALCulate<1|2>:LIMit<1...8>:CONTrol:DOMain	FREQuency | TIME	
FSU + FSE	CALCulate<1|2>:LIMit<1...8>:CONTrol:MODE	RELative | ABSolute	
FSU + FSE	CALCulate<1|2>:LIMit<1...8>:CONTrol:OFFset	<numeric value>	
FSU + FSE	CALCulate<1|2>:LIMit<1...8>:CONTrol:SHIFt	<numeric_value>	
FSE	CALCulate<1|2>:LIMit<1...8>:CONTrol:SPACing	LINear | LOGarithmic	not available for FSU
FSE	CALCulate<1|2>:LIMit<1...8>:CONTrol:UNIT[:TIME]	S | SYM	not available for FSU
FSU + FSE	CALCulate<1|2>:LIMit<1...8>:CONTrol[:DATA]	<numeric value>, <numeric value>	
FSU + FSE	CALCulate<1|2>:LIMit<1...8>:COPY	1 to 8|<name>	
FSU + FSE	CALCulate<1|2>:LIMit<1...8>:DELete		
FSU + FSE	CALCulate<1|2>:LIMit<1...8>:FAIL?		
FSU + FSE	CALCulate<1|2>:LIMit<1...8>:LOWer:MARGin	<numeric value>	
FSU + FSE	CALCulate<1|2>:LIMit<1...8>:LOWer:MODE	RELative | ABSolute	
FSU + FSE	CALCulate<1|2>:LIMit<1...8>:LOWer:OFFset	<numeric value>	
FSU + FSE	CALCulate<1|2>:LIMit<1...8>:LOWer:SHIFt	<numeric_value>	
FSE	CALCulate<1|2>:LIMit<1...8>:LOWer:SPACing	LINear | LOGarithmic	not available for FSU
FSU + FSE	CALCulate<1|2>:LIMit<1...8>:LOWer:STATe	ON | OFF	
FSU	CALCulate<1|2>:LIMit<1...8>:LOWer:THReshold	<numeric value>	new function for FSU

Devices	Command	Parameter	Notes
FSU + FSE	CALCulate<1|2>:LIMit<1...8>:LOWer[:DATA]	<numeric value>	
FSE	CALCulate<1|2>:LIMit<1...8>:MARGin	0 to 100DB	not available for FSU, FSET and ESI
FSU + FSE	CALCulate<1|2>:LIMit<1...8>:NAME	1 to 8|<string>	
FSE	CALCulate<1|2>:LIMit<1...8>:SPECtrum:MODulation:EXCeptions?	ARFCn | TXBand | RXBand| COMBined | DCSRx1800	not available for FSU, FSET and ESI
FSE	CALCulate<1|2>:LIMit<1...8>:SPECtrum:MODulation:FAILs?	ARFCn | TXBand | RXBand| COMBined | DCSRx1800	not available for FSU, FSET and ESI
FSE	CALCulate<1|2>:LIMit<1...8>:SPECtrum:MODulation?	ARFCn | TXBand | RXBand| COMBined | DCSRx1800	not available for FSU, FSET and ESI
FSE	CALCulate<1|2>:LIMit<1...8>:SPECtrum:SWITching:FAILs?		not available for FSU, FSET and ESI
FSE	CALCulate<1|2>:LIMit<1...8>:SPECtrum:SWITching?		not available for FSU, FSET and ESI
FSE	CALCulate<1|2>:LIMit<1...8>:SPURious:FAILs?	TXBand | OTXBand| RXBand | IDLeband	not available for FSU, FSET and ESI
FSE	CALCulate<1|2>:LIMit<1...8>:SPURious?	TXBand | OTXBand| RXBand | IDLeband	not available for FSU, FSET and ESI
FSU + FSE	CALCulate<1|2>:LIMit<1...8>:STATe	ON | OFF	
FSU + FSE	CALCulate<1|2>:LIMit<1...8>:TRACe	1 to 3	FSU: 3 traces are available per screen FSE: 4 traces are available in full screen mode and 2 traces per screen in split screen mode
FSU	CALCulate<1|2>:LIMit<1...8>:UNIT	DBM | DBPW | WATT | DBUV | DBMV | VOLT | DBUA | AMPere | DB | DBUV_M | DBUA_M | DEG | RAD | S | HZ | PCT | UNITLESS	Available units are compatible to the FSE
FSE/ FSIQ	CALCulate<1|2>:LIMit<1...8>:UNIT	DBM | DBPW | WATT | DBUV | DBMV | VOLT | DBUA | AMPere | DB | DBUV_MHZ | DBMV_MHZ | DBUA_MHZ | |DBUV_M | DBUA_M | DBUV_MHZ | DBUA_MHZ | DEG | RAD | S | HZ | PCT | UNITLESS	only the following units are available for the FSU:DBM | DBPW | WATT | DBUV | DBMV | VOLT | DBUA | AMPere | DB | DBUV_M | DBUA_M | DEG | RAD | S | HZ | PCT | UNITLESS
FSET/ ESI	CALCulate<1|2>:LIMit<1...8>:UNIT	DBM | DBPW | WATT | DBUV | DBMV | VOLT | DBUA | AMPere | DB | DBUV_MHZ | DBMV_MHZ | DBUA_MHZ | |DBUV_M | DBUA_M | DBUV_MHZ | DBUA_MHZ | DEG | RAD | S | HZ | PCT | UNITLESS	only the following units are available for the FSU:DBM | DBPW | WATT | DBUV | DBMV | VOLT | DBUA | AMPere | DB | DBUV_M | DBUA_M | DEG | RAD | S | HZ | PCT | UNITLESS
FSU + FSE	CALCulate<1|2>:LIMit<1...8>:UPPer:MARGin	<numeric value>	
FSU + FSE	CALCulate<1|2>:LIMit<1...8>:UPPer:MODE	RELative | ABSolute	
FSU + FSE	CALCulate<1|2>:LIMit<1...8>:UPPer:OFFset	<numeric value>	
FSU + FSE	CALCulate<1|2>:LIMit<1...8>:UPPer:SHIFt	<numeric_value>	
FSE	CALCulate<1|2>:LIMit<1...8>:UPPer:SPACing	LINear | LOGarithmic	not available for FSU
FSU + FSE	CALCulate<1|2>:LIMit<1...8>:UPPer:STATe	ON | OFF	
FSU	CALCulate<1|2>:LIMit<1...8>:UPPer:THReshold	<numeric value>	new function for FSU
FSU + FSE	CALCulate<1|2>:LIMit<1...8>:UPPer[:DATA]	<numeric value>	
FSU + FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion:ZOOM	<numeric value>	FSU: function uses always marker 1 as its reference marker; FSE: all available markers can be used as a reference marker
FSU + FSE	CALCulate<1|2>:MARKer<1...4>:AOFF		
FSU + FSE	CALCulate<1|2>:MARKer<1...4>:COUNt	ON | OFF	
FSU + FSE	CALCulate<1|2>:MARKer<1...4>:COUNt:FREQuency?		
FSU + FSE	CALCulate<1|2>:MARKer<1...4>:COUNt:RESolution	0.1 | 1 | 10 | 100 | 1000 | 10000 Hz	
FSE	CALCulate<1|2>:MARKer<1...4>:COUPled[STATe]	ON | OFF	not available for FSU
FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion:ADEMod		not available for FSU and FSET

<table>
<tr><th>Devices</th><th>Command</th><th>Parameter</th><th>Notes</th></tr>
<tr><td>FSE</td><td>CALCulate<1|2>:MARKer<1...4>:FUNCtion:ADEMod:AM[:RESult]?</td><td>PPEak | MPEak | MIDDle | RMS</td><td>not available for FSU and FSET</td></tr>
<tr><td>FSE</td><td>CALCulate<1|2>:MARKer<1...4>:FUNCtion:ADEMod:CARRier</td><td></td><td>not available for FSU and FSET</td></tr>
<tr><td>FSE</td><td>CALCulate<1|2>:MARKer<1...4>:FUNCtion:ADEMod:FERRor</td><td></td><td>not available for FSU and FSET</td></tr>
<tr><td>FSE</td><td>CALCulate<1|2>:MARKer<1...4>:FUNCtion:ADEMod:FM</td><td>PPEak | MPEak | MIDDle | RMS | RDEV</td><td>not available for FSU and FSET</td></tr>
<tr><td>FSE</td><td>CALCulate<1|2>:MARKer<1...4>:FUNCtion:ADEMod:PM</td><td>PPEak | MPEak | MIDDle | RMS</td><td>not available for FSU and FSET</td></tr>
<tr><td>FSE</td><td>CALCulate<1|2>:MARKer<1...4>:FUNCtion:ADEMod:SINad:RESult?</td><td></td><td>not available for FSU and FSET</td></tr>
<tr><td>FSE</td><td>CALCulate<1|2>:MARKer<1...4>:FUNCtion:ADEMod:SINad</td><td>ON | OFF</td><td>not available for FSU and FSET</td></tr>
<tr><td>FSU + FSE</td><td>CALCulate<1|2>:MARKer<1...4>:FUNCtion:CENTer</td><td></td><td></td></tr>
<tr><td>FSU + FSE</td><td>CALCulate<1|2>:MARKer<1...4>:FUNCtion:CSTep</td><td></td><td></td></tr>
<tr><td>FSE</td><td>CALCulate<1|2>:MARKer<1...4>:FUNCtion:DDEMod:RESult?</td><td>MERM | MEPK | MEPS | PERM PEPK | PEPS | EVRM | EVPK | EVPS IQOF | IQIM |ADR | FERR | FEPK | RHO | DEV | FSRM | FSUK | FSUS | DTTS</td><td>not available for FSU</td></tr>
<tr><td>FSU</td><td>CALCulate<1|2>:MARKer<1...4>:FUNCtion:DEModulation: CONTinuous</td><td></td><td>new function for FSU</td></tr>
<tr><td>FSU + FSE</td><td>CALCulate<1|2>:MARKer<1...4>:FUNCtion:DEModulation:HOLDoff</td><td>10ms to 1000s</td><td></td></tr>
<tr><td>FSU + FSE</td><td>CALCulate<1|2>:MARKer<1...4>:FUNCtion:DEModulation:SELect</td><td>AM | FM</td><td></td></tr>
<tr><td>FSU + FSE</td><td>CALCulate<1|2>:MARKer<1...4>:FUNCtion:DEModulation[:STATe]</td><td>ON | OFF</td><td></td></tr>
<tr><td>FSU</td><td>CALCulate<1|2>:MARKer<1...4>:FUNCtion:MDEPth:RESult?</td><td></td><td>new function for FSU</td></tr>
<tr><td>FSU</td><td>CALCulate<1|2>:MARKer<1...4>:FUNCtion:MDEPth[:STATe]</td><td></td><td>new function for FSU</td></tr>
<tr><td>FSE</td><td>CALCulate<1|2>:MARKer<1...4>:FUNCtion:MSTep</td><td></td><td>not available for FSU</td></tr>
<tr><td>FSU + FSE</td><td>CALCulate<1|2>:MARKer<1...4>:FUNCtion:NDBDown</td><td><numeric value></td><td></td></tr>
<tr><td>FSU + FSE</td><td>CALCulate<1|2>:MARKer<1...4>:FUNCtion:NDBDown:FREQuency?</td><td></td><td></td></tr>
<tr><td>FSU + FSE</td><td>CALCulate<1|2>:MARKer<1...4>:FUNCtion:NDBDown:RESult?</td><td></td><td></td></tr>
<tr><td>FSU + FSE</td><td>CALCulate<1|2>:MARKer<1...4>:FUNCtion:NDBDown:STATe</td><td>ON | OFF</td><td></td></tr>
<tr><td>FSU + FSE</td><td>CALCulate<1|2>:MARKer<1...4>:FUNCtion:NOISe:RESult?</td><td></td><td></td></tr>
<tr><td>FSU + FSE</td><td>CALCulate<1|2>:MARKer<1...4>:FUNCtion:NOISe:STATe</td><td>ON | OFF</td><td></td></tr>
<tr><td>FSE</td><td>CALCulate<1|2>:MARKer<1...4>:FUNCtion:POWer:CFILter</td><td>ON | OFF</td><td>not available for FSU</td></tr>
<tr><td>FSU + FSE</td><td>CALCulate<1|2>:MARKer<1...4>:FUNCtion:POWer:PRESet</td><td>NADC | TETRA | PDC | PHS | CDPD | FWCDma | RWCDma | F8CDma | R8CDma | F19Cdma | R19Cdma | FW3Gppcdma| RW3Gppcdma | D2CDma | S2CDma | M2CDma | NONE</td><td>available standards are compatible to the FSE</td></tr>
<tr><td>FSU</td><td>CALCulate<1|2>:MARKer<1...4>:FUNCtion:POWer:RESult:PHZ</td><td>ON | OFF</td><td>new function for FSU</td></tr>
<tr><td>FSU + FSE</td><td>CALCulate<1|2>:MARKer<1...4>:FUNCtion:POWer:RESult?</td><td>ACPower | CPOWer | OBANdwidth | OBWidth</td><td>CN and CN0 are not available on the FSU
ACPower and CPOWer are not available on the FSET</td></tr>
<tr><td>FSU</td><td>CALCulate<1|2>:MARKer<1...4>:FUNCtion:POWer:SELect?</td><td>ACPower | CPOWer | OBANdwidth | OBWidth</td><td>CN and CN0 are not available on the FSU</td></tr>
<tr><td>FSE</td><td>CALCulate<1|2>:MARKer<1...4>:FUNCtion:POWer:SELect?</td><td>ACPower | CPOWer | OBANdwidth | OBWidth | CN | CN0</td><td>CN and CN0 are not available on the FSU and FSET</td></tr>
<tr><td>FSET</td><td>CALCulate<1|2>:MARKer<1...4>:FUNCtion:POWer:SELect?</td><td>OBANdwidth | OBWidth</td><td></td></tr>
<tr><td>FSU + FSE</td><td>CALCulate<1|2>:MARKer<1...4>:FUNCtion:POWer[:STATe]</td><td>OFF</td><td></td></tr>
<tr><td>FSU + FSE</td><td>CALCulate<1|2>:MARKer<1...4>:FUNCtion:REFerence</td><td></td><td></td></tr>
<tr><td>FSE</td><td>CALCulate<1|2>:MARKer<1...4>:FUNCtion:SFACtor</td><td>(60dB/3dB) | (60dB/6dB)</td><td>not available for FSU</td></tr>
<tr><td>FSE</td><td>CALCulate<1|2>:MARKer<1...4>:FUNCtion:SFACtor:FREQuency?</td><td></td><td>not available for FSU</td></tr>
<tr><td>FSE</td><td>CALCulate<1|2>:MARKer<1...4>:FUNCtion:SFACtor:RESult?</td><td></td><td>not available for FSU</td></tr>
<tr><td>FSE</td><td>CALCulate<1|2>:MARKer<1...4>:FUNCtion:SFACtor:STATe</td><td>ON | OFF</td><td>not available for FSU</td></tr>
<tr><td>FSE</td><td>CALCulate<1|2>:MARKer<1...4>:FUNCtion:STARt</td><td></td><td>not available for FSU</td></tr>
<tr><td>FSE</td><td>CALCulate<1|2>:MARKer<1...4>:FUNCtion:STOP</td><td></td><td>not available for FSU</td></tr>
<tr><td>FSU</td><td>CALCulate<1|2>:MARKer<1...4>:FUNCtion:STRack: BANDwidth|BWIDth</td><td>10 Hz to MAX(span)</td><td>new function for FSU. Replaces DISP:FLINE of the FSE.</td></tr>
<tr><td>FSU</td><td>CALCulate<1|2>:MARKer<1...4>:FUNCtion:STRack:THReshold</td><td>-330 to +30 dBm</td><td>new function for FSU</td></tr>
</table>

Devices	Command	Parameter	Notes
FSU	CALCulate<1|2>:MARKer<1...4>:FUNCtion:STRack:TRACe	1 to 3	new function for FSU
FSU + FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion:STRack[:STATe]	ON | OFF	
FSU + FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary:AOFF		
FSU + FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary:AVERage	ON | OFF	
FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary:MAXimum: AVERage:RESult?		not available for FSU
FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary:MAXimum: PHOLd:RESult?		not available for FSU
FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary:MAXimum: RESult?		not available for FSU
FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary:MAXimum [:STATe]	ON | OFF	not available for FSU
FSU + FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary:MEAN: AVERage:RESult?		
FSU + FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary:MEAN:PHOLd:R ESult?		
FSU + FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary:MEAN:RESult?		
FSU + FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary:MEAN[:STATe]	ON | OFF	
FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary:MIDDle: AVERage:RESult?		not available for FSU
FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary:MIDDle: PHOLd:RESult?		not available for FSU
FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary:MIDDle: RESult?		not available for FSU
FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary:MIDDle [:STATe]	ON | OFF	not available for FSU
FSU	CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary:MODE	ABSolute | RELative	new function for FSU
FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary:MPEak: AVERage:RESult?		not available for FSU
FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary:MPEak: PHOLd:RESult?		not available for FSU
FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary:MPEak: RESult?		not available for FSU
FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary:MPEak [:STATe]	ON | OFF	not available for FSU
FSU + FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary:PHOLd	ON | OFF	
FSU + FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary:PPEak: AVERage:RESult?		
FSU + FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary:PPEak:PHOLd:R ESult?		
FSU + FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary:PPEak:RESult?		
FSU + FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary:PPEak[:STATe]	ON | OFF	
FSU	CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary:REFerence: AUTO	ONCE	new function for FSU
FSU + FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary:RMS:AVERage:R ESult?		
FSU + FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary:RMS:PHOLd: RESult?		
FSU + FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary:RMS:RESult?		
FSU + FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary:RMS[:STATe]	ON | OFF	
FSU	CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary:SDEViation: RESult?		new function for FSU
FSU	CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMarySDEViation: AVERage:RESult?		new function for FSU
FSU	CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary:SDEViation: PHOLd:RESult?		new function for FSU
FSU	CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary:SDEViation [:STATe]	ON | OFF	new function for FSU
FSU + FSE	CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary[:STATe]	ON | OFF	
FSU	CALCulate<1|2>:MARKer<1...4>:FUNCtion:TOI:RESult?		new function for FSU
FSU	CALCulate<1|2>:MARKer<1...4>:FUNCtion:TOI[:STATe]	ON | OFF	new function for FSU
FSU + FSE	CALCulate<1|2>:MARKer<1...4>:LOEXclude	ON | OFF	
FSE	CALCulate<1|2>:MARKer<1...4>:MAXimum:APEak		not available for FSU
FSU + FSE	CALCulate<1|2>:MARKer<1...4>:MAXimum:LEFT		
FSU + FSE	CALCulate<1|2>:MARKer<1...4>:MAXimum:NEXT		
FSU + FSE	CALCulate<1|2>:MARKer<1...4>:MAXimum:RIGHt		
FSU + FSE	CALCulate<1|2>:MARKer<1...4>:MAXimum[:PEAK]		
FSU + FSE	CALCulate<1|2>:MARKer<1...4>:MINimum:LEFT		
FSU + FSE	CALCulate<1|2>:MARKer<1...4>:MINimum:NEXT		
FSU + FSE	CALCulate<1|2>:MARKer<1...4>:MINimum:RIGHt		

Devices	Command	Parameter	Notes
FSU + FSE	CALCulate<1|2>:MARKer<1...4>:MINimum[:PEAK]		
FSU + FSE	CALCulate<1|2>:MARKer<1...4>:PEXCursion	<numeric value>	
FSE	CALCulate<1|2>:MARKer<1...4>:READout	MPHase | RIMaginary	not available for FSU
FSE	CALCulate<1|2>:MARKer<1...4>:SCOupled[STATe]	ON | OFF	not available for FSU
FSE	CALCulate<1|2>:MARKer<1...4>:STEP:AUTO	ON | OFF	not available for FSU
FSE	CALCulate<1|2>:MARKer<1...4>:STEP[:INCRement]	<numeric_value>	not available for FSU
FSU + FSE	CALCulate<1|2>:MARKer<1...4>:TRACe	1 to 3	FSU: 3 traces are available per screen FSE: 4 traces are available in full screen mode and 2 traces per screen in split screen mode
FSU + FSE	CALCulate<1|2>:MARKer<1...4>:X	0 to MAX (frequency| sweep time)	additional unit SYM is available for FSE
FSU	CALCulate<1|2>:MARKer<1...4>:X:SLIMits:LEFT	0 to MAX (frequency|sweep time)	new function for FSU. Replaces DISP:FLIN and DISP:TLIN commands of the FSE
FSU	CALCulate<1|2>:MARKer<1...4>:X:SLIMits:RIGHt	0 to MAX (frequency|sweep time)	new function forFSU. Replaces DISP:FLIN and DISP:TLIN commands of the FSE
FSU + FSE	CALCulate<1|2>:MARKer<1...4>:X:SLIMits[:STATe]	ON | OFF	
FSU + FSE	CALCulate<1|2>:MARKer<1...4>:Y?		
FSU	CALCulate<1|2>:MARKer<1...4>:Y:PERCent	<numeric_value>	new function for FSU
FSU + FSE	CALCulate<1|2>:MARKer<1...4>[:STATe]	ON | OFF	
FSU	CALCulate<1|2>:MATH:MODE	LINear | LOGarithmic	affects all traces on the FSU; therefore the numeric suffix :MATH<1...4> is not allowed for the FSU
FSE	CALCulate<1|2>:MATH<1...4>:MODE	LINear | LOGarithmic	for FSE, only the trace indicated by a numeric suffix is affected
FSU	CALCulate<1|2>:MATH:POS	-100PCT to 200PCT	new function for FSU; replacement for CALC:RLINe of the FSE
FSU + FSE	CALCulate<1|2>:MATH:STATe	ON | OFF	for FSU, traces can only be subtracted from trace 1; therefore there is no numeric suffix behind :MATH
FSU + FSE	CALCulate<1|2>:MATH[:EXPRession][:DEFine]	<expr>	for FSU, traces can only be subtracted from trace 1; therefore there is no numeric suffix behind :MATH and <expr> may only consist of (TRACE1-TRACE2) or (TRACE1-TRACE3)
FSE	CALCulate<1|2>:RLINe	MIN to MAX	not available for FSU (replaced by CALC:MATH:POS)
FSE	CALCulate<1|2>:RLINe:STATe	ON | OFF	not available for FSU (replaced by CALC:MATH:POS)
FSU + FSE	CALCulate<1|2>:THReshold	MIN to MAX	
FSU + FSE	CALCulate<1|2>:THReshold:STATe	ON | OFF	
FSE	CALCulate<1|2>:TLINe<1|2>	0 to 1000s	not available on the FSU; replaced by CALC:SLIMits:LEFT and CALC:SLIMits:RIGHt
FSE	CALCulate<1|2>:TLINe<1|2>:STATe	ON | OFF	not available on the FSU; replaced by CALC:SLIMits:LEFT and CALC:SLIMits:RIGHt
FSE	CALCulate<1|2>:UNIT:ANGLe	DEG | RAD	not available for FSU
FSU	CALCulate<1|2>:UNIT:POWer	DBM | V| A| W | DBPW | WATT | DBUV | DBMV | VOLT | DBUA | AMPere	available units are compatible to the FSE

Devices	Command	Parameter	Notes
FSET/ ESI	CALCulate<1|2>:UNIT:POWer	DBM | V | W | DB | PCT | UNITLESS | DBPW | WATT | DBUV | DBMV | VOLT | DBUA | AMPere | DBPT | DBUV_MHZ | DBMV_MHZ | DBUA_MHZ | DBUV_M | DBUA_M | DBUV_MMHZ | DBUA_MMHZ	the FSU supports the following units:DBM | V| A| W | DBPW | WATT | DBUV | DBMV | VOLT | DBUA | AMPere
FSE/ FSIQ	CALCulate<1|2>:UNIT:POWer	DBM | V | W | DB | PCT | UNITLESS | DBPW | WATT | DBUV | DBMV | VOLT | DBUA | AMPere | DBUV_MHZ | DBMV_MHZ | DBUA_MHZ | DBUV_M | DBUA_M | DBUV_MMHZ | DBUA_MMHZ	the FSU supports the following units:DBM | V| A| W | DBPW | WATT | DBUV | DBMV | VOLT | DBUA | AMPere
FSE	CALCulate<1|2>:X:UNIT:TIME	S | SYM	not available for FSU
FSU	CALibration:ABORt		new function for FSU
FSE	CALibration:BANDwidth | BWIDth[:RESolution]?		not available for FSU
FSE	CALibration:IQ?		not available for FSU
FSE	CALibration:LDETector?		not available for FSU
FSE	CALibration:LOSuppression?		not available for FSU
FSE	CALibration:PPEak?		not available for FSU
ESI	CALibration:PRESelector?		not available for FSU
FSU	CALibration:RESult?		new function for FSU
FSE	CALibration:SHORt?		not available for FSU
FSU + FSE	CALibration:STATe	ON | OFF	
FSU + FSE	CALibration[:ALL]?		
FSE	CONFigure:BURSt:PFERror:COUNt	1 to 1000	not available for FSU and FSET
FSE	CONFigure:BURSt:PFERror[IMMediate]		not available for FSU and FSET
FSE	CONFigure:BURSt:POWer:CONDition	NORMal | EXTReme	not available for FSU and FSET
FSE	CONFigure:BURSt:POWer:COUNt	1 to 1000	not available for FSU and FSET
FSE	CONFigure:BURSt:POWer[IMMediate]		not available for FSU and FSET
FSE	CONFigure:BURSt:PTEMplate:[IMMediate]		not available for FSU and FSET
FSE	CONFigure:BURSt:PTEMplate:COUNt	1 to 1000	not available for FSU and FSET
FSE	CONFigure:BURSt:PTEMplate:SELect	FULL | TOP | RISing | FALLing	not available for FSU and FSET
FSE	CONFigure:BURst:REFerence:AUTO	ON | OFF	not available for FSU and FSET
FSE	CONFigure:SPECtrum:MODulation:COUNt	1 to 1000	not available for FSU and FSET
FSE	CONFigure:SPECtrum:MODulation:RANGe	ARFCn | TXBand | RXBand | COMBined | DCSRx1800	not available for FSU and FSET
FSE	CONFigure:SPECtrum:MODulation:TGATe	ON | OFF	not available for FSU and FSET
FSE	CONFigure:SPECtrum:MODulation[:IMMediate]		not available for FSU and FSET
FSE	CONFigure:SPECtrum:SWITching:COUNt	1 to 1000	not available for FSU and FSET
FSE	CONFigure:SPECtrum:SWITching[:IMMediate]		not available for FSU and FSET
FSE	CONFigure:SPURious:ANTenna	CONDucted | RADiated	not available for FSU and FSET
FSE	CONFigure:SPURious:COUN:RXBandt	1 to 1000	not available for FSU and FSET
FSE	CONFigure:SPURious:COUNt	1 to 1000	not available for FSU and FSET
FSE	CONFigure:SPURious:RANGe	TXBand | OTXBand | RXBand | IDLeband | COMBined	not available for FSU and FSET
FSE	CONFigure:SPURious:STEP:COUNt?		not available for FSU and FSET

Devices	Command	Parameter	Notes
FSE	CONFigure:SPURious:STEP<1..26>	ON | OFF	not available for FSU and FSET
FSE	CONFigure:SPURious[:IMMediate]		not available for FSU and FSET
FSE	CONFigure[:BTS]:ARFCn	<numeric_value>	not available for FSU and FSET
FSE	CONFigure[:BTS]:ARFCn:AUTO	ONCE	not available for FSU and FSET
FSE	CONFigure[:BTS]:CHANnel:SFH	ON | OFF	not available for FSU and FSET
FSE	CONFigure[:BTS]:CHANnel:SLOT	0 to 7	not available for FSU and FSET
FSE	CONFigure[:BTS]:CHANnel:SLOT:AUTO	ONCE	not available for FSU and FSET
FSE	CONFigure[:BTS]:CHANnel:TSC	0 to 7	not available for FSU and FSET
FSE	CONFigure[:BTS]:CHANnel:TSC:AUTO	ON | OFF	not available for FSU and FSET
FSE	CONFigure[:BTS]:COSiting	ON | OFF	not available for FSU and FSET
FSE	CONFigure[:BTS]:LIMit:FREQency	<numeric_value>	not available for FSU and FSET
FSE	CONFigure[:BTS]:LIMit:PPEak	<numeric_value>	not available for FSU and FSET
FSE	CONFigure[:BTS]:LIMit:PRMS	<numeric_value>	not available for FSU and FSET
FSE	CONFigure[:BTS]:LIMit:STANdard	ON | OFF	not available for FSU and FSET
FSE	CONFigure[:BTS]:NETWork:PHASe	1|2[,PLUS]	not available for FSU and FSET
FSE	CONFigure[:BTS]:NETWork[:TYPE]	PGSM |PGSM900 | EGSM |EGSM900 | DCS |GSM1800 | PCS | GSM1900 | RGSM | RGSM900	not available for FSU and FSET
FSE	CONFigure[:BTS]:POWer:CLASs	1 to 8 | 1 to 4 | M1 | M2 | M3	not available for FSU and FSET
FSE	CONFigure[:BTS]:POWer:COUPled	ON | OFF	not available for FSU and FSET
FSE	CONFigure[:BTS]:POWer:DYNamic	0 to 15	not available for FSU and FSET
FSE	CONFigure[:BTS]:POWer:EXPected	<numeric_value>	not available for FSU and FSET
FSE	CONFigure[:BTS]:POWer:LIMit	<numeric_value>	not available for FSU and FSET
FSE	CONFigure[:BTS]:POWer:SINGle:CLEar		not available for FSU and FSET
FSE	CONFigure[:BTS]:POWer:SINGle[:STATe]	ON | OFF	not available for FSU and FSET
FSE	CONFigure[:BTS]:POWer:STATic	0 to 6	not available for FSU and FSET
FSE	CONFigure[:BTS]:PRESet		not available for FSU and FSET
FSE	CONFigure[:BTS]:SWEeptime	STANdard | AUTO	not available for FSU and FSET
FSE	CONFigure[:BTS]:TXSupp	ON | OFF	not available for FSU and FSET
FSE	CONFigure[:BTS]MEASurement?		not available for FSU and FSET
FSE	CONFigure[:MS]:ARFCn	<numeric_value>	not available for FSU and FSET
FSE	CONFigure[:MS]:ARFCn:AUTO	ONCE	not available for FSU and FSET
FSE	CONFigure[:MS]:CHANnel:SFH	ON | OFF	not available for FSU and FSET
FSE	CONFigure[:MS]:CHANnel:TSC	0 to 7	not available for FSU and FSET
FSE	CONFigure[:MS]:LIMit:FREQuency	<numeric_value>	not available for FSU and FSET
FSE	CONFigure[:MS]:LIMit:PPEak	<numeric_value>	not available for FSU and FSET

Devices	Command	Parameter	Notes
FSE	CONFigure[:MS]:LIMit:PRMS	<numeric_value>	not available for FSU and FSET
FSE	CONFigure[:MS]:LIMit:STANdard	ON | OFF	not available for FSU and FSET
FSE	CONFigure[:MS]:NETWork:PHASe	1|2[,PLUS]	not available for FSU and FSET
FSE	CONFigure[:MS]:NETWork[:TYPE]	PGSM |PGSM900 | EGSM |EGSM900 | DCS |GSM1800 | PCS | GSM1900 | RGSM | RGSM900	not available for FSU and FSET
FSE	CONFigure[:MS]:POWer:CLASs	<numeric_value>	not available for FSU and FSET
FSE	CONFigure[:MS]:POWer:COUPled	ON | OFF	not available for FSU and FSET
FSE	CONFigure[:MS]:POWer:EXPected	<numeric_value>	not available for FSU and FSET
FSE	CONFigure[:MS]:POWer:LEVel	0 to 31	not available for FSU and FSET
FSE	CONFigure[:MS]:POWer:LIMit	<numeric_value>	not available for FSU and FSET
FSE	CONFigure[:MS]:POWer:SINGle:CLEar		not available for FSU and FSET
FSE	CONFigure[:MS]:POWer:SINGle[:STATe]	ON | OFF	not available for FSU and FSET
FSE	CONFigure[:MS]:POWer:SMALl	ON | OFF	not available for FSU and FSET
FSE	CONFigure[:MS]:PRESet		not available for FSU and FSET
FSE	CONFigure[:MS]:SWEeptime	STANdard | AUTO	not available for FSU and FSET
FSE	CONFigure[:MS]:TXSupp	ON | OFF	not available for FSU and FSET
FSE	CONFigure[:MS]MEASurement?		not available for FSU and FSET
FSET	DIAGnostic:INFO:CCOunt:ATTenuation?		not available for FSU
FSE	DIAGnostic:INFO:CCOunt:ATTenuation<1 | 10>?		not available for FSU
FSIQ	DIAGnostic:INFO:CCOunt:ATTenuation<1 | 2 | 3>?		not available for FSU
ESI	DIAGnostic:INFO:CCOunt:ATTenuation<1|2|4>?		not available for FSU
FSE	DIAGnostic:INFO:CCOunt:PRESelector<1..6>?		not available for FSU
FSU	DIAGnostic:SERVice:CSOurce[:POWer]	<numeric_value>	new function for FSU
FSE	DIAGnostic:SERVice:FUNCtion	<numeric_value>, <numeric_value> to	not available for FSU. Replaced by DIAG:SERV:SFUNction
FSET	DIAGnostic:SERVice:HGENerator	OFF | 10 kHz | 100 kHz | BALanced	not available for FSU
FSU + FSE	DIAGnostic:SERVice:INPut[:SELect]	CALibration | RF	
FSU	DIAGnostic:SERVice:INPut:PULSed[:STATe]		new function for FSU
FSU	DIAGnostic:SERVice:INPut:PULSed:PRATe	<numeric_value>	new function for FSU
FSU + FSE	DIAGnostic:SERVice:NSOurce	ON | OFF	
FSU	DIAGnostic:SERVice:SFUNction	<string> to	replacement for DIAG:SERV:FUNC of FSU; necessary due to different parameter formats needed on the FSU
FSU	DIAGnostic:SERVice:STESt:RESult?		new function for FSU
FSU + FSE	DISPlay:ANNotation:FREQuency	ON | OFF	
	DISPlay:BARGraph:LEVel:LOWer		not available for FSU
	DISPlay:BARGraph:LEVel:UPPer		not available for FSU
FSU + FSE	DISPlay:CMAP<1...26>:DEFault<1|2>		larger selection of independently configurable items (1 to 26)
FSU + FSE	DISPlay:CMAP<1...26>:HSL	0 to 1,0 to 1,0 to 1	larger selection of independently configurable items (1 to 26)
FSU + FSE	DISPlay:CMAP<1...26>:PDEFined	<color>	larger selection of independently configurable items (1 to 26)
FSU + FSE	DISPlay:FORMat	SINGle | SPLit	
FSU + FSE	DISPlay:LOGO	ON | OFF	

<table>
<tr><th>Devices</th><th>Command</th><th>Parameter</th><th>Notes</th></tr>
<tr><td>FSE</td><td>DISPlay:PROGram[:MODE]</td><td>ON | OFF</td><td>not available for FSU</td></tr>
<tr><td>FSU + FSE</td><td>DISPlay:PSAVe:HOLDoff</td><td>0 to 60</td><td></td></tr>
<tr><td>FSU + FSE</td><td>DISPlay:PSAVe[:STATe]</td><td>ON | OFF</td><td></td></tr>
<tr><td>FSE</td><td>DISPlay[:WINDow<1|2>]:FEED</td><td>'AF' | 'VIDeo'</td><td>not available for FSU</td></tr>
<tr><td>FSE</td><td>DISPlay[:WINDow<1|2>]:MINFo</td><td>ON | OFF</td><td>not available for FSU</td></tr>
<tr><td>FSU</td><td>DISPlay[:WINDow<1|2>]:SELect</td><td></td><td>new function for FSU</td></tr>
<tr><td>FSU + FSE</td><td>DISPlay[:WINDow<1|2>]:TEXT:STATe</td><td>ON | OFF</td><td></td></tr>
<tr><td>FSU + FSE</td><td>DISPlay[:WINDow<1|2>]:TEXT[:DATA]</td><td><string></td><td></td></tr>
<tr><td>FSU + FSE</td><td>DISPlay[:WINDow<1|2>]:TIME</td><td>ON | OFF</td><td></td></tr>
<tr><td>FSU + FSE</td><td>DISPlay[:WINDow<1|2>]:TRACe<1...3>:MODE</td><td>WRITe | VIEW | AVERage | MAXHold | MINHold</td><td>FSU: 3 traces are available per screen
FSE: 4 traces are available in full screen mode and 2 traces per screen in split screen mode</td></tr>
<tr><td>FSE</td><td>DISPlay[:WINDow<1|2>]:TRACe<1...4>:EYE:COUNt</td><td>1 to Result Length</td><td>not available for FSU</td></tr>
<tr><td>FSE</td><td>DISPlay[:WINDow<1|2>]:TRACe<1...4>:MODE:ANALog</td><td>ON | OFF</td><td>not available for FSU</td></tr>
<tr><td>FSE</td><td>DISPlay[:WINDow<1|2>]:TRACe<1...4>:MODE:CWRite</td><td>ON | OFF</td><td>not available for FSU</td></tr>
<tr><td>FSE</td><td>DISPlay[:WINDow<1|2>]:TRACe<1...4>:MODE:HCONtinuous</td><td>ON | OFF</td><td>not available for FSU</td></tr>
<tr><td>FSE</td><td>DISPlay[:WINDow<1|2>]:TRACe<1...4>:SYMBol</td><td>DOTS | BARS | OFF</td><td>not available for FSU</td></tr>
<tr><td>FSE</td><td>DISPlay[:WINDow<1|2>]:TRACe<1...4>:X:SPACing</td><td>LINear | LOGarithmic</td><td>not available for FSU</td></tr>
<tr><td>FSE</td><td>DISPlay[:WINDow<1|2>]:TRACe<1...4>:X[:SCALe]:RVALue</td><td><numeric value></td><td>not available for FSU</td></tr>
<tr><td>FSE</td><td>DISPlay[:WINDow<1|2>]:TRACe<1...4>:X[:SCALe]:ZOOM</td><td>ON | OFF</td><td>not available for FSU</td></tr>
<tr><td>FSE</td><td>DISPlay[:WINDow<1|2>]:TRACe<1...4>:X[:SCALe]:ZOOM [:FREQuency]:CENTer</td><td><numeric_value></td><td>not available for FSU</td></tr>
<tr><td>FSE</td><td>DISPlay[:WINDow<1|2>]:TRACe<1...4>:X[:SCALe]:ZOOM [:FREQuency]:</td><td><numeric_value></td><td>not available for FSU</td></tr>
<tr><td>FSE</td><td>DISPlay[:WINDow<1|2>]:TRACe<1...4>:X[:SCALe]:ZOOM [:FREQuency]:</td><td><numeric_value></td><td>not available for FSU</td></tr>
<tr><td>FSU</td><td>DISPlay[:WINDow<1|2>]:TRACe<1...3>:Y:SPACing</td><td>LINear | LOGarithmic</td><td>FSU: TRACe<1...3></td></tr>
<tr><td>FSE</td><td>DISPlay[:WINDow<1|2>]:TRACe<1...4>:Y:SPACing</td><td>LINear | LOGarithmic | PERCent</td><td>PERCent is not available for FSU + FSE: TRACE<1...4></td></tr>
<tr><td>FSU + FSE</td><td>DISPlay[:WINDow<1|2>]:TRACe<1...3>:Y[:SCALe]</td><td>10dB to 200dB</td><td>FSU: TRACe<1...3>
FSE: TRACE<1...4></td></tr>
<tr><td>FSET/ ESI</td><td>DISPlay[:WINDow<1|2>]:TRACe<1...4>:Y[:SCALe]:BOTTom</td><td><numeric value></td><td>not available for FSU</td></tr>
<tr><td>FSU + FSE</td><td>DISPlay[:WINDow<1|2>]:TRACe<1...3>:Y[:SCALe]:MODE</td><td>ABSolute | RELative</td><td>FSU: TRACe<1...3>
FSE: TRACE<1...4></td></tr>
<tr><td>FSE</td><td>DISPlay[:WINDow<1|2>]:TRACe<1...4>:Y[:SCALe]:PDIVision</td><td></td><td>not available for FSU</td></tr>
<tr><td>FSU + FSE</td><td>DISPlay[:WINDow<1|2>]:TRACe<1...3>:Y[:SCALe]:RLEVel</td><td>-130dBm to 30dBm</td><td>FSU: TRACe<1...3>
FSE: TRACE<1...4></td></tr>
<tr><td>FSU + FSE</td><td>DISPlay[:WINDow<1|2>]:TRACe<1...3>:Y[:SCALe]:RLEVel:OFFSet</td><td>-200dB to 200dB</td><td>FSU: TRACe<1...3>
FSE: TRACE<1...4></td></tr>
<tr><td>FSU + FSE</td><td>DISPlay[:WINDow<1|2>]:TRACe<1...3>:Y[:SCALe]:RPOSition</td><td>0 to 100 PCT</td><td>FSU: TRACe<1...3>
FSE: TRACE<1...4></td></tr>
<tr><td>FSU + FSE</td><td>DISPlay[:WINDow<1|2>]:TRACe<1...3>:Y[:SCALe]:RVALue</td><td><numeric value></td><td>FSU: TRACe<1...3>
FSE: TRACE<1...4></td></tr>
<tr><td>FSE</td><td>DISPlay[:WINDow<1|2>]:TRACe<1...4>:Y[:SCALe]:RVALue:AUTO</td><td>ON | OFF</td><td>not available for FSU</td></tr>
<tr><td>FSET/ ESI</td><td>DISPlay[:WINDow<1|2>]:TRACe<1...4>:Y[:SCALe]:TOP</td><td><numeric value></td><td>not available for FSU</td></tr>
<tr><td>FSU</td><td>DISPlay[:WINDow<1|2>]:TRACe<1...3>[:STATe]</td><td>ON | OFF</td><td>FSU: TRACe<1...3>
FSE: TRACE<1...4></td></tr>
<tr><td>FSE</td><td>FETCh:BURSt:FERRor:AVERage?</td><td></td><td>not available for FSU and FSET</td></tr>
<tr><td>FSE</td><td>FETCh:BURSt:FERRor:MAXimum?</td><td></td><td>not available for FSU and FSET</td></tr>
<tr><td>FSE</td><td>FETCh:BURSt:FERRor:STATus?</td><td></td><td>not available for FSU and FSET</td></tr>
<tr><td>FSE</td><td>FETCh:BURSt:PERRor:PEAK:AVERage?</td><td></td><td>not available for FSU and FSET</td></tr>
<tr><td>FSE</td><td>FETCh:BURSt:PERRor:PEAK:MAXimum?</td><td></td><td>not available for FSU and FSET</td></tr>
<tr><td>FSE</td><td>FETCh:BURSt:PERRor:PEAK:STATus?</td><td></td><td>not available for FSU and FSET</td></tr>
</table>

<table>
<tr><th>Devices</th><th>Command</th><th>Parameter</th><th>Notes</th></tr>
<tr><td>FSE</td><td>FETCh:BURSt:PERRor:RMS:AVERage?</td><td></td><td>not available for FSU and FSET</td></tr>
<tr><td>FSE</td><td>FETCh:BURSt:PERRor:RMS:MAXimum?</td><td></td><td>not available for FSU and FSET</td></tr>
<tr><td>FSE</td><td>FETCh:BURSt:PERRor:RMS:STATus?</td><td></td><td>not available for FSU and FSET</td></tr>
<tr><td>FSE</td><td>FETCh:BURSt:POWer[:IMMediate]?</td><td></td><td>not available for FSU and FSET</td></tr>
<tr><td>FSE</td><td>FETCh:MODulation[:ALL]?</td><td>ARFCn | TXBand | RXBand |COMBined | DCSRx1800</td><td>not available for FSU and FSET</td></tr>
<tr><td>FSE</td><td>FETCh:PTEMplate:REFerence?</td><td>TXBand</td><td>not available for FSU and FSET</td></tr>
<tr><td>FSE</td><td>FETCh:SPECtrum:MODulation:REFerence?</td><td>TXBand</td><td>not available for FSU and FSET</td></tr>
<tr><td>FSE</td><td>FETCh:SPECtrum:SWITching:REFerence?</td><td>TXBand</td><td>not available for FSU and FSET</td></tr>
<tr><td>FSE</td><td>FETCh:SPECtrum:SWITching[:ALL]?</td><td></td><td>not available for FSU and FSET</td></tr>
<tr><td>FSE</td><td>FETCh:SPURious:STEP?</td><td></td><td>not available for FSU and FSET</td></tr>
<tr><td>FSE</td><td>FETCh:SPURious[:ALL]?</td><td>TXBand OTXBand | RXBand | IDLeband</td><td>not available for FSU and FSET</td></tr>
<tr><td>FSE</td><td>FORMat:DEXPort:APPend[:STATe] ON|OFF[,32]</td><td></td><td>not available for FSU</td></tr>
<tr><td>FSU + FSE</td><td>FORMat:DEXPort:DSEParator</td><td>POINt|COMMa</td><td></td></tr>
<tr><td>FSE</td><td>FORMat:DEXPort:HEADer[:STATe] ON|OFF[,32]</td><td></td><td>not available for FSU</td></tr>
<tr><td>FSU</td><td>FORMat[:DATA]</td><td>ASCii | REAL[,32]</td><td></td></tr>
<tr><td>FSE</td><td>FORMat[:DATA]</td><td>ASCii | REAL | UINT [,32]</td><td>UINT is not available for FSU</td></tr>
<tr><td>FSU + FSE</td><td>HCOPy:ABORt</td><td></td><td></td></tr>
<tr><td>FSU</td><td>HCOPy:DESTination<1|2></td><td>'MMEM' |
'SYST:COMM:PRIN' |
'SYST:COMM:CLIP'</td><td></td></tr>
<tr><td>FSE/</td><td>HCOPy:DESTination<1|2></td><td>'SYST:COMM:GPIB'
|'SYST:COMM:SER1' |
'SYST:COMM:SER2' |
'SYST:COMM:CENT' |
'MMEM' |
'SYST:COMM:PRIN'|'SYST
:COMM:CLIP'</td><td>SYST:COMM:GPIB/SER1/SER2 is not available for FSU</td></tr>
<tr><td>FSIQ/
ESI</td><td>HCOPy:DESTination<1|2></td><td>"MMEM' |
'SYST:COMM:PRIN'|
'SYST:COMM:CLIP'</td><td></td></tr>
<tr><td>FSU + FSE</td><td>HCOPy:DEVice:COLor</td><td>ON | OFF</td><td></td></tr>
<tr><td>FSU</td><td>HCOPy:DEVice:LANGuage<1|2></td><td>GDI | WMF | EWMF | BMP</td><td></td></tr>
<tr><td>FSE/</td><td>HCOPy:DEVice:LANGuage<1|2></td><td>HPGL | PCL4 | PCL5 |
POSTscript | ESCP | WMF
| PCX | HP7470 to</td><td></td></tr>
<tr><td>FSIQ/
ESI</td><td>HCOPy:DEVice:LANGuage<1|2></td><td>WMF | GDI | EWMF | BMP
to</td><td></td></tr>
<tr><td>FSE/</td><td>HCOPy:DEVice:PRESet<1|2></td><td>ON | OFF</td><td>not available for FSU</td></tr>
<tr><td>FSE/</td><td>HCOPy:DEVice:RESolution<1|2></td><td>150 | 300</td><td>not available for FSU</td></tr>
<tr><td>FSU + FSE</td><td>HCOPy:ITEM:ALL</td><td></td><td></td></tr>
<tr><td>FSE</td><td>HCOPy:ITEM:FFEed<1|2>:STATe</td><td>ON | OFF</td><td>not available for FSU</td></tr>
<tr><td>FSE</td><td>HCOPy:ITEM:LABel:TEXT</td><td><string></td><td>not available for FSU</td></tr>
<tr><td>FSE</td><td>HCOPy:ITEM:PFEed<1|2>:STATe</td><td>ON | OFF</td><td>not available for FSU</td></tr>
<tr><td>FSU + FSE</td><td>HCOPy:ITEM:WINDow<1|2>:TABle:STATe</td><td>ON | OFF</td><td></td></tr>
<tr><td>FSU + FSE</td><td>HCOPy:ITEM:WINDow<1|2>:TEXT</td><td><string></td><td></td></tr>
<tr><td>FSE</td><td>HCOPy:ITEM:WINDow<1|2>:TRACe:CAINcrement</td><td>ON | OFF</td><td>not available for FSU</td></tr>
<tr><td>FSU + FSE</td><td>HCOPy:ITEM:WINDow<1|2>:TRACe:STATe</td><td>ON | OFF</td><td></td></tr>
<tr><td>FSE</td><td>HCOPy:PAGE:DIMensions:FULL</td><td></td><td>not available for FSU</td></tr>
<tr><td>FSE</td><td>HCOPy:PAGE:DIMensions:QUADrant<1...4></td><td></td><td>not available for FSU</td></tr>
<tr><td>FSU + FSE</td><td>HCOPy:PAGE:ORIentation<1|2></td><td>LANDscape | PORTrait</td><td></td></tr>
<tr><td>FSU + FSE</td><td>HCOPy[:IMMediate]</td><td></td><td></td></tr>
<tr><td>FSET/
ESI</td><td>HOLD</td><td></td><td>not available for FSU</td></tr>
<tr><td>FSU + FSE</td><td>INITiate<1|2>:CONMeas</td><td>ON | OFF</td><td></td></tr>
<tr><td>FSU + FSE</td><td>INITiate<1|2>:CONTinuous</td><td>ON | OFF</td><td></td></tr>
</table>

Devices	Command	Parameter	Notes
FSU + FSE	INITiate<1|2>:DISPlay	ON | OFF	
FSU + FSE	INITiate<1|2>[:IMMediate]		
FSET	INPut:PRESelection:CATalog?		not available for FSU
FSET	INPut:PRESelection:USET:NAME	'name of user defined preselector set (to edit existing set or to create new set)'	not available for FSU
FSET	INPut:PRESelection:USET:CLEar		not available for FSU
FSET	INPut:PRESelection:USET:COMMent	'comment for preselector-set'	not available for FSU
FSET	INPut:PRESelection:USET:LRANge[:DATA]	<numeric value>, <numeric value>, <numeric_value>	not available for FSU
FSET	INPut:PRESelection:USET:MRANge[:DATA]	<numeric value>, <numeric value>, <numeric_value>	not available for FSU
FSU + FSE	INPut<1|2>:ATTenuation	0 to 70dB	
FSET	INPut<1|2>:ATTenuation	0 to 70 | 80dB	80 dB not available for FSU
FSU + FSE	INPut<1|2>:ATTenuation:AUTO	ON | OFF	
FSE	INPut<1|2>:ATTenuation:AUTO:MODE	NORMal | LNOise | LDIStorsion	not available for FSU
FSET/ ESI	INPut<1|2>:ATTenuation:PROTection	ON | OFF	not available for FSU
FSU	INPut<1|2>:ATTenuation:PROTection:PRESet		new function for FSU
FSET	INPut<1|2>:ATTenuation:STEPsize	1dB | 10dB	not available for FSU
FSET	INPut<1|2>:BIMPedance	150OHM | 600OHM | 10kOHM	not available for FSU
FSET	INPut<1|2>:COUPling	AC | DC	not available for FSU
FSU	INPut<1|2>:EATT	0 to 30dB	new function for FSU
FSU	INPut<1|2>:EATT:AUTO	ON | OFF	new function for FSU
FSU	INPut<1|2>:EATT:STATe	ON | OFF	new function for FSU
FSET	INPut<1|2>:GAIN	0 to 30dB	not available for FSU
FSET/ ESI	INPut<1|2>:GAIN:AUTO	ON | OFF	not available for FSU
FSU + FSE	INPut<1|2>:GAIN:STATe	ON | OFF	
FSU + FSE	INPut<1|2>:IMPedance	50 | 75	
FSE	INPut<1|2>:IMPedance:CORRection	RAM | RAZ	not available for FSU
FSET	INPut<1|2>:LISN:PEARth	GROunded | FLOating	not available for FSU
FSET	INPut<1|2>:LISN:PHASe	L1 | L2 | L3 | N	not available for FSU
FSET	INPut<1|2>:LISN[:TYPE]	TWOphase | FOURphase | OFF	not available for FSU
FSU	INPut<1|2>:MIXer:AUTO	ON | OFF	new function for FSU
FSU	INPut<1|2>:MIXer[:POWer]	<numeric value>	new function for FSU
FSE	INPut<1|2>:MIXer	<numeric value>	not available for FSU
FSET	INPut<1|2>:PRESelection:COUPling	ON | OFF	not available for FSU
FSET	INPut<1|2>:PRESelection:COUPling:HIGH:FREQuency	5MHz to 500MHz	not available for FSU
FSET	INPut<1|2>:PRESelection:COUPling:HIGH:SET	'name of preselector set for high RBW'	not available for FSU
FSET	INPut<1|2>:PRESelection:COUPling:LOW:FREQuency	10Hz to 5MHz	not available for FSU
FSET	INPut<1|2>:PRESelection:COUPling:LOW:SET	"name of preselector set for low RBW'	not available for FSU
FSET	INPut<1|2>:PRESelection:COUPling:MID:SET	"name of preselector set for medium RBW'	not available for FSU
FSET	INPut<1|2>:PRESelection:FILTer:HPASS[:FREQuency]	100Hz to 5MHz	not available for FSU
FSET	INPut<1|2>:PRESelection:FILTer:LPASS[:FREQuency]	20KHz to 40MHz	not available for FSU
FSET	INPut<1|2>:PRESelection:FILTer[:STATe]	ON | OFF	not available for FSU
FSET	INPut<1|2>:PRESelection:SET	NARRow | NORMal | WIDE	not available for FSU
FSET	INPut<1|2>:PRESelection:USET[:SELect]	"name of user defined preselector set'	not available for FSU
FSET	INPut<1|2>:PRESelection[:STATe]	ON | OFF	not available for FSU
FSET	INPut<1|2>:TYPE	RF | BALanced	not available for FSU
ESI	INPut<1|2>:TYPE	INPUT1 | INPUT2	not available for FSU
FSE	INPut<1|2>:UPORt<1|2>:STATe	ON | OFF	not available for FSU
FSE	INPut<1|2>:UPORt<1|2>[:VALue]?		not available for FSU
ESI	INPut2:COUPling	AC | DC	not available for FSU

Devices	Command	Parameter	Notes
FSU	INSTrument:COUPle	NONE | RLEVel | CF_B | CF_A	available coupling modes between Screen A and Screen B have been changed between FSE and FSU
FSE	INSTrument:COUPle	NONE | MODE | X | Y | CONTrol | XY | XCONtrol | YCONtrol | ALL	Available coupling modes between screen A and screen B have been changed between FSE and FSU
FSU	INSTrument<1|2>:NSELect	1	currently only parameter value 1 available
ESI	INSTrument<1|2>:NSELect	1 to 3 | 6	4 parameter values are available
FSE/ FSIQ	INSTrument<1|2>:NSELect	1 to 5	5 parameter values are available
FSET	INSTrument<1|2>:NSELect	1 | 2 | 6	3 parameter values are available
FSU	INSTrument<1|2>[:SELect]	SANalyzer	Currently only SANalyzer available
FSE/ FSIQ	INSTrument<1|2>[:SELect]	SANalyzer | DDEMod | ADEMod | BGSM | MGSM	5 parameters are available.
ESI	INSTrument<1|2>[:SELect]	RECeiver | SANalyzer | DDEMod | ADEMod	4 parameters are available.
FSET	INSTrument<1|2>[:SELect]	ANalyzer | DDEMod | RECeiver	3 parameters are available.
FSU + FSE	MMEMory:CATalog?	string	
FSU + FSE	MMEMory:CDIRectory	directory name	
FSU + FSE	MMEMory:CLear:ALL		
FSU + FSE	MMEMory:CLear:STATe	1,path	
FSU + FSE	MMEMory:COMMent	<string>	
FSU + FSE	MMEMory:COPY	path\file, path\file	
FSU + FSE	MMEMory:DATA	filename [, <block data>]	
FSU + FSE	MMEMory:DELete	path\filename	
FSU + FSE	MMEMory:LOAD:AUTO	1,path	
FSU + FSE	MMEMory:LOAD:STATe	1,path	
FSU + FSE	MMEMory:MDIRectory	path	
FSU + FSE	MMEMory:MOVE	path	
FSU + FSE	MMEMory:MSIS	'A:' | 'D:'	FSU: valid drives are A: and D: FSE: valid drives are A: and C:
FSU + FSE	MMEMory:NAME	path\filename	
FSU + FSE	MMEMory:RDIRectory	directory	
FSU + FSE	MMEMory:SELect[:ITEM]:ALL		
FSE	MMEMory:SELect[:ITEM]:CSETup	ON | OFF	not available for FSU (default setting on the FSU)
FSE	MMEMory:SELect[:ITEM]:CVL:ALL	ON | OFF	not available for FSU and FSET
FSE	MMEMory:SELect[:ITEM]:CVL[:ACTive]	ON | OFF	not available for FSU and FSET
FSU + FSE	MMEMory:SELect[:ITEM]:DEFault		
FSE	MMEMory:SELect[:ITEM]:GSETup	ON | OFF	not available for FSU (default setting on the FSU)
FSE	MMEMory:SELect[:ITEM]:HCOPy	ON | OFF	not available for FSU (default setting on the FSU)
FSU + FSE	MMEMory:SELect[:ITEM]:HWSettings	ON | OFF	
FSU + FSE	MMEMory:SELect[:ITEM]:LINes:ALL	ON | OFF	
FSE	MMEMory:SELect[:ITEM]:LINes:ALL	ON | OFF	
FSE	MMEMory:SELect[:ITEM]:LINes[:ACTive]	ON | OFF	not available for FSU (default setting on the FSU)
FSE	MMEMory:SELect[:ITEM]:MACRos	ON | OFF	not available for FSU
FSU + FSE	MMEMory:SELect[:ITEM]:NONE		
FSU + FSE	MMEMory:SELect[:ITEM]:SCData	ON | OFF	
FSU	MMEMory:SELect[:ITEM]:TRACe[:ACTive]	ON | OFF	no numeric suffixes behind TRACe
FSE	MMEMory:SELect[:ITEM]:TRACe<1...4>	ON | OFF	numeric suffixes behind TRACe
FSE	MMEMory:SELect[:ITEM]:TRANsducer:ALL	ON | OFF	not available for FSU

Devices	Command	Parameter	Notes
FSE	MMEMory:SELect[:ITEM]:TRANsducer[:ACTive]	ON | OFF	not available for FSU
FSU + FSE	MMEMory:STORe:STATe	1,path	
FSU + FSE	MMEMory:STORe:TRACe	1 to 3,path	
FSE	OUTPut:AF:SENSitivity	<numeric_value>	not available for FSU and FSET
FSE	OUTPut:UPORt<1|2>:STATe	ON | OFF	not available for FSU
FSE	OUTPut:UPORt<1|2>[:VALue]	#B00000000 to #B11111111	not available for FSU
FSU + FSE	OUTPut<1|2>[:STATe]	ON | OFF	
FSE	READ:BURSt:FERRor:AVERage?		not available for FSU and FSET
FSE	READ:BURSt:FERRor:MAXimum?		not available for FSU and FSET
FSE	READ:BURSt:FERRor:STATus?		not available for FSU and FSET
FSE	READ:BURSt:PERRor:PEAK:AVERage?		not available for FSU and FSET
FSE	READ:BURSt:PERRor:PEAK:MAXimum?		not available for FSU and FSET
FSE	READ:BURSt:PERRor:PEAK:STATus?		not available for FSU and FSET
FSE	READ:BURSt:PERRor:RMS:AVERage?		not available for FSU and FSET
FSE	READ:BURSt:PERRor:RMS:MAXimum?		not available for FSU and FSET
FSE	READ:BURSt:PERRor:RMS:STATus?		not available for FSU and FSET
FSE	READ:BURSt:POWer:DYNamic?		not available for FSU and FSET
FSE	READ:BURSt:POWer:LEVel?		not available for FSU and FSET
FSE	READ:BURSt:POWer:STATic?		not available for FSU and FSET
FSE	READ:BURSt:POWer?		not available for FSU and FSET
FSE	READ:BURSt:REFerence[:IMMediate?]		not available for FSU and FSET
FSE	READ:SPECtrum:MODulation[:ALL]?		not available for FSU and FSET
FSE	READ:SPECtrum:SWITching[:ALL]?		not available for FSU and FSET
FSE	READ:SPURious:STEP?		not available for FSU and FSET
FSE	READ:SPURious[:ALL]?		not available for FSU and FSET
FSE	[SENSe<1|2>:]ADEMod:AF:COUPling	AC | DC	not available for FSU and FSET
FSE	[SENSe<1|2>:]ADEMod:RTIMe	ON | OFF	not available for FSU and FSET
FSE	[SENSe<1|2>:]ADEMod:SBANd	NORMal | INVerse	not available for FSU and FSET
FSE	[SENSe<1|2>:]ADEMod:SQUelch:LEVel	30 to 150 dBm	not available for FSU and FSET
FSE	[SENSe<1|2>:]ADEMod:SQUelch[:STATe]	ON | OFF	not available for FSU and FSET
FSET	[SENSe<1|2>:]AM:RANGe[:UPPer]	3PCT | 10 PCT | 100PCT	not available for FSU
FSE	[SENSe<1|2>:]AVERage:AUTO	ON | OFF	not available for FSU
FSU + FSE	[SENSe<1|2>:]AVERage:COUNt	0 to 32767	
FSE	[SENSe<1|2>:]AVERage:COUNt	0 to 32767	
FSU	[SENSe<1|2>:]AVERage:TYPE	VIDeo | LINear	command is used to select logarithmic or linear averaging on the FSU; therefore parameters are incompatible to the FSE
FSE	[SENSe<1|2>:]AVERage:TYPE	MAXimum | MINimum | SCALar	command is used to select logarithmic or linear averaging on the FSU; therefore parameters are incompatible to the FSE
FSU + FSE	[SENSe<1|2>:]AVERage[:STATe<1...3>]	ON | OFF	

<table>
<tr><th>Devices</th><th>Command</th><th>Parameter</th><th>Notes</th></tr>
<tr><td>FSE</td><td>[SENSe<1|2>:]BANDwidth|BWIDth:DEMod</td><td><numeric_value></td><td>not available for FSU and FSET</td></tr>
<tr><td>FSU</td><td>[SENSe<1|2>:]BANDwidth|BWIDth:PLL</td><td>WIDE | NORMal | NARRow</td><td>new function for FSU</td></tr>
<tr><td>FSE</td><td>[SENSe<1|2>:]BANDwidth|BWIDth:PLL</td><td>AUTO | HIGH | MEDium | LOW</td><td>not available for FSU</td></tr>
<tr><td>FSU + FSE</td><td>[SENSe<1|2>:]BANDwidth|BWIDth:VIDeo</td><td>1Hz to 10MHz</td><td>FSU</td></tr>
<tr><td>FSET</td><td>[SENSe<1|2>:]BANDwidth|BWIDth:VIDeo</td><td>1Hz to 500MHz</td><td></td></tr>
<tr><td>FSU + FSE</td><td>[SENSe<1|2>:]BANDwidth|BWIDth:VIDeo:AUTO</td><td>ON | OFF</td><td></td></tr>
<tr><td>FSET</td><td>[SENSe<1|2>:]BANDwidth|BWIDth:VIDeo:EXTernal[:STATe]</td><td>ON | OFF</td><td>not available for FSU</td></tr>
<tr><td>FSU</td><td>[SENSe<1|2>:]BANDwidth|BWIDth:VIDeo:RATio</td><td>0.0001 to 1</td><td>only numeric values available. Parameter ranges differ between FSU and FSE</td></tr>
<tr><td>FSE</td><td>[SENSe<1|2>:]BANDwidth|BWIDth:VIDeo:RATio</td><td>0.001 to 1000 | SINe | PULSe | NOISe</td><td>also text parameters are available. Parameter ranges differ between FSU and FSE
not available for FSET</td></tr>
<tr><td>FSU + FSE</td><td>[SENSe<1|2>:]BANDwidth|BWIDth[:RESolution]</td><td>10Hz to 10MHz (anal. filter)
1Hz to 10MHz (FFT filter)</td><td>FSE: 10Hz to 10MHz (models 20) 1Hz to 10MHz (models 30)</td></tr>
<tr><td>FSET</td><td>[SENSe<1|2>:]BANDwidth|BWIDth[:RESolution]</td><td>10 Hz to 500MHz</td><td></td></tr>
<tr><td>FSU + FSE</td><td>[SENSe<1|2>:]BANDwidth|BWIDth[:RESolution]:AUTO</td><td>ON | OFF</td><td></td></tr>
<tr><td>FSE</td><td>[SENSe<1|2>:]BANDwidth|BWIDth[:RESolution]:MODE</td><td>ANALog | DIGital</td><td>not available for FSU and FSET</td></tr>
<tr><td>FSU + FSE</td><td>[SENSe<1|2>:]BANDwidth|BWIDth[:RESolution]:MODE:FFT</td><td>ON | OFF</td><td>old command that is still supported, but has been replaced on the FSU by [SENSe<1|2>:]BANDwidth|BWIDth[:RESolution]:TYPE</td></tr>
<tr><td>FSU + FSE</td><td>[SENSe<1|2>:]BANDwidth|BWIDth[:RESolution]:RATio</td><td>0.0001 to 1</td><td></td></tr>
<tr><td>FSU</td><td>[SENSe<1|2>:]BANDwidth|BWIDth[:RESolution]:TYPE</td><td>NORMal | FFT | CFILter | RRC</td><td>new function for FSU</td></tr>
<tr><td>FSU + FSE</td><td>[SENSe<1|2>:]CORRection:COLLect[:ACQuire]</td><td>THRough | OPEN</td><td></td></tr>
<tr><td>FSE</td><td>[SENSe<1|2>:]CORRection:CVL:BAND</td><td>A|Q|U|V|E|W|F|D|G|Y|J</td><td>not available for FSU and FSET</td></tr>
<tr><td>FSE</td><td>[SENSe<1|2>:]CORRection:CVL:BIAS</td><td><numeric_value></td><td>not available for FSU and FSET</td></tr>
<tr><td>FSE</td><td>[SENSe<1|2>:]CORRection:CVL:CATalog?</td><td></td><td>not available for FSU and FSET</td></tr>
<tr><td>FSE</td><td>[SENSe<1|2>:]CORRection:CVL:CLEar</td><td></td><td>not available for FSU and FSET</td></tr>
<tr><td>FSE</td><td>[SENSe<1|2>:]CORRection:CVL:COMMent</td><td><string></td><td>not available for FSU and FSET</td></tr>
<tr><td>FSE</td><td>[SENSe<1|2>:]CORRection:CVL:DATA</td><td><freq>,<level> to</td><td>not available for FSU and FSET</td></tr>
<tr><td>FSE</td><td>[SENSe<1|2>:]CORRection:CVL:MIXer</td><td><string></td><td>not available for FSU and FSET</td></tr>
<tr><td>FSE</td><td>[SENSe<1|2>:]CORRection:CVL:PORTs</td><td>2 | 3</td><td>not available for FSU and FSET</td></tr>
<tr><td>FSE</td><td>[SENSe<1|2>:]CORRection:CVL:SELect</td><td><file_name></td><td>not available for FSU and FSET</td></tr>
<tr><td>FSE</td><td>[SENSe<1|2>:]CORRection:CVL:SNUMber</td><td><string></td><td>not available for FSU and FSET</td></tr>
<tr><td>FSE</td><td>[SENSe<1|2>:]CORRection:CVL:TYPE</td><td>ODD | EVEN | EODD</td><td>not available for FSU and FSET</td></tr>
<tr><td>FSE/ FSIQ</td><td>[SENSe<1|2>:]CORRection:LOSS:INPut[:MAGNitude]</td><td><numeric_value></td><td>not available for FSU</td></tr>
<tr><td>FSU + FSE</td><td>[SENSe<1|2>:]CORRection:METHod</td><td>TRANsmission | REFLexion</td><td></td></tr>
<tr><td>FSU + FSE</td><td>[SENSe<1|2>:]CORRection:RECall</td><td></td><td></td></tr>
<tr><td>FSE</td><td>[SENSe<1|2>:]CORRection:RXGain:INPut[:MAGNitude]</td><td><numeric_value></td><td>not available for FSU, FSET and ESI</td></tr>
<tr><td>FSU + FSE</td><td>[SENSe<1|2>:]CORRection[:STATe]</td><td>ON | OFF</td><td></td></tr>
<tr><td>FSE</td><td>[SENSe<1|2>:]CORRection:TRANsducer:ACTive?</td><td></td><td>not available for FSU</td></tr>
<tr><td>FSE</td><td>[SENSe<1|2>:]CORRection:TRANsducer:CATalog?</td><td></td><td>not available for FSU</td></tr>
<tr><td>FSE</td><td>[SENSe<1|2>:]CORRection:TRANsducer:COMMent</td><td><string></td><td>not available for FSU</td></tr>
<tr><td>FSE</td><td>[SENSe<1|2>:]CORRection:TRANsducer:DATA</td><td><freq>,<level> to</td><td>not available for FSU</td></tr>
<tr><td>FSE</td><td>[SENSe<1|2>:]CORRection:TRANsducer:DELete</td><td></td><td>not available for FSU</td></tr>
<tr><td>FSE</td><td>[SENSe<1|2>:]CORRection:TRANsducer:SCALing</td><td>LINear|LOGarithmic</td><td>not available for FSU</td></tr>
</table>

Devices	Command	Parameter	Notes
FSE	[SENSe<1|2>:]CORRection:TRANsducer:SELect	<name>	not available for FSU
FSE	[SENSe<1|2>:]CORRection:TRANsducer:UNIT	<string>	not available for
FSE	[SENSe<1|2>:]CORRection:TRANsducer[:STATe]	ON | OFF	not available for FSU
FSE	[SENSe<1|2>:]CORRection:TSET:ACTive?		not available for FSU
FSE	[SENSe<1|2>:]CORRection:TSET:BREak	ON | OFF	not available for FSU
FSE	[SENSe<1|2>:]CORRection:TSET:CATalog?		not available for FSU
FSE	[SENSe<1|2>:]CORRection:TSET:COMMent	<string>	not available for FSU
FSE	[SENSe<1|2>:]CORRection:TSET:DELete		not available for FSU
FSE	[SENSe<1|2>:]CORRection:TSET:RANGe<1...10>	<freq>,<freq>,<name> to	not available for FSU
FSE	[SENSe<1|2>:]CORRection:TSET:SELect	<name>	not available for FSU
FSE	[SENSe<1|2>:]CORRection:TSET:UNIT	<string>	not available for FSU
FSE	[SENSe<1|2>:]CORRection:TSET[:STATe]	ON | OFF	not available for FSU
FSE	[SENSe<1|2>:]DDEMod:FILTer:ALPHa	0.2 to 1	not available for FSU
FSE	[SENSe<1|2>:]DDEMod:FILTer:MEASurement	OFF | RCOSine | RRCosine | GAUSsian | B22 | B25 | B44 | QFM | QFR | QRM | QRR | A25Fm | EMES | EREF	not available for FSU
FSE	[SENSe<1|2>:]DDEMod:FILTer:REFerence	RCOSine | RRCosine | GAUSsian | B22 | B25 | B44 | QFM | QFR | QRM | QRR | A25Fm | EMES | EREF	not available for FSU
FSE	[SENSe<1|2>:]DDEMod:FORMat	QPSK | PSK | MSK |QAM | FSK	not available for FSU
FSE	[SENSe<1|2>:]DDEMod:FSK:NSTate	2 | 4	not available for FSU
FSE	[SENSe<1|2>:]DDEMod:MSK:FORMat	TYPE1 | TYPE2 | NORMal | DIFFerential	not available for FSU
FSE	[SENSe<1|2>:]DDEMod:NORMalize	ON | OFF	not available for FSU
FSE	[SENSe<1|2>:]DDEMod:PRATe	1 | 2 | 4 | 8 | 16	not available for FSU
FSE/ ESI	[SENSe<1|2>:]DDEMod:PRESet	GSM | EDGe | NADC | TETRa | DCS1800 | PCS1900 | PHS | PDCup | PDCDown | APCO25CQPSK | APCO25C4FM | CDPD | DECT | CT2 | ERMes | MODacom | PWT | TFTS | F16 | F322 | F324 | F64 | FQCDma | RQCDma | FNADc | RNADc | BPSK18 | GMSK18 | QPSK18 | GMSK36	not available for FSU
FSIQ	[SENSe<1|2>:]DDEMod:PRESet	GSM | EDGe | NADC | TETRa | PHS | PDCup | PDCDown | APCO25CQPSK | APCO25C4FM | CDPD | DECT | CT2 | ERMes | MODacom | PWT | TFTS | F16 | F322 | F324 | F64 | FWCDma | RWCDma | FW3Gppcdma | RW3Gppcdma | BPSK18 | GMSK18 | QPSK18 | GMSK36	not available for FSU
FSET	[SENSe<1|2>:]DDEMod:PRESet	GSM | EDGe | NADC | TETRa | DCS1800 | PCS1900 | PHS | PDCup | PDCDown | APCO25CQPSK | APCO25C4FM | CDPD | DECT | CT2 | ERMes | MODacom | PWT | TFTS | F16 | F322 | F324 | F64 | FQCDma | RQCDma | FNADc | RNADc | BPSK18 | GMSK18 | QPSK18 | GMSK36	not available for FSU
FSE	[SENSe<1|2>:]DDEMod:PSK:FORMat	NORMal | DIFFerential | N3Pi8	not available for FSU
FSE	[SENSe<1|2>:]DDEMod:PSK:NSTate	2 | 8	not available for FSU
FSE	[SENSe<1|2>:]DDEMod:QAM:NSTate	16	not available for FSU

Devices	Command	Parameter	Notes
FSE	[SENSe<1|2>:]DDEMod:QPSK:FORMat	NORMal | DIFFerential | OFFSet | DPI4	not available for FSU
FSE	[SENSe<1|2>:]DDEMod:SBANd	NORMal | INVerse	not available for FSU
FSE	[SENSe<1|2>:]DDEMod:SEARch:PULSe:STATe	ON | OFF	not available for FSU
FSE	[SENSe<1|2>:]DDEMod:SEARch:SYNC:CATalog?		not available for FSU
FSE	[SENSe<1|2>:]DDEMod:SEARch:SYNC:COMMent	<string>	not available for FSU
FSE	[SENSe<1|2>:]DDEMod:SEARch:SYNC:DATA	<string>	not available for FSU
FSE	[SENSe<1|2>:]DDEMod:SEARch:SYNC:NAME	<string>	not available for FSU
FSE	[SENSe<1|2>:]DDEMod:SEARch:SYNC:OFFSet	<numeric_value>	not available for FSU
FSE	[SENSe<1|2>:]DDEMod:SEARch:SYNC:PATTern	<string>	not available for FSU
FSE	[SENSe<1|2>:]DDEMod:SEARch:SYNC:SELect	<string>	not available for FSU
FSE	[SENSe<1|2>:]DDEMod:SEARch:SYNC:STATe	ON | OFF	not available for FSU
FSE	[SENSe<1|2>:]DDEMod:SEARch:TIME	100 to 1600	not available for FSU
FSE	[SENSe<1|2>:]DDEMod:SRATe	160 Hz to 1,6 MHz	not available for FSU
FSIQ	[SENSe<1|2>:]DDEMod:SRATe	160 Hz to 7 MHz	not available for FSU
	[SENSe<1|2>:]DDEMod:TIME	1 to Frame Length	not available for FSU
FSET	[SENSe<1|2>:]DEMod	OFF | AM | AMVideo | FM | PM	not available for FSU
ESI	[SENSe<1|2>:]DEMod	OFF | AM | FM	not available for FSU
FSET	[SENSe<1|2>:]DEMod:FILTer:HPASs:FREQuency	0 Hz | 10 Hz | 100 Hz | 1 kHZ	not available for FSU
FSET	[SENSe<1|2>:]DEMod:FILTer[:LPASs]:AUTO	ON | OFF	not available for FSU
FSET	[SENSe<1|2>:]DEMod:FILTer[:LPASs]:FREQuency	<numeric_value>	not available for FSU
FSE	[SENSe<1|2>:]DETector<1...4>:CMEM[:STATe]	ON | OFF	not available for FSU
FSU	[SENSe<1|2>:]DETector<1...3>[:FUNCtion]	APEak |NEGative | POSitive | SAMPle | RMS | AVERage | QPEak	FSU: number of traces restricted to 3; detector settings correspond to selected screen FSE: Qpeak not available
ESI	[SENSe<1|2>:]DETector<1..4>[:FUNCtion]	APEak |NEGative | POSitive | SAMPle | RMS | AVERage | QPEak	
FSU + FSE	[SENSe<1|2>:]DETector<1...3>[:FUNCtion]:AUTO	ON | OFF	number of traces restricted to 3
FSET	[SENSe<1|2>:]DETector<1...4>:PSTRetch:AUTO	ON | OFF	not available for FSU
FSET	[SENSe<1|2>:]DETecto<1...4>r:PSTRetch[:STATe]	ON | OFF	not available for FSU
ESI	[SENSe<1|2>:]DETector<1...4>:RECeiver[:FUNCtion]	POSitive |NEGative| RMS | AVERage | QPEak	not available for FSU
FSET	[SENSe<1|2>:]DETector<1...4>:RECeiver[:FUNCtion]	POSitive | NEGative | RMS | AVERage	not available for FSU
FSE	[SENSe<1|2>:]FILTer:CCITt[:STATe]	ON | OFF	not available for FSU and FSET
FSE	[SENSe<1|2>:]FILTer:CMESsage[:STATe]	ON | OFF	not available for FSU and FSET
FSE	[SENSe<1|2>:]FILTer:DEMPhasis:LINK	DISPlay | AUDio	not available for FSU and FSET
FSE	[SENSe<1|2>:]FILTer:DEMPhasis:TCONstant	<numeric_value>	not available for FSU and FSET
FSE	[SENSe<1|2>:]FILTer:DEMPhasis[:STATe]	ON | OFF	not available for FSU and FSET
FSE	[SENSe<1|2>:]FILTer:HPASs:FREQuency	30 Hz | 300 HZ	not available for FSU and FSET
FSET	[SENSe<1|2>:]FILTer:HPASs:FREQuency	10 kHz | 1 kHz | 100 Hz	not available for FSU
FSE	[SENSe<1|2>:]FILTer:HPASs[:STATe]	ON | OFF	not available for FSU
FSE	[SENSe<1|2>:]FILTer:LPASs:FREQuency	3 kHz| 15 kHz	not available for FSU and FSET
FSE	[SENSe<1|2>:]FILTer:LPASs[:STATe]	ON | OFF	not available for FSU and FSET
FSET	[SENSe<1|2>:]FILTer:NOTCh[:STATe]	ON | OFF	not available for FSU
FSET	[SENSe<1|2>:]FM[:DEViation]:RANGe:UPPer	ON | OFF	not available for FSU
FSET	[SENSe<1|2>:]FM[:DEViation]:RANGe[:UPPer]	<numeric_value>	not available for FSU
FSU + FSE	[SENSe<1|2>:]FREQuency:CENTer	0 to f_{max}	frequency ranges are different for FSU and FSE
FSE	[SENSe<1|2>:]FREQuency:CENTer:LINK	STARt | STOP | SPAN	not available for FSU
FSU + FSE	[SENSe<1|2>:]FREQuency:CENTer:STEP	0 to f_{max}	frequency ranges are different for FSU and FSE
FSU + FSE	[SENSe<1|2>:]FREQuency:CENTer:STEP:LINK	SPAN | RBW | OFF	

<table>
<tr><th>Devices</th><th>Command</th><th>Parameter</th><th>Notes</th></tr>
<tr><td>FSU + FSE</td><td>[SENSe<1|2>:]FREQuency:CENTer:STEP:LINK:FACTor</td><td>1 to 100 PCT</td><td></td></tr>
<tr><td>FSU + FSE</td><td>[SENSe<1|2>:]FREQuency:MODE</td><td>CW|FIXed | SWEep</td><td></td></tr>
<tr><td>FSU + FSE</td><td>[SENSe<1|2>:]FREQuency:OFFSet</td><td><numeric_value></td><td></td></tr>
<tr><td>FSET</td><td>[SENSe<1|2>:]FREQuency:RANGe</td><td>2 GHz | 22 GHz</td><td>not available for FSU</td></tr>
<tr><td>FSU + FSE</td><td>[SENSe<1|2>:]FREQuency:SPAN</td><td>0 to f_{max}</td><td>frequency ranges are different for FSU and FSE</td></tr>
<tr><td>FSU + FSE</td><td>[SENSe<1|2>:]FREQuency:SPAN:FULL</td><td></td><td></td></tr>
<tr><td>FSE</td><td>[SENSe<1|2>:]FREQuency:SPAN:LINK</td><td>CENTer | STOP | SPAN</td><td>not available for FSU</td></tr>
<tr><td>FSU + FSE</td><td>[SENSe<1|2>:]FREQuency:STARt</td><td>0 to f_{max}</td><td>frequency ranges are different for FSU and FSE</td></tr>
<tr><td>FSET</td><td>[SENSe<1|2>:]FREQuency:STARt:FLINe[:STATe]</td><td>ON | OFF</td><td>not available for FSU. Replaced by CALC:MARK:FUNC:SLIMits</td></tr>
<tr><td>FSE</td><td>[SENSe<1|2>:]FREQuency:STARt:LINK</td><td>CENTer | STOP | SPAN</td><td>not available for FSU</td></tr>
<tr><td>FSU + FSE</td><td>[SENSe<1|2>:]FREQuency:STOP</td><td>0 to f_{max}</td><td>frequency ranges are different for FSU and FSE</td></tr>
<tr><td>FSET</td><td>[SENSe<1|2>:]FREQuency:STOP:FLINe[:STATe]</td><td>ON | OFF</td><td>not available for FSU; replaced by CALC:MARK:FUNC:SLIMits.</td></tr>
<tr><td>FSE</td><td>[SENSe<1|2>:]FREQuency:STOP:LINK</td><td>CENTer | STARt | SPAN</td><td>not available for FSU</td></tr>
<tr><td>FSET/ ESI</td><td>[SENSe<1|2>:]FREQuency[:CW|:FIXed]</td><td>f_{min} to f_{max}</td><td>not available for FSU</td></tr>
<tr><td>FSET/ ESI</td><td>[SENSe<1|2>:]FREQuency[:CW|:FIXed]:STEP</td><td>f_{min} to f_{max}</td><td>not available for FSU</td></tr>
<tr><td>FSU</td><td>[SENSe<1|2>:]LIST:POWer:RESult?</td><td></td><td>new function for FSU</td></tr>
<tr><td>FSU</td><td>[SENSe<1|2>:]LIST:POWer[:SEQuence]</td><td><analyzer freq>, <ref level>,<rf att>,<el att>, <filter type>,<rbw>,<vbw>, <meas time>, <trigger level>,...</td><td>new function for FSU</td></tr>
<tr><td>FSU</td><td>[SENSe<1|2>:]LIST:POWer:SET</td><td><PEAK meas>, <RMS meas>, <AVG meas>, <trigger mode>, <trigger slope>, <trigger offset>, <gate length></td><td>new function for FSU</td></tr>
<tr><td>FSU</td><td>[SENSe<1|2>:]LIST:POWer:STATe</td><td>ON | OFF</td><td>new function for FSU</td></tr>
<tr><td>FSE</td><td>[SENSe<1|2>:]MIXer:BIAS</td><td><numeric_value></td><td>not available for FSU</td></tr>
<tr><td>FSE</td><td>[SENSe<1|2>:]MIXer:BIAS:LIMit:MIN</td><td><numeric_value></td><td>not available for FSU</td></tr>
<tr><td>FSE</td><td>[SENSe<1|2>:]MIXer:BIAS:LIMit[:MAX]</td><td><numeric_value></td><td>not available for FSU</td></tr>
<tr><td>FSE</td><td>[SENSe<1|2>:]MIXer:BLOCk</td><td>ON | OFF</td><td>not available for FSU</td></tr>
<tr><td>FSE</td><td>[SENSe<1|2>:]MIXer:HARMonic</td><td><numeric_value></td><td>not available for FSU</td></tr>
<tr><td>FSE</td><td>[SENSe<1|2>:]MIXer:HARMonic:BAND</td><td>A | Q | U | V | E | W | F | D | G | Y | J</td><td>not available for FSU</td></tr>
<tr><td>FSE</td><td>[SENSe<1|2>:]MIXer:HARMonic:TYPE</td><td>ODD | EVEN | EODD</td><td>not available for FSU</td></tr>
<tr><td>FSE</td><td>[SENSe<1|2>:]MIXer:LOSS:HIGH</td><td><numeric_value></td><td>not available for FSU</td></tr>
<tr><td>FSE</td><td>[SENSe<1|2>:]MIXer:LOSS:TABLE</td><td><file_name></td><td>not available for FSU</td></tr>
<tr><td>FSE</td><td>[SENSe<1|2>:]MIXer:LOSS[:LOW]</td><td><numeric_value></td><td>not available for FSU</td></tr>
<tr><td>FSE</td><td>[SENSe<1|2>:]MIXer:PORTs</td><td>2 | 3</td><td>not available for FSU</td></tr>
<tr><td>FSE</td><td>[SENSe<1|2>:]MIXer:SIGNal</td><td>2 | 3</td><td>not available for FSU</td></tr>
<tr><td>FSE</td><td>[SENSe<1|2>:]MIXer:THReshold</td><td>0.1 to 100 dB</td><td>not available for FSU</td></tr>
<tr><td>FSE</td><td>[SENSe<1|2>:]MIXer[:STATe]</td><td>ON | OFF</td><td>not available for FSU</td></tr>
<tr><td>FSU</td><td>[SENSe<1|2>:]MPOWer[:SEQuence]</td><td><analyzer freq>, <rbw>,<meas time>, <trigger source>, <trigger level>, <trigger offset>, <type of meas>, <# of meas></td><td>new function for FSU</td></tr>
<tr><td>FSU</td><td>[SENSe<1|2>:]MPOWer:RESult[:LIST]?</td><td></td><td>new function for FSU</td></tr>
<tr><td>FSU</td><td>[SENSe<1|2>:]MPOWer:RESult:MIN?</td><td></td><td>new function for FSU</td></tr>
<tr><td>FSE</td><td>[SENSe<1|2>:]MSUMmary:AHOLd[:STATe]</td><td>ON | OFF</td><td>not available for FSU and FSET</td></tr>
<tr><td>FSE</td><td>[SENSe<1|2>:]MSUMmary:MODE</td><td>ABSolute | RELative</td><td>not available for FSU and FSET</td></tr>
<tr><td>FSE</td><td>[SENSe<1|2>:]MSUMmary:MTIMe</td><td>0.1S | 1S</td><td>not available for FSU and FSET</td></tr>
</table>

Devices	Command	Parameter	Notes
FSE	[SENSe<1|2>:]MSUMmary:REFerence	<numeric_value>	not available for FSU and FSET
FSE	[SENSe<1|2>:]MSUMmary:REFerence:AUTO	ONCE	not available for FSU and FSET
FSE	[SENSe<1|2>:]MSUMmary:RUNit	PCT | DB	not available for FSU and FSET
FSET	[SENSe<1|2>:]PM[:DEViation]:RANGe[:UPPer]	<numeric_value>	not available for FSU
FSU + FSE	[SENSe<1|2>:]POWer:ACHannel:ACPairs	0 to 3	FSU: new parameter value 0 for channel power measurement
FSU + FSE	[SENSe<1|2>:]POWer:ACHannel:BANDwidth|BWIDth:ACHannel	100 to 1000MHz	FSU: parameter range starts at 100Hz FSE: parameter range starts at 0 Hz
FSU + FSE	[SENSe<1|2>:]POWer:ACHannel:BANDwidth|BWIDth:ALTernate<1|2>	100 to 1000MHz	FSU: parameter range starts at 100Hz FSE: parameter range starts at 0 Hz
FSU + FSE	[SENSe<1|2>:]POWer:ACHannel:BANDwidth|BWIDth[:CHANnel]	100 to 1000MHz	FSU: parameter range starts at 100Hz FSE: parameter range starts at 0 Hz
FSU + FSE	[SENSe<1|2>:]POWer:ACHannel:MODE	ABSolute | RELative	
FSU + FSE	[SENSe<1|2>:]POWer:ACHannel:PRESet	ACPower | CPOWer | OBANdwidth | OBWidth	CN and CN0 are not available for FSU
FSU	[SENSe<1|2>:]POWer:ACHannel:PRESet:RLEVel		new function for FSU
FSU + FSE	[SENSe<1|2>:]POWer:ACHannel:REFerence:AUTO	ONCE	
FSU + FSE	[SENSe<1|2>:]POWer:ACHannel:SPACing[:ACHannel]	100Hz to 2000MHz	different parameter range
FSE	[SENSe<1|2>:]POWer:ACHannel:SPACing[:UPPer]	0 to 1000MHz	not available for FSU and FSET
FSU + FSE	[SENSe<1|2>:]POWer:ACHannel:SPACing:ALTernate<1|2>	100Hz to 2000MHz	different parameter range
FSU + FSE	[SENSe<1|2>:]POWer:BANDwidth|BWIDth	10 to 99.9PCT	different parameter range
FSU	[SENSe<1|2>:]POWer:HSPeed	ON | OFF	new function for FSU
FSU	[SENSe<1|2>:]POWer:NCORrection	ON | OFF	new function for FSU
FSU	[SENSe<1|2>:]POWer:TRACe	1 to 3	new function for FSU
FSU + FSE	[SENSe<1|2>:]ROSCillator:[INTernal:]TUNe	0 to 4095	
FSU + FSE	[SENSe<1|2>:]ROSCillator:[INTernal:]TUNe:SAVe		
FSE	[SENSe<1|2>:]ROSCillator:EXTernal:FREQuency	1MHz to 16MHz	not available for FSU
FSU + FSE	[SENSe<1|2>:]ROSCillator:SOURce	INTernal | EXTernal	
FSET/ ESI	[SENSe<1|2>:]SCAN<:RANGes[COUNt]	1 to 10	not available for FSU
FSE/ ESI	[SENSe<1|2>:]SCAN<1...10>:BANDwidth:RESolution	f_{min} to f_{max}	not available for FSU
FSET/ ESI	[SENSe<1|2>:]SCAN<1...10>:INPut:ATTenuation	dB_{min} to dB_{max}	not available for FSU
FSET/ ESI	[SENSe<1|2>:]SCAN<1...10>:INPut:ATTenuation:AUTO	ON | OFF	not available for FSU
FSET	[SENSe<1|2>:]SCAN<1...10>:INPut:BIMPedance	150OHM | 600OHM | 10kOHM	not available for FSU
FSET	[SENSe<1|2>:]SCAN<1...10>:INPut:GAIN	0dB to 30dB	not available for FSU
FSET/ ESI	[SENSe<1|2>:]SCAN<1...10>:INPut:GAIN:AUTO	ON | OFF	not available for FSU
ESI	[SENSe<1|2>:]SCAN<1...10>:INPut:GAIN:STATe	ON | OFF	not available for FSU
ESI	[SENSe<1|2>:]SCAN<1...10>:INPut:TYPE	INPUT1 | INPUT2	not available for FSU
FSET	[SENSe<1|2>:]SCAN<1...10>:INPut:TYPE	RF | BALanced	not available for FSU
FSET/ ESI	[SENSe<1|2>:]SCAN<1...10>:STARt	f_{min} to f_{max}	not available for FSU
FSET/ ESI	[SENSe<1|2>:]SCAN<1...10>:STEP	f_{min} to f_{max}	not available for FSU
FSET/ ESI	[SENSe<1|2>:]SCAN<1...10>:STOP	f_{min} to f_{max}	not available for FSU
FSET/ ESI	[SENSe<1|2>:]SCAN<1...10>:TIME	100 µs to 100 s	not available for FSU
FSU + FSE	[SENSe<1|2>:]SWEep:COUNt	0 to 32767	
FSU + FSE	[SENSe<1|2>:]SWEep:EGATe	ON | OFF	
FSU + FSE	[SENSe<1|2>:]SWEep:EGATe:HOLDoff	0 to 100s	
FSU + FSE	[SENSe<1|2>:]SWEep:EGATe:LENGth	0 to 100s	
FSE	[SENSe<1|2>:]SWEep:EGATe:LENGth	0 to 100s	

Devices	Command	Parameter	Notes
FSE	[SENSe<1|2>:]SWEep:EGATe:LEVel	-5V to +5V	not availabe for FSU
FSU + FSE	[SENSe<1|2>:]SWEep:EGATe:POLarity	POSitive | NEGative	
FSU + FSE	[SENSe<1|2>:]SWEep:EGATe:SOURce	EXTernal | IFPower	
FSU + FSE	[SENSe<1|2>:]SWEep:EGATe:TYPE	LEVel | EDGE	
FSE	[SENSe<1|2>:]SWEep:GAP	ON | OFF	not available for FSU
FSE	[SENSe<1|2>:]SWEep:GAP:LENGth	0 to 100s	not available for FSU
FSE	[SENSe<1|2>:]SWEep:GAP:PRETrigger	0 to 100s	not available for FSU
FSE	[SENSe<1|2>:]SWEep:GAP:TRGTogap	0 to 100s	not available for FSU
FSET/ ESI	[SENSe<1|2>:]SWEep:SPACing	LINear | LOGarithmic | AUTO	not available for FSU
FSE/ FSIQ	[SENSe<1|2>:]SWEep:SPACing	LINear | LOGarithmic	not available for FSU
FSU + FSE	[SENSe<1|2>:]SWEep:TIME	2.5ms to 1000s | 1µs to 16000s	different parameter ranges for FSU and FSE
FSU + FSE	[SENSe<1|2>:]SWEep:TIME:AUTO	ON | OFF	
FSE	[SENSe<1|2>:]TCAPture:LENGth	1024 | 2048 | 4096 | 8192 | 16384	not available for FSU
FSE	[SENSe<1|2>:]TV:PSOFfset	0 to 6.5 MHz	not available for FSU and FSET
FSE	[SENSe<1|2>:]TV[:STATe]	ON | OFF	not available for FSU and FSET
FSU + FSE	SOURce:AM:STATe	ON | OFF	
FSU + FSE	SOURce:DM:STATe	ON | OFF	
FSU	SOURce:EXTernal[:STATe]	ON | OFF	new command for FSU
FSU	SOURce:EXTernal:FREQuency:OFFset	<numeric_value>	new command for FSU
FSU	SOURce:EXTernal:FREQuency[:FACTor]:NUMerator	<numeric_value>	new command for FSU
FSU	SOURce:EXTernal:FREQuency[:FACTor]:DENominator	<numeric_value>	new command for FSU
FSU	SOURce:EXTernal:FREQuency:SWEep[:STATe]	ON | OFF	new command for FSU
FSU	SOURce:EXTernal:POWer[:LEVel]	<numeric_value>	new command for FSU
FSU + FSE	SOURce:FM:STATe	ON | OFF	
FSU + FSE	SOURce:FREQuency:OFFSet	-150Hz to 150MHz	different value ranges for FSU and FSE
FSE	SOURce:POWer:ALC:SOURce	INTernal | EXTernal	not available for FSU and FSET
FSU + FSE	SOURce:POWer[:LEVel][:IMMediate]:OFFSet	-200dB to +200dB	
FSU + FSE	SOURce:POWer[:LEVel][:IMMediate][:AMPLitude]	-30dBm to 0dBm	different value ranges for FSU and FSE
FSU + FSE	STATus:OPERation:CONDition?		
FSE	STATus:OPERation:CONDition?		
FSU + FSE	STATus:OPERation:ENABle	0 to 65535	
FSU + FSE	STATus:OPERation:NTRansition	0 to 65535	
FSU + FSE	STATus:OPERation:PTRansition	0 to 65535	
FSU + FSE	STATus:OPERation[:EVENt?]		
FSU + FSE	STATus:PRESet		
FSU + FSE	STATus:QUEStionable:ACPLimit:CONDition?		
FSU + FSE	STATus:QUEStionable:ACPLimit:ENABle	0 to 65535	
FSU + FSE	STATus:QUEStionable:ACPLimit:NTRansition	0 to 65535	
FSU + FSE	STATus:QUEStionable:ACPLimit:PTRansition	0 to 65535	
FSU + FSE	STATus:QUEStionable:ACPLimit[:EVENt]?		
FSU + FSE	STATus:QUEStionable:CONDition?		
FSU + FSE	STATus:QUEStionable:ENABle	0 to 65535	
FSU + FSE	STATus:QUEStionable:FREQuency:CONDition?		
FSU + FSE	STATus:QUEStionable:FREQuency:ENABle	0 to 65535	
FSU + FSE	STATus:QUEStionable:FREQuency:NTRansition	0 to 65535	
FSU + FSE	STATus:QUEStionable:FREQuency:PTRansition	0 to 65535	
FSU + FSE	STATus:QUEStionable:FREQuency[:EVENt]?		
FSU + FSE	STATus:QUEStionable:LIMit<1|2>:CONDition?		FSU: individual registers for screen A and B
FSU + FSE	STATus:QUEStionable:LIMit<1|2>:ENABle	0 to 65535	FSU: individual registers for screen A and B
FSU + FSE	STATus:QUEStionable:LIMit<1|2>:NTRansition	0 to 65535	FSU: individual registers for screen A and B
FSU + FSE	STATus:QUEStionable:LIMit<1|2>:PTRansition	0 to 65535	FSU: individual registers for screen A and B

Devices	Command	Parameter	Notes
FSU + FSE	STATus:QUEStionable:LIMit<1|2>[:EVENt]?		FSU: individual registers for screen A and B
FSU + FSE	STATus:QUEStionable:LMARgin<1|2>:CONDition?		FSU: individual registers for screen A and B
FSU + FSE	STATus:QUEStionable:LMARgin<1|2>:ENABle	0 to 65535	FSU: individual registers for screen A and B
FSU + FSE	STATus:QUEStionable:LMARgin<1|2>:NTRansition	0 to 65535	FSU: individual registers for screen A and B
FSU + FSE	STATus:QUEStionable:LMARgin<1|2>:PTRansition	0 to 65535	FSU: individual registers for screen A and B
FSU + FSE	STATus:QUEStionable:LMARgin<1|2>[:EVENt]?		FSU: individual registers for screen A and B
FSU + FSE	STATus:QUEStionable:NTRansition	0 to 65535	
FSU + FSE	STATus:QUEStionable:POWer:CONDition?		
FSU + FSE	STATus:QUEStionable:POWer:ENABle	0 to 65535	
FSU + FSE	STATus:QUEStionable:POWer:NTRansition	0 to 65535	
FSU + FSE	STATus:QUEStionable:POWer:PTRansition	0 to 65535	
FSU + FSE	STATus:QUEStionable:POWer[:EVENt]?		
FSU + FSE	STATus:QUEStionable:PTRansition	0 to 65535	
FSE	STATus:QUEStionable:SYNC:CONDition?		not available for FSU
FSE	STATus:QUEStionable:SYNC:ENABle	0 to 65535	not available for FSU
FSE	STATus:QUEStionable:SYNC:NTRansition	0 to 65535	not available for FSU
FSE	STATus:QUEStionable:SYNC:PTRansition	0 to 65535	not available for FSU
FSE	STATus:QUEStionable:SYNC[:EVENt]?		not available for FSU
FSE	STATus:QUEStionable:TRANsducer:CONDition?		not available for FSU
FSE	STATus:QUEStionable:TRANsducer:ENABle	0 to 65535	not available for FSU
FSE	STATus:QUEStionable:TRANsducer:NTRansition	0 to 65535	not available for FSU
FSE	STATus:QUEStionable:TRANsducer:PTRansition	0 to 65535	not available for FSU
FSE	STATus:QUEStionable:TRANsducer[:EVENt]?		not available for FSU
FSU + FSE	STATus:QUEStionable[:EVENt]?		
FSU + FSE	STATus:QUEue[:NEXT?]		
FSE	SYSTem:BINFo?		not available for FSU
FSU	SYSTem:COMMunicate:GPIB:RDEVice:GENerator<1|2>:ADDRess	0 to 30	new command for FSU
FSE	SYSTem:COMMunicate:GPIB:RDEVice<1|2>:ADDRess	0 to 30	not available for FSU
FSU + FSE	SYSTem:COMMunicate:GPIB[:SELF]:ADDRess	0 to 30	
FSU + FSE	SYSTem:COMMunicate:GPIB[:SELF]:RTERminator	LFEOI | EOI	
FSU + FSE	SYSTem:COMMunicate:PRINter:ENUMerate:FIRSt?		
FSU + FSE	SYSTem:COMMunicate:PRINter:ENUMerate:NEXT?		
FSU	SYSTem:COMMunicate:PRINter:SELect<1|2>	<printer_name>	numeric suffix behind SELect
FSIQ/ ESI	SYSTem:COMMunicate:PRINter<1|2>:SELect	<printer_name>	numeric suffix behind PRINters
FSU	SYSTem:COMMunicate:RDEVice:GENerator<1|2>:LINK	GPIB | TTL	new function for FSU
FSU	SYSTem:COMMunicate:RDEVice:GENerator<1|2>:TYPE	<name>	new function for FSU
FSU + FSE	SYSTem:COMMunicate:SERial:CONTrol:DTR	IBFull | OFF	only SERial1 available for FSU
FSU + FSE	SYSTem:COMMunicate:SERial:CONTrol:RTS	IBFull | OFF	only SERial1 available for FSU
FSU + FSE	SYSTem:COMMunicate:SERial[:RECeive]:BAUD	110 | 300 | 600 | 1200 | 2400 | 9600 | 19200	only SERial1 available for FSU
FSU + FSE	SYSTem:COMMunicate:SERial[:RECeive]:BITS	7 | 8	only SERial1 available for FSU
FSU + FSE	SYSTem:COMMunicate:SERial[:RECeive]:PACE	XON | NONE	only SERial1 available for FSU
FSU + FSE	SYSTem:COMMunicate:SERial[:RECeive]:PARity[:TYPE]	EVEN | ODD | NONE	only SERial1 available for FSU
FSU + FSE	SYSTem:COMMunicate:SERial[:RECeive]:SBITs	1 | 2	only SERial1 available for FSU
FSU + FSE	SYSTem:DATE	1980 to 2099, 1 to 12, 1 to 31	
FSU	SYSTem:DISPlay:FPANel	ON | OFF	new function for FSU
FSU + FSE	SYSTem:DISPlay:UPDate	ON | OFF	
FSU + FSE	SYSTem:ERRor[:NEXT]?		new function for FSU, but compatible to SYSTem:ERRor? on the FSE
FSU	SYSTem:ERRor:LIST?		new function for FSU
FSU	SYSTem:ERRor:CLEar:ALL		new command for FSU

Devices	Command	Parameter	Notes
FSU + FSE	SYSTem:PASSword[:CENable]	'pass word	
FSU + FSE	SYSTem:PRESet		
ESI/ FSIQ	SYSTem:PRESet:COMPatible	FSE | OFF	not available for FSU
FSU + FSE	SYSTem:SET		
FSU + FSE	SYSTem:SPEaker:VOLume	0 to 1	
FSU + FSE	SYSTem:TIME	0 to 23, 0 to 59, 0 to 59	
FSU + FSE	SYSTem:VERSion?		
FSU + FSE	TRACe:COPY	TRACE1 | TRACE2 | TRACE3 , TRACE1 | TRACE2 | TRACE3	only TRACE1...TRACE3 available for FSU
FSET/ ESI	TRACe:FEED:CONTrol<1...4>	ALWays | NEVer	not available for FSU
FSU + FSE	TRACe[:DATA]	TRACE1 | TRACE2 | TRACE3 , <block> | <numeric_value>	only TRACE1...TRACE3 available for FSU
FSET/ ESI	TRACe[:DATA]	TRACE1| TRACE2| TRACE3| TRACE4| SINGle| SCAN| STATus, <block> | <numeric_value>	
FSU	TRACe:IQ:DATA?		new function for FSU
FSU	TRACe:IQ:DATA:MEMory?	<offset samples>, <# of samples>	new function for FSU
FSU	TRACe:IQ:SET	<filter type>, <rbw>, <sample rate>, <trigger source>, <trigger slope>, <pretrigger samples>, <# of samples>	new function for FSU
FSU	TRACe:IQ:SRATe	16kHz to 32MHz	new function for FSU
FSU	TRACe:IQ[:STATe]	ON | OFF	new function for FSU
FSU + FSE	TRIGger<1|2>[:SEQuence]:HOLDoff	0 to 100s	
FSE	TRIGger<1|2>[:SEQuence]:LEVel:AF	-120 to +120PCT	not available for FSU
FSE	TRIGger<1|2>[:SEQuence]:LEVel:VIDeo	0 to 100PCT	not available for FSU; replaced by TRIGger:SEQuence:SOURce :VIDeo
FSE	TRIGger<1|2>[:SEQuence]:LEVel[:EXTernal]	-5.0 to +5.0V	not available for FSU
FSU + FSE	TRIGger<1|2>[:SEQuence]:SLOPe	POSitive | NEGative	
FSU	TRIGger<1|2>[:SEQuence]:SOURce	IMMediate | LINE | EXTernal | VIDeo | IFPower	
FSE/ ESI	TRIGger<1|2>[:SEQuence]:SOURce	IMMediate | LINE | EXTernal | VIDeo | RFPower | TV | AF	
FSIQ	TRIGger<1|2>[:SEQuence]:SOURce	IMMediate | LINE | EXTernal | VIDeo | RFPower | AF	
FSET	TRIGger<1|2>[:SEQuence]:SOURce	IMMediate | LINE | EXTernal | VIDeo	
FSU + FSE	TRIGger<1|2>[:SEQuence]:SOURce:VIDeo	0 to 100PCT	
FSE/ ESI	TRIGger<1|2>[:SEQuence]:SYNChronize:ADJust:FRAMe	0 to 100s	not available for FSU
FSE	TRIGger<1|2>[:SEQuence]:SYNChronize:ADJust:FRAMe:AUTO	ONCE	not available for FSU and FSET
FSE	TRIGger<1|2>[:SEQuence]:SYNChronize:ADJust:SLOT	0 to 100s	not available for FSU and FSET
FSE	TRIGger<1|2>[:SEQuence]:SYNChronize:ADJust:SLOT:AUTO	ONCE	not available for FSU and FSET
FSE	TRIGger<1|2>[:SEQuence]:SYNChronize:SOURce	FRAMe | TSC	not available for FSU and FSET
FSE/ ESI	TRIGger<1|2>[:SEQuence]:VIDeo:FIELd:SELect	ALL | ODD | EVEN	not available for FSU
FSE/ ESI	TRIGger<1|2>[:SEQuence]:VIDeo:FORMat:LPFRame	525 | 625	not available for FSU
FSE/ ESI	TRIGger<1|2>[:SEQuence]:VIDeo:LINE:NUMBer	<numeric_value>	not available for FSU
FSE/ ESI	TRIGger<1|2>[:SEQuence]:VIDeo:SSIGnal:POLarity	NEGative | POSitive	not available for FSU

Devices	Command	Parameter	Notes
FSU	UNIT<1|2>:POWer	DBM | DBPW | WATT | DBUV | DBMV | VOLT | DBUA | AMP | V | A | W	available units are compatible to the FSE.
FSE/ FSIQ	UNIT<1|2>:POWer	DBM | DBPW | WATT | DBUV | DBMV | VOLT | DBUA | AMP | DB | PCT | UNITLESS | DBUV_MHZ | DBMV_MHZ | DBUA_MHZ | DBUV_M | DBIA_M | DBUV_MMHZ | DBUA_MMHZ	for FSU, the following units apply:DBM | DBPW | WATT | DBUV | DBMV | VOLT | DBUA | AMP | V | A | W
FSET/ ESI	UNIT<1|2>:POWer	DBM | DBPW | DBPT | WATT | DBUV | DBMV | VOLT | DBUA | AMPere | V | W | DB | PCT | UNITLESS | DBUV_MHZ | DBMV_MHZ | DBUA_MHZ | DBUV_M | DBIA_M | DBUV_MMHZ | DBUA_MMHZ	for FSU, the following units apply:DBM | DBPW | WATT | DBUV | DBMV | VOLT | DBUA | AMP | V | A | W
FSE	UNIT<1|2>:PROBe	ON | OFF	not available for FSU

Alphabetical List of Commands

In the following, all remote-control commands are listed with their parameters and page numbers. Generally, they are arranged alphabetically according to the keywords of the command. The list of common commands starts the table.

<table>
<tr><th>Command</th><th>Parameter</th><th>Page</th></tr>
<tr><td>*CAL?</td><td></td><td>6.4</td></tr>
<tr><td>*ESE</td><td>0 to 255</td><td>6.4</td></tr>
<tr><td>*ESR?</td><td></td><td>6.4</td></tr>
<tr><td>*IDN?</td><td></td><td>6.4</td></tr>
<tr><td>*IST?</td><td></td><td>6.4</td></tr>
<tr><td>*OPC</td><td></td><td>6.4</td></tr>
<tr><td>*OPT?</td><td></td><td>6.4</td></tr>
<tr><td>*PCB</td><td>0 to 30</td><td>6.4</td></tr>
<tr><td>*PRE</td><td>0 to 255</td><td>6.4</td></tr>
<tr><td>*PSC</td><td>0 | 1</td><td>6.4</td></tr>
<tr><td>*RST</td><td></td><td>6.4</td></tr>
<tr><td>*SRE</td><td>0 to 255</td><td>6.4</td></tr>
<tr><td>*STB?</td><td></td><td>6.4</td></tr>
<tr><td>*TRG</td><td></td><td>6.4</td></tr>
<tr><td>*TST?</td><td></td><td>6.4</td></tr>
<tr><td>*WAI</td><td></td><td>6.4</td></tr>
<tr><td>ABORt</td><td></td><td>6.8</td></tr>
<tr><td>CALCulate<1|2>:DELTamarker<1 to 4>[:STATe]</td><td>ON | OFF</td><td>6.9</td></tr>
<tr><td>CALCulate<1|2>:DELTamarker<1 to 4>:MODE</td><td>ABSolute | RELative</td><td>6.10</td></tr>
<tr><td>CALCulate<1|2>:DELTamarker<1 to 4>:AOFF</td><td></td><td>6.10</td></tr>
<tr><td>CALCulate<1|2>:DELTamarker<1 to 4>:TRACe</td><td>1 to 3</td><td>6.10</td></tr>
<tr><td>CALCulate<1|2>:DELTamarker<1 to 4>:X</td><td>0 to MAX (frequency | sweep time)</td><td>6.11</td></tr>
<tr><td>CALCulate<1|2>:DELTamarker<1 to 4>:X:RELative?</td><td></td><td>6.11</td></tr>
<tr><td>CALCulate<1|2>:DELTamarker<1 to 4>:Y?</td><td></td><td>6.12</td></tr>
<tr><td>CALCulate<1|2>:DELTamarker<1 to 4>:MAXimum[:PEAK]</td><td></td><td>6.12</td></tr>
<tr><td>CALCulate<1|2>:DELTamarker<1 to 4>:MAXimum:NEXT</td><td></td><td>6.12</td></tr>
<tr><td>CALCulate<1|2>:DELTamarker<1 to 4>:MAXimum:RIGHt</td><td></td><td>6.13</td></tr>
<tr><td>CALCulate<1|2>:DELTamarker<1 to 4>:MAXimum:LEFT</td><td></td><td>6.13</td></tr>
<tr><td>CALCulate<1|2>:DELTamarker<1 to 4>:MINimum[:PEAK]</td><td></td><td>6.13</td></tr>
<tr><td>CALCulate<1|2>:DELTamarker<1 to 4>:MINimum:NEXT</td><td></td><td>6.13</td></tr>
<tr><td>CALCulate<1|2>:DELTamarker<1 to 4>:MINimum:RIGHt</td><td></td><td>6.14</td></tr>
<tr><td>CALCulate<1|2>:DELTamarker<1 to 4>:MINimum:LEFT</td><td></td><td>6.14</td></tr>
<tr><td>CALCulate<1|2>:DELTamarker<1 to 4>:FUNCtion:FIXed[:STATe]</td><td>ON | OFF</td><td>6.14</td></tr>
<tr><td>CALCulate<1|2>:DELTamarker<1...4>:FUNCtion:FIXed:RPOint:MAXimum[:PEAK]</td><td><numeric_value></td><td>6.15</td></tr>
<tr><td>CALCulate<1|2>:DELTamarker<1 to 4>:FUNCtion:FIXed:RPOint:Y</td><td></td><td>6.15</td></tr>
<tr><td>CALCulate<1|2>:DELTamarker<1 to 4>:FUNCtion:FIXed:RPOint:Y:OFFSet</td><td><numeric_value></td><td>6.15</td></tr>
<tr><td>CALCulate<1|2>:DELTamarker<1 to 4>:FUNCtion:FIXed:RPOint:X</td><td><numeric_value></td><td>6.16</td></tr>
<tr><td>CALCulate<1|2>:DELTamarker<1 to 4>:FUNCtion:PNOise[:STATe]</td><td>ON | OFF</td><td>6.16</td></tr>
</table>

Command	Parameter	Page
CALCulate<1|2>:DELTamarker<1 to 4>:FUNCtion:PNOise:RESult?		6.16
CALCulate<1|2>:LIMit<1 to 8>:TRACe	1 to 3	6.18
CALCulate<1|2>:LIMit<1 to 8>:STATe	ON | OFF	6.18
CALCulate<1|2>:LIMit<1 to 8>:UNIT	DBM | DBPW | WATT | DBUV | DBMV | VOLT | DBUA | AMPere | DB | DBUV_M | DBUA_M | DEG | RAD | S | HZ | PCT | UNITLESS	6.19
CALCulate<1|2>:LIMit<1 to 8>:FAIL?		6.19
CALCulate<1|2>:LIMit<1 to 8>:CLEar[:IMMediate]		6.19
CALCulate<1|2>:LIMit<1 to 8>:COMMent	<string>	6.19
CALCulate<1|2>:LIMit<1 to 8>:COPY	1 to 8 | <name>	6.19
CALCulate<1|2>:LIMit<1 to 8>:NAME	1 to 8 | <string>	6.20
CALCulate<1|2>:LIMit<1 to 8>:DELete		6.20
CALCulate<1|2>:LIMit<1 to 8>:ACPower[:STATe]	ON | OFF	6.21
CALCulate<1|2>:LIMit<1 to 8>:ACPower:ACHannel[:RELative]	0 to 100 dB, 0 to 100 dB	6.22
CALCulate<1|2>:LIMit<1 to 8>:ACPower:ACHannel[:RELative]:STATe	ON | OFF	6.23
CALCulate<1|2>:LIMit<1 to 8>:ACPower:ACHannel:ABSolute	-200 to 200 DBM, -200 to 200 DBM	6.24
CALCulate<1|2>:LIMit<1 to 8>:ACPower:ACHannel:ABSolute:STATe	ON | OFF	6.25
CALCulate<1|2>:LIMit<1 to 8>:ACPower:ACHannel:RESult?		6.26
CALCulate<1|2>:LIMit<1 to 8>:ACPower:ALTernate<1|2>[:RELative]	0 to 100 DB, 0 to 100 DB	6.27
CALCulate<1|2>:LIMit<1 to 8>:ACPower:ALTernate<1|2>:STATe[:RELative]	ON | OFF	6.28
CALCulate<1|2>:LIMit<1 to 8>:ACPower:ALTernate<1|2>:ABSolute	-200 to 200 DBM, -200 to 200 DBM	6.29
CALCulate<1|2>:LIMit<1 to 8>:ACPower:ALTernate<1|2>:ABSolute:STATe	ON | OFF	6.30
CALCulate<1|2>:LIMit<1 to 8>:ACPower:ALTernate<1|2>:ABSolute:RESult?		6.31
CALCulate<1|2>:LIMit<1 to 8>:CONTrol[:DATA]	<numeric_value>,<numeric_value>..	6.32
CALCulate<1|2>:LIMit<1 to 8>:CONTrol:DOMain	FREQuency | TIME	6.32
CALCulate<1|2>:LIMit<1 to 8>:CONTrol:OFFset	<numeric_value>	6.33
CALCulate<1|2>:LIMit<1 to 8>:CONTrol:MODE	RELative | ABSolute	6.33
CALCulate<1|2>:LIMit<1 to 8>:CONTrol:SHIFt	<numeric_value>	6.33
CALCulate<1|2>:LIMit<1 to 8>:LOWer[:DATA]	<numeric_value>	6.34
CALCulate<1|2>:LIMit<1 to 8>:LOWer:STATe	ON | OFF	6.35
CALCulate<1|2>:LIMit<1 to 8>:LOWer:OFFset	<numeric_value>	6.35
CALCulate<1|2>:LIMit<1 to 8>:LOWer:MARGin	<numeric_value>	6.35
CALCulate<1|2>:LIMit<1 to 8>:LOWer:MODE	RELative | ABSolute	6.35
CALCulate<1|2>:LIMit<1 to 8>:LOWer:SHIFt	<numeric_value>	6.36
CALCulate<1|2>:LIMit<1 to 8>:LOWer:THReshold	<numeric value>	6.36
CALCulate<1|2>:LIMit<1 to 8>:UPPer[:DATA]	<num_value>,<num_value>..	6.37
CALCulate<1|2>:LIMit<1 to 8>:UPPer:STATe	ON | OFF	6.38
CALCulate<1|2>:LIMit<1 to 8>:UPPer:OFFset	<numeric_value>	6.38
CALCulate<1|2>:LIMit<1 to 8>:UPPer:MARGin	<numeric_value>	6.38
CALCulate<1|2>:LIMit<1 to 8>:UPPer:MODE	RELative | ABSolute	6.39
CALCulate<1|2>:LIMit<1 to 8>:UPPer:SHIFt	<numeric_value>	6.39
CALCulate<1|2>:LIMit<1 to 8>:UPPer:THReshold	<numeric value>	6.39
CALCulate<1|2>:MARKer<1 to 4>[:STATe]	ON | OFF	6.40
CALCulate<1|2>:MARKer<1 to 4>:AOFF		6.41

Command	Parameter	Page
CALCulate<1|2>:MARKer<1 to 4>:TRACe	1 to 3	6.41
CALCulate<1|2>:MARKer<1 to 4>:X	0 to MAX (frequency | sweep time)	6.41
CALCulate<1|2>:MARKer<1 to 4>:X:SLIMits[:STATe]	ON | OFF	6.41
CALCulate<1|2>:MARKer<1 to 4>:X:SLIMits:LEFT	0 to MAX (frequency|sweep time)	6.42
CALCulate<1|2>:MARKer<1 to 4>:X:SLIMits:RIGHt	0 to MAX (frequency|sweep time)	6.42
CALCulate<1|2>:MARKer<1 to 4>:COUNt	ON | OFF	6.43
CALCulate<1|2>:MARKer<1 to 4>:COUNt:RESolution	0.1 | 1 | 10 | 100 | 1000 | 10000 Hz	6.43
CALCulate<1|2>:MARKer<1 to 4>:COUNt:FREQuency?		6.43
CALCulate<1|2>:MARKer<1 to 4>:LOEXclude	ON | OFF	6.44
CALCulate<1|2>:MARKer<1 to 4>:Y?		6.44
CALCulate<1|2>:MARKer<1...4>:Y:PERCent	0 ... 100%	6.44
CALCulate<1|2>:MARKer<1 to 4>:MAXimum[:PEAK]		6.45
CALCulate<1|2>:MARKer<1 to 4>:MAXimum:NEXT		6.45
CALCulate<1|2>:MARKer<1 to 4>:MAXimum:RIGHt		6.45
CALCulate<1|2>:MARKer<1 to 4>:MAXimum:LEFT		6.45
CALCulate<1|2>:MARKer<1 to 4>:MINimum[:PEAK]		6.46
CALCulate<1|2>:MARKer<1 to 4>:MINimum:NEXT		6.47
CALCulate<1|2>:MARKer<1 to 4>:MINimum:RIGHt		6.47
CALCulate<1|2>:MARKer<1 to 4>:MINimum:LEFT		6.47
CALCulate<1|2>:MARKer<1 to 4>:PEXCursion	<numeric_value>	6.48
CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:NDBDown	<numeric_value>	6.49
CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:NDBDown:STATe	ON | OFF	6.50
CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:NDBDown:RESult?		6.50
CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:NDBDown:FREQuency?		6.50
CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:ZOOM	<numeric_value>	6.51
CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:NOISe[:STATe]	ON | OFF	6.51
CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:NOISe:RESult?		6.51
CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:DEModulation:SELect	AM | FM	6.52
CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:DEModulation[:STATe]	ON | OFF	6.52
CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:DEModulation:HOLDoff	10ms to 1000s	6.52
CALCulate<1|2>:MARKer<1...4>:FUNCtion:DEModulation:CONTinuous	ON | OFF99	6.52
CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:MDEPth[:STATe]		6.53
CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:MDEPth:RESult?		6.53
CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:TOI[:STATe]	ON | OFF	6.54
CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:TOI:RESult?		6.54
CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:CENTer	ON | OFF	6.55
CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:CSTep	ON | OFF	6.55
CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:REFerence	6.55	
CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:POWer:SELect?	ACPower | CPOWer | OBANdwidth | OBWidth	6.56
CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:POWer:RESult?	ACPower | CPOWer | OBANdwidth | OBWidth	6.57
CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:POWer:RESult:PHZ?	ACPower | CPOWer	6.59
CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:POWer[:STATe]	OFF	6.60
CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:POWer:PRESet	NADC | TETRA | PDC | PHS | CDPD | CDMA | NONE	6.60
CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:STRack[:STATe]	ON | OFF	6.61

Command	Parameter	Page
CALCulate<1|2>:MARKer<1...4>:FUNCtion:STRack:BANDwidth|BWIDth	10 Hz to MAX(SPAN)	6.61
CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:STRack:THReshold	-330 dBm to.+30 dBm	6.62
CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:STRack:TRACe	1 to 3	6.62
CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:STATe	ON | OFF	6.64
CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:PPEak[:STATe]	ON | OFF	6.64
CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:PPEak:RESult?		6.64
CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:PPEak:AVERage:RESult?		6.65
CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:PPEak:PHOLd:RESult?		6.65
CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:RMS[:STATe]	ON | OFF	6.66
CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:RMS:RESult?		6.66
CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:RMS:AVERage:RESult?		6.66
CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:RMS:PHOLd:RESult?		6.67
CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:MEAN[:STATe]	ON | OFF	6.67
CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:MEAN:RESult?		6.68
CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:MEAN:AVERage:RESult?		6.68
CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:MEAN:PHOLd:RESult?		6.69
CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:SDEViation[:STATe]	ON | OFF	6.69
CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:SDEViation:RESult?		6.70
CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:SDEV:AVERage:RESult?		6.70
CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:SDEV:PHOLd:RESult?		6.71
CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:PHOLd	ON | OFF	6.71
CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:AVERage	ON | OFF	6.72
CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:MODE	ABSolute | RELative	6.72
CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:REFerence:AUTO	ONCE	6.73
CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:AOFF		6.73
CALCulate<1|2>:MATH[:EXPRession][:DEFine]	<expr>	6.74
CALCulate<1|2>:MATH:POSition	-100PCT to 200PCT	6.74
CALCulate<1|2>:MATH:STATe	ON | OFF	6.75
CALCulate<1|2>:MATH:MODE	LINear | LOGarithmic	6.75
CALCulate:STATistics:APD[:STATe]	ON | OFF	6.76
CALCulate:STATistics:CCDF[:STATe]	ON | OFF	6.76
CALCulate:STATistics:NSAMples	100 to 1E9	6.77
CALCulate:STATistics:SCALe:AUTO	ONCE	6.77
CALCulate:STATistics:SCALe:X:RLEVel	-130dBm to 30dBm	6.77
CALCulate:STATistics: SCALe:X:RANGe	-10dB to 200dB	6.78
CALCulate:STATistics:SCALe:Y:UPPer	-1E-8 to 1.0	6.78
CALCulate:STATistics: SCALe:Y:LOWer	-1E-9 to 0.1	6.78
CALCulate:STATistics:PRESet		6.78

Command	Parameter	Page
CALCulate:STATistics:Result<1 to 3>?	MEAN|PEAK|CFACtor|ALL	6.79
CALCulate<1|2>:THReshold	MINimum to MAXimum (depending on current unit)	6.80
CALCulate<1|2>:THReshold:STATe	ON | OFF	6.80
CALCulate<1|2>:UNIT:POWer	DBM | V| A| W | DBPW | WATT | DBUV | DBMV | VOLT | DBUA | AMPere |	6.81
CALibration[:ALL]		6.82
CALibration:ABORt		6.82
CALibration:RESult?		6.83
CALibration:STATe	ON | OFF	6.83
CONFigure:CHANnel:TSC	0...7	6.84
CONFigure:RESTore		6.84
CONFigure:BURSt:PFERror[IMMediate]		6.85
CONFigure:BURSt:POWer[IMMediate]		6.85
CONFigure:BURSt:PTEMplate:[IMMediate]		6.86
CONFigure:BURSt:PTEMplate:SELect	FULL | TOP | RISing | FALLing	6.86
CONFigure:SPECtrum:MODulation[:IMMediate]		6.87
CONFigure:SPECtrum:SWITching[:IMMediate]		6.87
CONFigure:SPURious[:IMMediate]		6.88
DIAGnostic<1|2>:SERVice:INPut[:SELect]	CALibration | RF	6.89
DIAGnostic<1|2>:SERVice:INPut:PULSed[:State]	ON | OFF	6.89
DIAGnostic<1|2>:SERVice:INPut:PULSed:PRATe	10 kHz | 100 kHz | 1 MHz | 640 MHz	6.90
DIAGnostic<1|2>:SERVice:SFUNction	<string>...	6.90
DIAGnostic<1|2>:SERVice:NSOurce	ON|OFF	6.90
DIAGnostic<1|2>:SERVice:CSOurce[:POWer]	<numeric_value>	6.90
DIAGnostic<1|2>:SERVice:STESt:RESult?		6.91
DISPlay:FORmat	SINGle | SPLit	6.93
DISPlay:ANNotation:FREQuency	ON | OFF	6.93
DISPlay:LOGO	ON | OFF	6.93
DISPlay:PSAVe[:STATe]	ON | OFF	6.93
DISPlay:PSAVe:HOLDoff	0 to 60	6.93
DISPlay:CMAP<1 to 27>:DEFault<1|2>		6.94
DISPlay:CMAP<1 to 26>:HSL	0 to 1 (tint), 0 to 1 (saturation), 0 to 1 (brightness)	6.94
DISPlay:CMAP<1 to 26>:PDEFined	<color>	6.95
DISPlay[:WINDow<1|2>]:SELect		6.95
DISPlay[:WINDow<1|2>]:TEXT[:DATA]	<string>	6.95
DISPlay[:WINDow<1|2>]:TEXT:STATe	ON | OFF	6.96
DISPlay[:WINDow<1|2>]:TIME	ON | OFF	6.96
DISPlay[:WINDow<1|2>]:TRACe<1 to 3>:Y[:SCALe]	10dB to 200dB	6.96
DISPlay[:WINDow<1|2>]:TRACe<1 to 3>:Y[:SCALe]:MODE	ABSolute | RELative	6.96
DISPlay[:WINDow<1|2>]:TRACe<1 to 3>:Y[:SCALe]:RLEVel	-200dBm 130dBm to 30dBm	6.97
DISPlay[:WINDow<1|2>]:TRACe<1 to 3>:Y[:SCALe]:RLEVel:OFFSet	-200dB to 200dB	6.97
DISPlay[:WINDow<1|2>]:TRACE<1 to 3>:Y[:SCALe]:RVALue	<numeric_value>	6.97
DISPlay[:WINDow<1|2>]:TRACe<1 to 3>:Y[:SCALe]:RPOSition	0 to 100 PCT	6.98
DISPlay[:WINDow<1|2>]:TRACe<1 to 3>:Y:SPACing	LINear | LOGarithmic | PERCent	6.98
DISPlay[:WINDow<1|2>]:TRACe<1 to 3>:MODE	WRITe | VIEW | AVERage | MAXHold |	6.98

Command	Parameter	Page
	MINHold	
DISPlay[:WINDow<1|2>]:TRACE<1 to 3>[:STATe]	ON | OFF	6.99
FETCh:BURSt:PERRor:RMS:AVERage?		6.100
FETCh:BURSt:PERRor:RMS:MAXimum?		6.101
FETCh:BURSt:PERRor:PEAK:AVERage?		6.101
FETCh:BURSt:PERRor:PEAK:MAXimum?		6.102
FETCh:BURSt:FERRor:AVERage?		6.102
FETCh:BURSt:FERRor:MAXimum?		6.103
FETCh:BURSt:PTEMplate:REFerence?	§	6.103
FETCh:SPECtrum:MODulation:REFerence?	§	6.106
FETCh:SPECtrum:SWITching[:ALL]?		6.106
FORMat[:DATA]	ASCii | REAL | UINT [,32]	6.108
FORMat:DEXPort:DSEParator	POINt|COMMa	6.108
HCOPy:ABORt		6.109
HCOPy:DESTination<1|2>	MMEM' | 'SYST:COMM:PRIN' | 'SYST:COMM:CLIP'	6.110
HCOPy:DEVice:COLor	ON | OFF	6.110
HCOPy:DEVice:LANGuage<1|2>	GDI | WMF | EWMF | BMP	6.111
HCOPy[:IMMediate]		6.111
HCOPy:DEVice:ITEM:ALL		6.112
HCOPy:ITEM:WINDow<1|2>:TABle:STATe	ON | OFF	6.112
HCOPy:ITEM:WINDow<1|2>:TEXT	<string>	6.112
HCOPy:ITEM:WINDow<1|2>:TRACe:STATe	ON | OFF	6.112
HCOPy:PAGE:ORIentation<1|2>	LANDscape | PORTrait	6.113
INITiate<1|2>:CONTinuous	ON | OFF	6.114
INITiate<1|2>:CONMeas		6.114
INITiate<1|2>[:IMMediate]		6.115
INITiate<1|2>:DISPlay	ON | OFF	6.115
INPut<1|2>:ATTenuation	0 to 70dB	6.116
INPut<1|2>:ATTenuation:AUTO	ON | OFF	6.116
INPut<1|2>:ATTenuation:PROTection:RESet	6.117	
INPut:COUPling%AC | DC	6.117	
INPut<1|2>:EATT	0 to 30dB	6.118
INPut<1|2>:EATT:AUTO	ON | OFF	6.118
INPut<1|2>:EATT:STATe	ON | OFF	6.118
INPut<1|2>:IMPedance	50 | 75	6.119
INPut<1|2>:MIXer[:POWer]	<numeric value>	6.119
INPut<1|2>:MIXer:AUTO	ON | OFF	6.119
INSTrument<1|2>[:SELect]	SANalyzer	6.120
INSTrument<1|2>:NSELect	1	6.120
INSTrument:COUPle	NONE | RLEVel | CF_B | CF_A	6.121
MMEMory:CATalog?	Pfad	6.123
MMEMory:CDIRectory	directory name	6.124
MMEMory:COPY	path, file name	6.124
MMEMory:DATA	<file name>,<block data>	6.125
MMEMory:DELete	path, file name	6.126

Command	Parameter	Page
MMEMory:INITialize	'A:'	6.126
MMEMory:LOAD:STATe	path, file name	6.127
MMEMory:LOAD:AUTO	1,Path	6.128
MMEMory:MDIRectory	path	6.128
MMEMory:MOVE	path, file name	6.129
MMEMory:MSIS	'A:' | 'D:'	6.129
MMEMory:NAME	path, file name	6.129
MMEMory:RDIRectory	directory name	6.130
MMEMory:STORe<1|2>:STATe	path, file name	6.130
MMEMory:STORe<1|2>:TRACe	1 to 3,Pfad	6.130
MMEMory:CLear:STATe	1,Path	6.131
MMEMory:CLear:ALL		6.131
MMEMory:SELect[:ITEM]:HWSettings	ON | OFF	6.131
MMEMory:SELect[:ITEM]:TRACE	ON | OFF	6.132
MMEMory:SELect[:ITEM]:LINes:ALL	ON | OFF	6.132
MMEMory:SELect[:ITEM]:SCData	ON | OFF	6.132
MMEMory:SELect[:ITEM]:ALL		6.132
MMEMory:SELect[:ITEM]:NONE		6.133
MMEMory:SELect[:ITEM]:DEFault		6.133
MMEMory:COMMent	<string>	6.133
READ:BURSt:PERRor:RMS:AVERage?		6.134
READ:BURSt:PERRor:RMS:MAXimum?		6.135
READ:BURSt:PERRor:PEAK:AVERage?		6.135
READ:BURSt:PERRor:PEAK:MAXimum?		6.136
READ:BURSt:FERRor:AVERage?		6.136
READ:BURSt:FERRor:MAXimum?		6.137
READ:BURSt:PTEMplate:REFerence[:IMMediate]?		6.137
READ:BURSt:REFerence[:IMMediate]?		6.138
READ:SPECtrum:MODulation[:ALL]?		6.139
READ:SPECtrum:MODulation:REFerence[:IMMediate]?	§	6.140
READ:SPECtrum:SWITching[:ALL]?		6.140
[SENSe<1|2>:]AVERage:COUNt	0 to 256	6.143
[SENSe<1|2>:]AVERage[:STATe<1 to 3>]	ON | OFF	6.143
[SENSe<1|2>:]AVERage:TYPE	VIDeo | LINear	6.143
[SENSe<1|2>:]BANDwidth|BWIDth[:RESolution]	10 Hz...50MHz	6.144
[SENSe<1|2>:]BANDwidth|BWIDth[:RESolution]:AUTO	ON | OFF	6.145
[SENSe<1|2>:]BANDwidth|BWIDth[:RESolution]:RATio	0.0001 to 1	6.145
[SENSe<1|2>:]BANDwidth|BWIDth[:RESolution]:TYPE NORMal | FFT | CFILter | RRC		6.145
[SENSe<1|2>:]BANDwidth|BWIDth:VIDeo	1Hz to 10MHz	6.146
[SENSe<1|2>:]BANDwidth|BWIDth:VIDeo:AUTO	ON | OFF	6.146
[SENSe<1|2>:]BANDwidth|BWIDth:VIDeo:RATio	0.01 to 1000	6.146
[SENSe<1|2>:]CORRection[:STATe	ON | OFF	6.147
[SENSe<1|2>:]CORRection:METHod	TRANsmission | REFLexion	6.147
[SENSe<1|2>:]CORRection:COLLect[:ACQuire]	THRough | OPEN	6.148
[SENSe<1|2>:]CORRection:RECall		6.148

<table>
<tr><th>Command</th><th>Parameter</th><th>Page</th></tr>
<tr><td>[SENSe<1|2>:]DETector<1 to 4>[:FUNCtion]</td><td>APEak |NEGative | POSitive | SAMPle | RMS | AVERage | QPEak</td><td>6.149</td></tr>
<tr><td>[SENSe<1|2>:]DETector<1 to 3>[:FUNCtion]:AUTO</td><td>ON | OFF</td><td>6.149</td></tr>
<tr><td>[SENSe<1|2>:]FREQuency:CENTer</td><td>0 GHz to f_{max}</td><td>6.150</td></tr>
<tr><td>[SENSe<1|2>:]FREQuency:CENTer:STEP</td><td>0 to f_{max}</td><td>6.150</td></tr>
<tr><td>[SENSe<1|2>:]FREQuency:CENTer:STEP:LINK</td><td>SPAN | RBW | OFF</td><td>6.150</td></tr>
<tr><td>[SENSe<1|2>:]FREQuency:CENTer:STEP:LINK:FACTor</td><td>1 to 100 PCT</td><td>6.151</td></tr>
<tr><td>[SENSe<1|2>:]FREQuency:SPAN</td><td>0 GHz to f_{max}</td><td>6.151</td></tr>
<tr><td>[SENSe<1|2>:]FREQuency:SPAN:FULL</td><td></td><td>6.151</td></tr>
<tr><td>[SENSe<1|2>:]FREQuency:STARt</td><td>0 GHz to f_{max}</td><td>6.151</td></tr>
<tr><td>[SENSe<1|2>:]FREQuency:STOP</td><td>0 GHz to f_{max}</td><td>6.152</td></tr>
<tr><td>[SENSe<1|2>:]FREQuency:MODE</td><td>CW|FIXed | SWEep</td><td>6.152</td></tr>
<tr><td>[SENSe<1|2>:]FREQuency:OFFSet</td><td><numeric_value></td><td>6.152</td></tr>
<tr><td>[SENSe<1|2>:]LIST:POWer[:SEQuence]</td><td><analyzer freq>,<ref level>,<rf att>,<el att>, <filter type>,<rbw>,<vbw>, <meas time>,<trigger level></td><td>6.154</td></tr>
<tr><td>[SENSe<1|2>:]LIST:POWer:SET</td><td><PEAK meas>,<RMS meas>,<AVG meas>, <trigger mode>,<trigger slope>,<trigger offset>, <gate length></td><td>6.157</td></tr>
<tr><td>[SENSe<1|2>:]LIST:POWer:RESult</td><td></td><td>6.158</td></tr>
<tr><td>[SENSe<1|2>:]LIST:POWer:STATe OFF</td><td></td><td>6.158</td></tr>
<tr><td>[SENSe<1|2>:]MPOWer[:SEQuence]</td><td><analyzer freq>,<rbw>,<meas time>,<trigger source>, <trigger level>,<trigger offset>,<type of meas>,<# of meas></td><td>6.160</td></tr>
<tr><td>[SENSe<1|2>:]MPOWer:RESult[:LIST]</td><td>6.162</td><td></td></tr>
<tr><td>[SENSe<1|2>:]POWer:ACHannel:SPACing:ACHannel</td><td>100 to 2000MHz</td><td>6.163</td></tr>
<tr><td>[SENSe<1|2>:]POWer:ACHannel:SPACing:ALTernate<1|2></td><td>100 to 2000MHz</td><td>6.164</td></tr>
<tr><td>[SENSe<1|2>:]POWer:ACHannel:ACPairs</td><td>0 to 3</td><td>6.164</td></tr>
<tr><td>[SENSe<1|2>:]POWer:ACHannel:BANDwidth|BWIDth[:CHANnel]</td><td>100 to 1000 MHz</td><td>6.164</td></tr>
<tr><td>[SENSe<1|2>:]POWer:ACHannel:BANDwidth|BWIDth:ACHannel</td><td>100 to 1000MHz</td><td>6.165</td></tr>
<tr><td>[SENSe<1|2>:]POWer:ACHannel:BANDwidth|BWIDth:ALTernate<1|2></td><td>100 to 2000MHz</td><td>6.165</td></tr>
<tr><td>[SENSe<1|2>:]POWer:ACHannel:MODE</td><td>ABSolute | RELative</td><td>6.165</td></tr>
<tr><td>[SENSe<1|2>:]POWer:ACHannel:REFerence:AUTO</td><td>ONCE</td><td>6.165</td></tr>
<tr><td>[SENSe<1|2>:]POWer:ACHannel:PRESet</td><td>ACPower | CPOWer | OBANdwidth | OBWidth</td><td>6.166</td></tr>
<tr><td>[SENSe<1|2>:]POWer:ACHannel:PRESet:RLEVel</td><td></td><td>6.166</td></tr>
<tr><td>[SENSe<1|2>:]POWer:BANDwidth|BWIDth</td><td>10 to 99.9PCT</td><td>6.167</td></tr>
<tr><td>[SENSe<1|2>:]POWer:HSPeed</td><td>ON | OFF</td><td>6.167</td></tr>
<tr><td>[SENSe<1|2>:]POWer:TRACe</td><td>1 to 3</td><td>6.167</td></tr>
<tr><td>[SENSe<1|2>:]ROSCillator:SOURce</td><td>INTernal | EXTernal</td><td>6.168</td></tr>
<tr><td>[SENSe<1|2>:]ROSCillator[:INTernal]:TUNe</td><td>0 to 4095</td><td>6.168</td></tr>
<tr><td>[SENSe<1|2>:]ROSCillator[:INTernal]:TUNe:SAVe</td><td></td><td>6.168</td></tr>
<tr><td>[SENSe<1|2>:]SWEep:TIME</td><td>5ms to 1000s | 1µs...16000s</td><td>6.169</td></tr>
<tr><td>[SENSe<1|2>:]SWEep:TIME:AUTO</td><td>ON | OFF</td><td>6.169</td></tr>
<tr><td>[SENSe<1|2>:]SWEep:COUNt</td><td>0 to 32767</td><td>6.170</td></tr>
<tr><td>[SENSe<1|2>:]SWEep:EGATe</td><td>ON | OFF</td><td>6.170</td></tr>
<tr><td>[SENSe<1|2>:]SWEep:EGATe:TYPE</td><td>LEVel | EDGE</td><td>6.171</td></tr>
<tr><td>[SENSe<1|2>:]SWEep:EGATe:POLarity</td><td>POSitive | NEGative</td><td>6.171</td></tr>
</table>

Command	Parameter	Page
[SENSe<1|2>:]SWEep:EGATe:HOLDoff	125ns to 100s	6.171
[SENSe<1|2>:]SWEep:EGATe:LENGth	0 to 100s	6.171
[SENSe<1|2>:]SWEep:EGATe:SOURce	EXTernal | IFPower	6.172
SOURce:EXTernal[:STATe]	ON | OFF	6.173
SOURce:EXTernal<1|2>:FREQuency[:FACTor]:DENominator	<numeric_value>	6.174
SOURce:EXTernal<1|2>:FREQuency[:FACTor]:NUMerator	<numeric_value>	6.174
SOURce:EXTernal<1|2>:FREQuency:OFFSet	<numeric_value>	6.175
SOURce:EXTernal:FREQuency:SWEep[:STATe]	ON | OFF	6.175
SOURce:EXTernal<1|2>:POWer[:LEVel]	<numeric_value>	6.175
STATus:OPERation[:EVENt]?		6.177
STATus:OPERation:CONDition?		6.177
STATus:OPERation:ENABle	0 to 65535	6.177
STATus:OPERation:PTRansition	0 to 65535	6.177
STATus:OPERation:NTRansition	0 to 65535	6.177
STATus:PRESet		6.178
STATus:QUEStionable[:EVENt]?		6.178
STATus:QUEStionable:CONDition?		6.178
STATus:QUEStionable:ENABle	0 to 65535	6.178
STATus:QUEStionable:PTRansition	0 to 65535	6.179
STATus:QUEStionable:NTRansition	0 to 65535	6.179
STATus:QUEStionable:POWer[:EVENt]?		6.179
STATus:QUEStionable:POWer:CONDition?		6.179
STATus:QUEStionable:POWer:ENABle	0 to 65535	6.179
STATus:QUEStionable:POWer:PTRansition	0 to 65535	6.180
STATus:QUEStionable:POWer:NTRansition	0 to 65535	6.180
STATus:QUEStionable:LIMit[:EVENt]?		6.180
STATus:QUEStionable:LIMit:CONDition?		6.180
STATus:QUEStionable:LIMit:ENABle	0 to 65535	6.180
STATus:QUEStionable:LIMit:PTRansition	0 to 65535	6.181
STATus:QUEStionable:LIMit:NTRansition	0 to 65535	6.181
STATus:QUEStionable:LMARgin[:EVENt]?		6.181
STATus:QUEStionable:LMARgin:CONDition?		6.181
STATus:QUEStionable:LMARgin:ENABle	0 to 65535	6.181
STATus:QUEStionable:LMARgin:PTRansition	0 to 65535	6.182
STATus:QUEStionable:LMARgin:NTRansition	0 to 65535	6.182
STATus:QUEStionable:ACPLimit[:EVENt]?		6.182
STATus:QUEStionable:ACPLimit:CONDition?		6.182
STATus:QUEStionable:ACPLimit:ENABle	0 to 65535	6.182
STATus:QUEStionable:ACPLimit:PTRansition	0 to 65535	6.183
STATus:QUEStionable:ACPLimit:NTRansition	0 to 65535	6.183
STATus:QUEStionable:FREQuency[:EVENt]?		6.183
STATus:QUEStionable:FREQuency:CONDition?		6.183
STATus:QUEStionable:FREQuency:ENABle	0 to 65535	6.183
STATus:QUEStionable:FREQuency:PTRansition	0 to 65535	6.184
STATus:QUEStionable:FREQuency:NTRansition	0 to 65535	6.184
STATus:QUEue[:NEXT]?		6.184

Command	Parameter	Page
SYSTem:COMMunicate:GPIB[:SELF]:ADDRess	0 to 30	6.186
SYSTem:COMMunicate:GPIB[:SELF]:RTERminator	LFEOI | EOI	6.186
SYSTem:COMMunicate:GPIB:RDEVice:GENerator<1|2>:ADDRess	0 to 30	6.186
SYSTem:COMMunicate:GPIB:RDEVice:GENerator<1|2>:LINK GPIB | TTL		6.186
SYSTem:COMMunicate:GPIB:RDEVice:GENerator<1|2>:TYPE <name>		6.187
SYSTem:COMMunicate:SERial:CONTrol:DTR	IBFull | OFF	6.188
SYSTem:COMMunicate:SERial:CONTrol:RTS	IBFull | OFF	6.188
SYSTem:COMMunicate:SERial[:RECeive]:BAUD	110 | 300 | 600 | 1200 | 2400 | 9600 | 19200	6.188
SYSTem:COMMunicate:SERial[:RECeive]:BITS	7 | 8	6.189
SYSTem:COMMunicate:SERial[:RECeive]:PARity[:TYPE]	EVEN | ODD | NONE	6.189
SYSTem:COMMunicate:SERial[:RECeive]:SBITs	1 | 2	6.189
SYSTem:COMMunicate:SERial[:RECeive]:PACE	XON | NONE	6.189
SYSTem:COMMunicate:PRINter:ENUMerate:FIRSt?		6.190
SYSTem:COMMunicate:PRINter:ENUMerate:NEXT?		6.190
SYSTem:COMMunicate:PRINter:SELect	<printer_name>	6.190
SYSTem:DATE	1980 to 2099, 1 to 12, 1 to 31	6.191
SYSTem:DISPlay:FPANel	ON | OFF	6.191
SYSTem:UPDate	ON | OFF	6.191
SYSTem:ERRor?		6.191
SYSTem:ERRor:LIST?		6.192
SYSTem:ERRor:CLEar:ALL		6.192
SYSTem:PASSword[:CENable]	'password'	6.192
SYSTem:PRESet		6.192
SYSTem:SET	<block>	6.193
SYSTem:SPEaker:VOLume	0 to 1	6.193
SYSTem:TIME	0 to 23, 0 to 59, 0 to 59	6.193
SYSTem:VERSion?		6.193
TRACe[:DATA]	TRACE1 | TRACE2 | TRACE3, <block> | <numeric_value>	6.194
TRACe:COPY	TRACE1 | TRACE2 | TRACE3 | TRACE4 ,TRACE1 | TRACE2 | TRACE3 | TRACE4	6.195
TRACe<1|2>:IQ:SRATe 16kHz...32MHz		6.201
TRIGger<1|2>[:SEQuence]:SOURce	IMMediate | EXTernal | VIDeo | IFPower	6.203
TRIGger<1|2>[:SEQuence]:LEVel:VIDeo	0 to 100 PCT	6.204
TRIGger<1|2>[:SEQuence]:HOLDoff	-100 to 100 s	6.205
TRIGger<1|2>[:SEQuence]:SLOPe	POSitive | NEGative	6.205
TRIGger<1|2>[:SEQuence]:SYNChronize:ADJust:EXTernal	-460µs...100s	6.205
TRIGger<1|2>[:SEQuence]:SYNChronize:ADJust:IFPower	-460µs...100s	6.205
UNIT<1|2>:POWer	DBM | DBPW | WATT | DBUV | DBMV | VOLT | DBUA | AMP | V | A | W	6.207

Table of Softkeys with IEC/IEEE-Bus Command Assignment

FREQUENCY Key

Softkey	Command
FREQ	
CENTER	[SENSe:]FREQuency:CENTer <num_value>
CF-STEPSIZE	
0.1 * SPAN	[SENSe:]FREQuency:CENTer:STEP:LINK SPAN; [SENSe:]FREQuency:CENTer:STEP:LINK:FACTor 10PCT
0.5 * SPAN	[SENSe:]FREQuency:CENTer:STEP:LINK SPAN; [SENSe:]FREQuency:CENTer:STEP:LINK:FACTor 50PCT
X * SPAN	[SENSe:]FREQuency:CENTer:STEP:LINK SPAN; [SENSe:]FREQuency:CENTer:STEP:LINK:FACTor <num_value>
0.1 * RBW	[SENSe:]FREQuency:CENTer:STEP:LINK RBW; [SENSe:]FREQuency:CENTer:STEP:LINK:FACTor 10PCT
0.5 * RBW	[SENSe:]FREQuency:CENTer:STEP:LINK RBW; [SENSe:]FREQuency:CENTer:STEP:LINK:FACTor 50PCT
X * RBW	[SENSe:]FREQuency:CENTer:STEP:LINK RBW; [SENSe:]FREQuency:CENTer:STEP:LINK:FACTor <num_value>
= CENTER	no corresponding IEC/IEEE-bus command
= MARKER	no corresponding IEC/IEEE-bus command
MANUAL	[SENSe:]FREQuency:CENTer:STEP <num_value>
START	[SENSe:]FREQuency:STARt <num_value>
STOP	[SENSe:]FREQuency:STOP <num_value>
FREQUENCY OFFSET	[SENSe:]FREQuency:OFFSet <num_value>
SIGNAL TRACK	
TRACK ON OFF	CALCulate<1|2>:MARKer<1...4>:FUNCtion:STRack[:STATe] ON | OFF
TRACK BW	CALCulate<1|2>:MARKer<1...4>:FUNCtion:STRack:BANDwidth <num_value>
TRACK THRESHOLD	CALCulate<1|2>:MARKer<1...4>:FUNCtion:STRack:THReshold <num_value>
SELECT TRACE	CALCulate<1|2>:MARKer<1...4>:FUNCtion:STRack:TRACe 1 | 2 | 3

SPAN Key

SPAN

SPAN MANUAL	`[SENSe:]FREQuency:SPAN <num_value>`
SWEEPTIME MANUAL	`[SENSe:]SWEeptime <num_value>`
FULL SPAN	`[SENSe:]FREQuency:SPAN:FULL`
ZERO SPAN	`[SENSe:]FREQuency:SPAN 0HZ` or `[SENSe:]FREQuency:MODE CW | FIXed`
LAST SPAN	no corresponding IEC/IEEE-bus command

AMPT Key

AMPT	
REF LEVEL	DISPlay[:WINDow<1|2>]:TRACe<1...3>:Y[:SCALe]:RLEVel <num_value>
RANGE LOG 100 dB	DISPlay[:WINDow<1|2>]:TRACe<1...3>:Y:SPACing LOGarithmic; DISPlay[:WINDow<1|2>]:TRACe<1...3>:Y[:SCALe] 100 dB
RANGE LOG MANUAL	DISPlay[:WINDow<1|2>]:TRACe<1...3>:Y:SPACing LOGarithmic; DISPlay[:WINDow<1|2>]:TRACe<1...3>:Y[:SCALe] <num_value>
RANGE LINEAR	DISPlay[:WINDow<1|2>]:TRACe<1...3>:Y:SPACing LINear
UNIT	
dBm	CALCulate<1|2>:UNIT:POWer DBM
dBmV	CALCulate<1|2>:UNIT:POWer DBMV
dBµV	CALCulate<1|2>:UNIT:POWer DBUV
dBµA	CALCulate<1|2>:UNIT:POWer DBUA
dBpW	CALCulate<1|2>:UNIT:POWer DBPW
VOLT	CALCulate<1|2>:UNIT:POWer VOLT
AMPERE	CALCulate<1|2>:UNIT:POWer AMPere
WATT	CALCulate<1|2>:UNIT:POWer WATT
RF ATTEN MANUAL	INPut:ATTenuation <num_value>
RF ATTEN AUTO	INPut:ATTenuation:AUTO ON
MIXER	
MIXER LVL AUTO	INPut<1|2>:MIXer:AUTO ON
MIXER LVL MANUAL	NPut<1|2>[:POWer]:MIXer <num_value>
REF LEVEL POSITION	DISPlay[:WINDow<1|2>]:TRACe<1...3>:Y[:SCALe]:RPOSition <num_value>
REF LEVEL OFFSET	DISPlay[:WINDow<1|2>]:TRACe<1...3>:Y[:SCALe]:RLEVel:OFFSet <num_value>
GRID ABS/REL	DISPlay[:WINDow<1|2>]:TRACe<1...3>:Y[:SCALe]:MODE ABSolute|RELative

EL ATTEN AUTO	INPut:EATT:AUTO ON (nur mit Option FSU-B25)
EL ATTEN MANUAL	INPut:EATT <num_value> (nur mit Option FSU-B25)
EL ATTEN OFF	INPut:EATT:STATe OFF (nur mit Option FSU-B25)
RF INPUT 50Ω 75Ω	INPut:IMPedance 50 | 75

MKR Key

MKR

MARKER 1..4

```
CALCulate<1|2>:MARKer<1...4>[:STATe]   ON | OFF;
CALCulate<1|2>:MARKer<1...4>:X <numeric value>;
CALCulate<1|2>:MARKer<1...4>:Y?
CALCulate<1|2>:DELTamarker1[:STATe]   ON | OFF;
CALCulate<1|2>:DELTamarker<1...4>:X <numeric value>;
CALCulate<1|2>:DELTamarker<1...4>:Y?
```

MARKER NORM DELTA

```
CALCulate<1|2>:DELTamarker<1...4>[:STATe]   ON | OFF;
```

SIGNAL COUNT

```
CALCulate<1|2>:MARKer<1...4>:COUNt   ON | OFF;
CALCulate<1|2>:MARKer<1...4>:COUNt:FREQuency?
```

REFERENCE FIXED

REF FXD FREQUENCY

```
CALCulate<1|2>:DELTamarker<1...4>:FUNCtion:FIXed[:STATe]
ON | OFF
```

REF POINT LEVEL

```
CALCulate<1|2>:DELTamarker<1..4>:FUNCtion:FIXed:RPOint:Y
<num_value>
```

REF POINT LVL OFFSET

```
CALCulate<1|2>:DELTamarker<1..4>:FUNCtion:FIXed:RPOint:Y
:OFFSet

<num_value>
```

REF POINT FREQUENCY

```
CALCulate<1|2>:DELTamarker<1..4>:FUNCtion:FIXed:RPOint:X
<num_value>
```

or:

REF POINT TIME

```
CALCulate<1|2>:DELTamarker<1..4>:FUNCtion:FIXed:RPOint:X
<num_value>
```

MARKER ZOOM

```
CALCulate<1|2>:MARKer<1...4>:FUNCtion:ZOOM <num_value>
```

ALL MARKER OFF

```
CALCulate<1|2>:MARKer<1...4>:AOFF
CALCulate<1|2>:DELTamarker<1...4>:AOFF
```

MKR-> TRACE

```
CALCulate<1|2>:MARKer<1...4>:TRACe <num_value>
CALCulate<1|2>:DELTamarker<1...4>:TRACe <num_value>
```

CNT RESOL

```
CALCulate<1|2>:MARKer<1...4>:COUNt:RESolution <numeric
value>
```

MKR-> Key

MKR->	
SELECT MARKER	no corresponding IEC/IEEE-bus command
PEAK	CALCulate<1|2>:MARKer<1...4>:MAXimum[:PEAK] CALCulate<1|2>:DELTamarker<1...4>:MAXimum[:PEAK]
CENTER =MKR FREQ	CALCulate<1|2>:MARKer<1...4>:FUNCtion:CENTer
REF LEVEL = MKR LVL	CALCulate<1|2>:MARKer<1...4>:FUNCtion:REFerence
NEXT PEAK	CALCulate<1|2>:MARKer<1...4>:MAXimum:NEXT CALCulate<1|2>:DELTamarker<1...4>:MAXimum:NEXT
NEXT MODE	
ABSOLUTE PEAK / MIN	CALCulate<1|2>:MARKer<1...4>:MAXimum:NEXT CALCulate<1|2>:DELTamarker<1...4>:MAXimum:NEXT CALCulate<1|2>:MARKer<1...4>:MINimum:NEXT CALCulate<1|2>:DELTamarker<1...4>:MINimum:NEXT
SEARCH NEXT LEFT	CALCulate<1|2>:MARKer<1...4>:MAXimum:LEFT CALCulate<1|2>:DELTamarker<1...4>:MAXimum:LEFT CALCulate<1|2>:MARKer<1...4>:MINimum:LEFT CALCulate<1|2>:DELTamarker<1...4>:MINimum:LEFT
SEARCH NEXT RIGHT	CALCulate<1|2>:MARKer<1...4>:MAXimum:RIGHt CALCulate<1|2>:DELTamarker<1...4>:MAXimum:RIGHt CALCulate<1|2>:MARKer<1...4>:MINimum:RIGHt CALCulate<1|2>:DELTamarker<1...4>:MINimum:RIGHt
SEARCH LIMITS	
LEFT LIMIT	CALCulate<1|2>:MARKer<1...4>:X:SLIMits[STATe] ON | OFF CALCulate<1|2>:MARKer<1...4>:X:SLIMits:LEFT <num_value>
RIGHT LIMIT	CALCulate<1|2>:MARKer<1...4>:X:SLIMits[STATe] ON | OFF CALCulate<1|2>:MARKer<1...4>:X:SLIMits:RIGHt <num_value>
THRESHOLD	CALCulate<1|2>:THReshold[STATe] ON | OFF CALCulate<1|2>:THReshold <num_value>
SEARCH LIM OFF	CALCulate<1|2>:MARKer<1...4>:X:SLIMits[STATe] OFF CALCulate<1|2>:THReshold[STATe] ON | OFF
PEAK EXCURSION	CALCulate<1|2>:MARKer<1...4>:PEXCursion <num_value>
MKR-> TRACE	CALCulate<1|2>:MARKer<1...4>:TRACe <numeric value> CALCulate<1|2>:DELTamarker<1...4>:TRACe <numeric value>
MKR-> CF STEPSIZE	CALCulate<1|2>:MARKer<1...4>:FUNCtion:CSTep
MIN	CALCulate<1|2>:MARKer<1...4>:MINimum[:PEAK] CALCulate<1|2>:DELTamarker<1...4>:MINimum[:PEAK]
MIN NEXT	CALCulate<1|2>:MARKer<1...4>:MINimum:NEXT CALCulate<1|2>:DELTamarker<1...4>:MINimum:NEXT

NEXT MODE	see above
EXCLUDE LO	CALCulate<1|2>:MARKer<1...4>:LOEXclude ON | OFF

MKR FCTN Key

MKR FUNC

SELECT MARKER

no corresponding IEC/IEEE-bus command

PEAK

CALCulate<1|2>:MARKer<1...4>:MAXimum[:PEAK]
CALCulate<1|2>:DELTamarker<1...4>:MAXimum[:PEAK]

NOISE MEAS

CALCulate<1|2>:MARKer<1...4>:FUNCtion:NOISe[:STATe] ON | OFF;
CALCulate<1|2>:MARKer<1...4>:FUNCtion:NOISe:RESult?

PHASE NOISE

PH NOISE ON OFF

CALCulate<1|2>:DELTamarker<1...4>:FUNCtion:PNOise[:STATe] ON | OFF
CALCulate<1|2>:DELTamarker<1...4>:FUNCtion:PNOise:RESult?

REF POINT LEVEL

CALCulate<1|2>:DELTamarker<1..4>:FUNCtion:FIXed:RPOint:Y <num_value>

REF POINT LVL OFFSET

CALCulate<1|2>:DELTamarker<1..4>:FUNCtion:FIXed:RPOint:Y:OFFSet

<num_value>

REF POINT FREQUENCY

CALCulate<1|2>:DELTamarker<1..4>:FUNCtion:FIXed:RPOint:X <num_value>

N dB DOWN

CALCulate<1|2>:MARKer<1...4>:FUNCtion:NDBDown[:STATe] ON | OFF
CALCulate<1|2>:MARKer<1...4>:FUNCtion:NDBDown <num_value>
CALCulate<1|2>:MARKer<1...4>:FUNCtion:NDBDown:RESult?
CALCulate<1|2>:MARKer<1...4>:FUNCtion:NDBDown:FREQuency

MARKER DEMOD

MKR DEMOD ON/OFF

CALCulate<1|2>:MARKer<1...4>:FUNCtion:DEModulation[:STATe] ON | OFF

AM

CALCulate<1|2>:MARKer<1...4>:FUNCtion:DEModulation:SELect AM

FM

CALCulate<1|2>:MARKer<1...4>:FUNCtion:DEModulation:SELect FM

MKR STOP TIME

CALCulate<1|2>:MARKer<1..4>:FUNCtion:DEModulation:HOLDoff <num_value>

MKR-> TRACE

CALCulate<1|2>:MARKer<1...4>:TRACe <numeric value>
CALCulate<1|2>:DELTamarker<1...4>:TRACe <numeric value>

BW Key

Softkey	Command
BW	
RES BW MANUAL	[SENSe:]BANDwidth|BWIDth:AUTO OFF [SENSe:]BANDwidth|BWIDth[:RESolution] <num_value>
VIDEO BW MANUAL	[SENSe:]BANDwidth|BWIDth:VIDeo:AUTO OFF [SENSe:]BANDwidth|BWIDth:VIDeo <num_value>
SWEEP TIME MANUAL	[SENSe:]SWEep:TIME:AUTO OFF [SENSe:]SWEep:TIME <num_value>
RES BW AUTO	[SENSe:]BANDwidth|BWIDth[:RESolution]:AUTO ON
VIDEO BW AUTO	[SENSe:]BANDwidth|BWIDth:VIDeo:AUTO ON
SWEEP TIME AUTO	[SENSe:]SWEep:TIME:AUTO ON
COUPLING RATIO	--
RBW / VBW SINE [1/3]	[SENSe:]BANDwidth|BWIDth:VIDeo:RATio 3
RBW / VBW PULSE [.1]	[SENSe:]BANDwidth|BWIDth:VIDeo:RATio 10
RBW / VBW NOISE [10]	[SENSe:]BANDwidth|BWIDth:VIDeo:RATio 0.1
RBW / VBW MANUAL	[SENSe:]BANDwidth|BWIDth:VIDeo:RATio <num_value>
SPAN / RBW AUTO [50]	[SENSe:]BANDwidth|BWIDth[:RESolution]:RATio 0.02
SPAN / RBW MANUAL	[SENSe:]BANDwidth|BWIDth[:RESolution]:RATio <num_value>
COUPLING DEFAULT	[SENSe:]BANDwidth|BWIDth[:RESolution]:AUTO ON; [SENSe:]BANDwidth|BWIDth:VIDeo:AUTO ON; [SENSe:]SWEep:TIME:AUTO ON
FILTER TYPE	[SENSe:]BANDwidth|BWIDth[:RESolution]:TYPE NORMal | FFT | CFILter | RRC

SWEEP Key

SWEEP	
CONTINUOUS SWEEP	INITiate:CONTinuous ON
SINGLE SWEEP	INITiate:CONTinuous OFF; INITiate:IMMediate
CONTINUE SGL SWEEP	INITiate:CONMeasure
SWEEP TIME MANUAL	[SENSe:]SWEep:TIME <num_value>
SWEEP TIME AUTO	[SENSe:]SWEep:TIME:AUTO ON | OFF
SWEEP COUNT	[SENSe:]SWEep:COUNt <num_value>
SGL SWEEP DISP OFF	INITiate:DISPlay OFF INITiate:IMMediate

MEAS Key

MEAS

TIME DOM POWER

CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary:RMS[:STATe] ON
CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary:PPEak[:STATe] ON
CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary:MEAN[:STATe] ON
CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary:SDEViation[:STATe] ON

POWER ON OFF

CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary:RMS[:STATe] ON|OFF
CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary:PPEak[:STATe] ON|OFF
CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary:MEAN[:STATe] ON|OFF
CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary:SDEViation[:STATe] ON|OFF

RMS

CALCulate<1|2>:MARKer<1..4>:FUNCtion:SUMMary:RMS[:STATe] ON | OFF
CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary:RMS:RESult?

PEAK

CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary:PPEak[:STATe] ON | OFF
CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary:PPEak:RESult?

MEAN

CALCulate<1|2>:MARKer<1..4>:FUNCtion:SUMMary:MEAN[:STATe] ON | OFF
CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary:MEAN:RESult?

STANDARD DEVIATION

CALCulate<1|2>:MARKer<1..4>:FUNCtion:SUMMary:SDEViation[:STATe] ON|OFF
CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary:SDEViation:RESult?

LIMITS ON OFF

CALCulate<1|2>:MARKer<1...4>:SLIMits ON | OFF

START LIMIT

CALCulate<1|2>:MARKer<1...4>:SLIMits:LEFT <num_value>

STOP LIMIT

CALCulate<1|2>:MARKer<1...4>:SLIMits:RIGHt <num_value>

SET REFERENCE

CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary:REFerence:AUTO ONCE

POWER ABS REL

CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary:MODE ABS | REL

MAX HOLD ON OFF

CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary:PHOLd ON | OFF
CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary:PPEak:PHOLd:RESult?
CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary:RMS:PHOLd:RESult?
CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMar:MEAN:PHOLd:RESult?
CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary:SDEViation:PHOLd:RESult?

AVERAGE ON OFF

CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary:AVERage ON | OFF
CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary:PPEak:AVERage:RESult?
CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary:RMS:AVERage:RESult?
CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMar:MEAN:AVERage:RESult?
CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary:SDEViation:AVERage:RES?

NUMBER OF SWEEPS

[SENSe:]SWEep:COUNt <num_value>

CHAN PWR ACP

--

CP / ACP ON OFF

CALCulate<1|2>:MARKer<1...4>:FUNCtion:POWer:SELect CPOWer | ACPower;
CALCulate<1|2>:MARKer<1...4>:FUNCtion:POWer:RESult? CPOWer | ACPower;
CALCulate<1|2>:MARKer<1...4>:FUNCtion:POWer[:STATe] OFF

CP / ACP STANDARD

CALCulate<1|2>:MARKer<1...4>:FUNCtion:POWer:PRESet <standard>

CP / ACP CONFIG

--

NO. OF ADJ CHAN

[SENSe:]POWer:ACHannel:ACPairs <num_value>

CHANNEL BANDWIDTH

[SENSe:]POWer:ACHannel:BANDwidth|BWIDth[:CHANnel] <num_value>

ADJ CHAN BANDWIDTH

[SENSe:]POWer:ACHannel:BANDwidth|BWIDth:ACHannel <num_value>
[SENSe:]POWer:ACHannel:BANDwidth|BWIDth:ALTernate<1|2> <num_value>

ADJ CHAN SPACING

[SENSe:]POWer:ACHannel:SPACing:ACHannel <num_value>
[SENSe:]POWer:ACHannel:SPACing:ALTernate<1|2> <num_value>

CP/ACP ABS/REL

[SENSe:]POWer:ACHannel:MODE ABSolute|RELative

FAST ACP ON OFF

[SENSe:]POWer:HSPeed ON | OFF

SELECT TRACE

[SENSe:]POWer:TRACe 1|2|3

ADJUST REF LVL

[SENSe:]POWer:ACHannel:PRESet:RLEVel

ADJUST SETTINGS

[SENSe:]POWer:ACHannel:PRESet ACPower|CPOWer|OBANdwidth|OBWidth

ACP LIMIT CHECK

CALCulate<1|2>:LIMit<1...8>:ACPower[:STATe] ON | OFF
CALCulate<1|2>:LIMit<1...8>:ACPower:ACHannel:RESult?
CALCulate<1|2>:LIMit<1...8>:ACPower:ALTernate<1|2>:RESult?

EDIT ACP LIMITS	CALCulate<1|2>:LIMit<1...8>:ACPower[:STATe] ON | OFF CALCulate<1|2>:LIMit<1...8>:ACPower:ACHannel[:RELative]:STATe ON | OFF CALCulate<1|2>:LIMit<1...8>:ACPower:ACHannel[:RELative] <num_val>,<num_val> CALCulate<1|2>:LIMit<1...8>:ACPower:ACHannel:ABSolute:STATe ON | OFF CALCulate<1|2>:LIMit<1...8>:ACPower:ACHannel:ABSolute <num_value>,<num_value> CALCulate<1|2>:LIMit<1...8>:ACPower:ALTernate[:RELative]:STATe ON | OFF CALCulate<1|2>:LIMit<1...8>:ACPower:ALTernate[:RELative] <num_value>,<num_value> CALCulate<1|2>:LIMit<1...8>:ACPower:ALTernate:ABSolute:STATe ON | OFF CALCulate<1|2>:LIMit<1...8>:ACPower:ALTernate:ABSolute <num_value>,<num_value>
SET CP REFERENCE	[SENSe:]POWer:ACHannel:REFerence:AUTO ONCE
CHAN PWR /HZ	CALCulate<1|2>:MARKer<1...4>:FUNCtion:POWer:RESult:PHZ ON | OFF
SWEEP TIME	[SENSe:]SWEep:TIME <num_value>
ADJUST REF LVL	[SENSe:]POWer:ACHannel:PRESet:RLEVel
ADJUST SETTINGS	[SENSe:]POWer:ACHannel:PRESet ACPower|CPOWer|OBANdwidth|OBWidth
OCCUPIED PWR BANDW	
OCCUP BW ON OFF	CALCulate<1|2>:MARKer<1...4>:FUNCtion:POWer:SELect OBANdwidth | OBWidth CALCulate<1|2>:MARKer<1...4>:FUNCtion:POWer:RESult? OBANdwidth| OBWidth CALCulate<1|2>:MARKer<1...4>:FUNCtion:POWer[:STATe] OFF
% POWER BANDWIDTH	[SENSe:]POWer:BANDwidth|BWIDth <num_value>
CHANNEL BANDWIDTH	[SENSe:]POWer:ACHannel:BANDwidth|BWIDth <num_value>
NOISE CORR ON OFF	[SENSe:]POWer:NCORrection ON | OFF
ADJUST REF LVL	[SENSe:]POWer:ACHannel:PRESet:RLEVel
ADJUST SETTINGS	[SENSe:]POWer:PRESet ACPower|CPOWer|OBANdwidth|OBWidth

Softkey	IEC/IEEE-bus command
SIGNAL STATISTIC	
APD ON OFF	CALCulate:STATistics:APD[:STATe] ON | OFF CALCulate:STATistics:RESult<1...3>? MEAN | PEAK | CFACtor | ALL
CCDF ON OFF	CALCulate:STATistics:CCDF[:STATe] ON | OFF CALCulate:STATistics:RESult<1...3>? MEAN | PEAK | CFACtor | ALL
PERCENT MARKER	CALC:MARK:Y:PERC 0...100%
RES BW	[SENSe:]BANDwidth[:RESolution]:AUTO OFF [SENSe:]BANDwidth[:RESolution] <num_value>
NO OF SAMPLES	CALCulate:STATistics:NSAMples <num_value>
SCALING	--
X-AXIS REF LEVEL	CALCulate:STATistics:X:RLEVel <num_value>
X-AXIS RANGE	CALCulate:STATistics:X:RANGe <num_value>
Y-AXIS MAX VALUE	CALCulate:STATistics:Y:UPPER <num_value>
Y-AXIS MIN VALUE	CALCulate:STATistics:Y:LOWer <num_value>
ADJUST SETTINGS	CALCulate:STATistics:SCALe:AUTO ONCE
DEFAULT SETTINGS	CALCulate:STATistics:PRESet
ADJUST SETTINGS	CALCulate:STATistics:SCALe:AUTO ONCE
SINGLE MEAS	INITiate:CONTinuous OFF; INITiate:IMMediate
CONT MEAS	INITiate:CONTinuous ON; INITiate:IMMediate
MODULATION DEPTH	CALCulate<1|2>:MARKer<1...4>:FUNCtion:MDEPth[:STATe] ON | OFF CALCulate<1|2>:MARKer<1...4>:FUNCtion:MDEPth:RESult?
TOI	CALCulate<1|2>:MARKer<1...4>:FUNCtion:TOI[:STATe] ON | OFF CALCulate<1|2>:MARKer<1...4>:FUNCtion:TOI:RESult?
SELECT MARKER	no corresponding IEC/IEEE-bus command

TRIG Key

Key	Command
TRIG	
FREE RUN	TRIGger[:SEQuence]:SOURce IMMediate
VIDEO	TRIGger[:SEQuence]:SOURce VIDeo TRIGger[:SEQuence]:LEVel:VIDeo <numeric value>
EXTERN	TRIGger[:SEQuence]:SOURce EXTernal [SENSe:]SWEep:EGATe:SOURce EXTernal
IF POWER	TRIGger[:SEQuence]:SOURce IFPower [SENSe:]SWEep:EGATe:SOURce IFPower
TRIGGER OFFSET	TRIGger[:SEQuence]:HOLDoff <num_value>
POLARITY POS/NEG	TRIGger[:SEQuence]:SLOPe POSitive | NEGative oder [SENSe:]SWEep:EGATe:POLarity POSitive | NEGative
GATED TRIGGER	[SENSe:]SWEep:EGATe ON | OFF [SENSe:]SWEep:EGATe:SOURce IFPower | EXTernal
GATE SETTINGS	--
GATE MODE LEVEL/EDGE	[SENSe:]SWEep:EGATe:TYPE LEVel | EDGE
POLARITY POS/NEG	[SENSe:]SWEep:EGATe:POLarity POSitive | NEGative
GATE DELAY	[SENSe:]SWEep:EGATe:HOLDoff <num_value>
GATE LENGTH	[SENSe:]SWEep:EGATe:LENGth <num_value>
SWEEP TIME	--

TRACE Key

TRACE	
SELECT TRACE	--
CLEAR/ WRITE	DISPlay[:WINDow<1|2>]:TRACe<1...3>:MODE WRITe
MAX HOLD	DISPlay[:WINDow<1|2>]:TRACe<1...3>:MODE MAXHold
AVERAGE	DISPlay[:WINDow<1|2>]:TRACe<1...3>:MODE AVERage oder: [SENSe:]AVERage[:STATe<1...3>] ON
VIEW	DISPlay[:WINDow<1|2>]:TRACe<1...3>:MODE VIEW
BLANK	DISPlay[:WINDow<1|2>]:TRACe<1...3>[:STATe] OFF
SWEEP COUNT	[SENSe:]SWEep:COUNt <num_value> oder: [SENSe:]AVERage:COUNt <num_value>
DETECTOR	--
AUTO SELECT	[SENSe:]DETector[:FUNCtion]:AUTO ON | OFF
DETECTOR AUTOPEAK	[SENSe:]DETector[:FUNCtion] APEak
DETECTOR MAX PEAK	[SENSe:]DETector[:FUNCtion] POSitive
DETECTOR MIN PEAK	[SENSe:]DETector[:FUNCtion] NEGative
DETECTOR SAMPLE	[SENSe:]DETector[:FUNCtion] SAMPle
DETECTOR RMS	[SENSe:]DETector[:FUNCtion] RMS
DETECTOR AVERAGE	[SENSe:]DETector[:FUNCtion] AVERage
DETECTOR QPK	[SENSe:]DETector[:FUNCtion] QPEak
TRACE MATH	--
T1-T2->T1	CALCulate<1|2>:MATH:STATe ON CALCulate<1|2>:MATH[:EXPRession][:DEFine] (TRACE1 - TRACE2)
T1-T3->T1	CALCulate<1|2>:MATH:STATe ON CALCulate<1|2>:MATH[:EXPRession][:DEFine] (TRACE1 - TRACE3)
TRACE POSITION	CALCulate<1|2>:MATH:POSition <num_value>

TRACE MATH OFF

```
CALCulate<1|2>:MATH:STATe OFF
```

MIN HOLD

```
DISPlay[:WINDow<1|2>]:TRACe<1...3>:MODE MINHold
```

AVG MODE LOG LIN

```
CALCulate<1|2>:MATH:MODE  LINear | LOGarithmic
or:
[SENSe:]AVERage:TYPE VIDeo | LINear
```

ASCII FILE EXPORT

```
FORMat[:DATA] ASCii
MMEMory:STORe<1|2>:TRACe 1,'TRACE.DAT'
```

DECIM SEP . ,

```
FORMat:DEXPort:DSEParator POINt | COMMa
```

COPY TRACE

```
TRACe:COPY     TRACE1|TRACE2|TRACE3,TRACE1|TRACE2|TRACE3
```

LINES Key

LINES

SELECT LIMIT LINE

selection:
```
CALCulate<1|2>:LIMit<1...8>:NAME <string>;
CALCulate<1|2>:LIMit<1...8>:UPPer:STATe ON | OFF
CALCulate<1|2>:LIMit<1...8>:LOWer:STATe ON | OFF
```
limit check:
```
CALCulate<1|2>:LIMit<1...8>:STATe ON | OFF
INITiate[:IMMediate]; WAI*
CALCulate<1|2>:LIMit<1...8>:FAIL?
```
trace assignment:
```
CALCulate<1|2>:LIMit<1...8>:TRACe 1|2|3
```

NEW LIMIT LINE

NAME

name:
```
CALCulate<1|2>:LIMit<1...8>:NAME <string>;
```
domain:
```
CALCulate<1|2>:LIMit<1...8>:CONTrol:DOMain FREQuency|TIME
```
scaling:
```
CALCulate<1|2>:LIMit<1...8>:CONTrol:MODE RELative | ABSolute
CALCulate<1|2>:LIMit<1...8>:UPPer:MODE RELative | ABSolute
CALCulate<1|2>:LIMit<1...8>:LOWer:MODE RELative | ABSolute
```
unit:
```
CALCulate<1|2>:LIMit<1...8>:UNIT DBM| DBPW| WATT| DBUV| VOLT|DBUA|AMPere| DB| DBUV_MHZ| DBUA_MHZ| DEG| RAD| S| HZ| PCT
```
margin:
```
CALCulate<1|2>:LIMit<1...8>:UPPer:MARGin <num_value>
CALCulate<1|2>:LIMit<1...8>:LOWer:MARGin <num_value>
```
threshold for relative y-scaling::
```
CALCulate<1|2>:LIMit<1...8>:UPPer:THReshold <num_value>
CALCulate<1|2>:LIMit<1...8>:LOWer:THReshold <num_value>
```
comment:
```
CALCulate<1|2>:LIMit<1...8>:COMMent <string>
```

VALUES

```
CALCulate<1|2>:LIMit<1...8>:CONTrol[:DATA] <num_value>, <num_value>..
CALCulate<1|2>:LIMit<1...8>:UPPer[:DATA] <num_value>, <num_value>..
CALCulate<1|2>:LIMit<1...8>:LOWer[:DATA] <num_value>,<num_value>..
```

INSERT VALUE

no corresponding IEC/IEEE-bus command

DELETE VALUE

no corresponding IEC/IEEE-bus command

SHIFT X LIMIT LINE

```
CALCulate<1|2>:LIMit<1...8>:CONTrol:SHIFt <num_value>
```

SHIFT Y LIMIT LINE

```
CALCulate<1|2>:LIMit<1...8>:UPPer:SHIFt <num_value>
CALCulate<1|2>:LIMit<1...8>:LOWer:SHIFt <num_value>
```

SAVE LIMIT LINE	automatically executed during IEC/IEEE-bus operation
EDIT LIMIT LINE	s. EDIT LIMIT LINE
COPY LIMIT LINE	`CALCulate<1|2>:LIMit<1...8>:COPY 1...8	<name>`
DELETE LIMIT LINE	`CALCulate<1|2>:LIMit<1...8>:DELete`
X OFFSET	`CALCulate<1|2>:LIMit<1...8>:CONTrol:OFFset <num_value>`
Y OFFSET	`CALCulate<1|2>:LIMit<1...8>:UPPer:OFFset <num_value>` `CALCulate<1|2>:LIMit<1...8>:LOWer:OFFset <num_value>`

DISP Key

DISP

FULL SCREEN	DISPlay:FORmat SINGle DISPlay[:WINDow<1|2>]:SELect
SPLIT SCREEN	DISPlay:FORmat SPLit
REF LEVEL COUPLED	INSTrument:COUPle RLEVel | NONE
CENTER B = MARKER A	INSTrument:COUPle CF_B | NONE
CENTER A = MARKER B	INSTrument:COUPle CF_A | NONE
CONFIG DISPLAY	--
SCREEN TITLE	DISPlay[:WINDow<1|2>]:TEXT[:DATA] <string> DISPlay[:WINDow<1|2>]:TEXT:STATe ON | OFF
TIME/DATE ON OFF	DISPlay[:WINDow<1|2>]:TIME ON | OFF
LOGO ON/OFF	DISPlay:LOGO ON|OFF
ANNOTATION ON/OFF	DISPlay:ANNotation:FREQuency ON|OFF
DATAENTRY OPAQUE	ohne Funktion im IEC-Bus-Betrieb
DEFAULT COLORS 1	DISPlay:CMAP<1...13>:DEFault1
DEFAULT COLORS 2	DISPlay:CMAP<1...13>:DEFault2
DISPLAY PWR SAVE	DISPlay:PSAVe[:STATe] ON | OFF DISPlay:PSAVe:HOLDoff <num_value>
SELECT OBJECT	--
BRIGHTNESS	DISPlay:CMAP:HSL <hue>,<sat>,<lum>
TINT	DISPlay:CMAP<1...13>:HSL <hue>,<sat>,<lum>
SATURATION	DISPlay:CMAP<1...13>:HSL <hue>,<sat>,<lum>
PREDEFINED COLORS	DISPlay:CMAP<1...13>:PDEFined BLACk| BLUE| BROWn| GREen| CYAN| RED| MAGenta| YELLow| WHITe| DGRAy| LGRAy| LBLUe| LGREen| LCYan| LRED| MAGenta

FILE Key

FILE	
SAVE	MMEMory:STORe:STATe 1,<file_name>
RECALL	MMEMory:LOAD:STATe 1,<file_name>
EDIT COMMENT	MMEMory:COMMent <string>
ITEMS TO SAVE/RCL	
SELECT ITEMS	MMEMory:SELect[:ITEM]:HWSettings ON|OFF MMEMory:SELect[:ITEM]:TRACe[:ACTive] ON|OFF MMEMory:SELect[:ITEM]:LINes:ALL ON|OFF MMEMory:SELect[:ITEM]:NONE
DEFAULT CONFIG	MMEMory:SELect[:ITEM]:DEFault
DISABLE ALL ITEMS	MMEMory:SELect[:ITEM]:NONE
ENABLE ALL ITEMS	MMEMory:SELect[:ITEM]:ALL
DATA SET LIST	--
DATA SET CLEAR	MMEMory:CLEar:STATe 1,<file_name>
DATA SET CLEAR ALL	MMEMory:CLEar:ALL
STARTUP RECALL	MMEMory:LOAD:AUTO 1,<file_name>
FILE MANAGER	
EDIT PATH	MMEMory:MSIS <device> MMEMory:CDIRectory <directory_name>
MAKE DIRECTORY	MMEMory:MDIRectory <directory_name>
FORMAT DISK	MMEMory:INITialize <msus>
RENAME	MMEMory:MOVE <file_source>,<file_destination>
SORT MODE	no corresponding IEC/IEEE-bus command
COPY	MMEMory:COPY <file_source>,<file_destination>
DELETE	MMEMory:DELete <file_name> MMEMory:RDIRectory <directory_name>

CAL Key

CAL

CAL TOTAL	CALibration[:ALL]?
CAL ABORT	CALibration:ABORt
CAL CORR ON OFF	CALibration:STATe ON | OFF
CAL RESULTS	CALibration:RESults?

SETUP Key

REFERENCE INT/EXT	[SENSe:]ROSCillator:SOURce INTernal|EXTernal
NOISE SCR ON OFF	DIAGnostic:SERVice:NSOurce ON | OFF <num_value>
PREAMP	INPut:GAIN <num_value> (nur mit Option Electronic Attenuator FSU-B25)
GENERAL SETUP	--
GPIB ADDRESS	SYSTem:COMMunicate:GPIB[:SELF]:ADDRess 0...30
COM INTERFACE	SYSTem:COMMunicate:SERial[:RECeive:]BAUD <num_value> SYSTem:COMMunicate:SERial[:RECeive]:BITS 7 | 8 SYSTem:COMMunicate:SERial:RECeive:PARity[:TYPE] EVEN | ODD | NONE SYSTem:COMMunicate:SERial[:RECeive]:SBITs 1|2 SYSTem:COMMunicate:SERial:CONTrol:DTR IBFull | OFF SYSTem:COMMunicate:SERial:CONTrol:RTS IBFull | OFF SYSTem:COMMunicate:SERial[:RECeive]:PACE XON | NONE
TIME+DATE	SYSTem:TIME 0...23, 0...59, 0...59 SYSTem:DATE <num>,<num>,<num>
CONFIGURE NETWORK	with option LAN-Interface FSU-B16 only --
NETWORK LOGIN	with option LAN-Interface FSU-B16 only --
SOFT FRONTPANEL	--
SYSTEM INFO	--
HARDWARE INFO	--
STATISTICS	--
SYSTEM MESSAGES	SYSTem:ERRor?
CLEAR ALL MESSAGES	SYSTem:ERRor?
SAVE CHANGES	--
SERVICE	--
INPUT RF	DIAGnostic:SERVice:INPut[:SELect] RF
INPUT CAL	DIAGnostic:SERVice:INPut[:SELect] CALibration DIAGnostic:SERVice:CSOurce[:POWer] <num_value>
SELFTEST	*TST?
SELFTEST RESULTS	DIAGnostic:SERVice:STEst:RESult?
REFERENCE FREQUENCY	[SENSE<1|2>:]ROSCillator[:INTernal]:TUNe 0...4095

CAL SIGNAL POWER	--
SAVE CHANGES	`[SENSE<1|2>:]ROSCillator[:INTernal]:TUNe:SAVe`
ENTER PASSWORD	`SYSTem:PASSword[:CENable] <string>`
SERVICE FUNCTION	`DIAGnostic:SERVice:SFUNction <string>`
FIRMWARE UPDATE	--
RESTORE FIRMWARE	--

HCOPY Key

HCOPY

PRINT SCREEN	`HCOPy:ITEM:ALL`
	`HCOPy:IMMediate`
	for printout into file add `MMEMory:NAME <file_name>`

PRINT TRACE	`HCOPy:ITEM:WINDow<1	2>:TRACe:STATe ON	OFF` `HCOPy:IMMediate` for printout into file add `MMEMory:NAME <file_name>`
PRINT TABLE	`HCOPy:ITEM:WINDow<1	2>:TABle:STATe ON	OFF` `HCOPy:IMMediate` for printout into file add `MMEMory:NAME <file_name>`
HARDCOPY ABORT	`HCOPy:ABORt`
DEVICE1	`SYSTem:COMMunicate:PRINter:ENUMerate:FIRSt?` `SYSTem:COMMunicate:PRINter:ENUMerate:NEXT?` `SYSTem:COMMunicate:PRINter:SELect <string>` `HCOPy:DESTination <string>` `HCOPy:DEVice:LANGuage GDI	WMF	EWMF	BMP` `HCOPy:PAGE:ORIentation<1|2> LANDscape	PORTrait`
DEVICE2	`SYSTem:COMMunicate:PRINter:ENUMerate:FIRSt?` `SYSTem:COMMunicate:PRINter:ENUMerate:NEXT?` `SYSTem:COMMunicate:PRINter:SELect "string>` `HCOPy:DESTination2 <string>` `HCOPy:DEVice:LANGuage GDI	WMF	EWMF	BMP` `HCOPy:PAGE:ORIentation<1|2> LANDscape	PORTrait`
COLOR ON/OFF	`HCOPy:DEVice:COLor ON	OFF`
COMMENT SCREEN A/B	`HCOPy:ITEM:WINDow<1|2>:TEXT <string>`
INSTALL PRINTER	

Hotkeys

SPECTRUM	INSTrument[:SELect] SANalyzer INSTrument:NSELect 1
NETWORK	with option external generator control FSP-B10 only. --
SCREEN A/B	FULL SCREEN: Selection of the active window: DISPlay[:WINDow<1|2>]:SELect The window valid for the setting is selected by the numeric suffix in the command, eg SENSe<1|2> SPLIT SCREEN: The two measurement windows are active. The window valid for the setting is selected by the numeric suffix in the command, eg SENSe<1|2>

Hotkey NETWORK

NETWORK	with option external generator control FSP-B10 only --
POWER OFFSET	
SOURCE CAL	with option external generator control FSP-B10 only
CAL TRANS	`[SENSe:]CORRection:METHod TRANsmission` `[SENSe:]CORRection:COLLect[:ACQuire] THRough`
CAL REFL SHORT	`[SENSe:]CORRection:METHod REFLexion` `[SENSe:]CORRection:COLLect[:ACQuire] THRough`
CAL REFL OPEN	`[SENSe:]CORRection:METHod REFLexion` `[SENSe:]CORRection:COLLect[:ACQuire] OPEN`
NORMALIZE	`[SENSe:]CORRection[:STATe] ON | OFF`
REF VALUE POSITION	`DISP:WIND:TRAC:Y:RPOS <num_value>`
REF VALUE	`DISP:WIND:TRAC:Y:RVAL <num_value>`
RECALL	`[SENSe:]CORRection:RECall`
EXT SOURCE	with option external generator control FSP-B10 only
EXT SRC ON / OFF	`SOURce:EXTernal[:STATe] ON | OFF`

SELECT GENERATOR
FREQUENCY SWEEP
	`SYSTem:COMMunicate:RDEVice:GENerator:TYPE 'SME02'`
	`SYSTem:COMMunicate:RDEVice:GENerator:LINK TTL`
	`SYSTem:COMMunicate:GPIB:RDEVice:GENerator:ADDRess 28`
	`SOURce:EXTernal:POWer -30dBm`
	`SOURce:EXTernal:FREQuency:NUMerator 4`
	`SOURce:EXTernal:FREQuency:DENominator 3`
	`SOURce:EXTernal:FREQuency:OFFSet 100MHZ`

Contents - Chapter 7 "Remote Control - Programming Examples"

7 Remote Control - Programming Examples

The following programming examples have a hierarchical structure, ie subsequent examples are based on previous ones. It is thus possible to compile very easily an operational program from the modules of the given examples.

Basic Steps of IEC/IEEE-Bus Programming

The examples explain the programming of the instrument and can serve as a basis to solve more complex programming tasks.

VISUAL BASIC has been used as programming language. However, the programs can be translated into other languages.

Including IEC-Bus Library for VisualBasic

Programming hints:

- **Output of texts using the "Print" function**

  The following programming examples are based on the assumption that all subroutines are part of a form (file extension: .FRM). In this case the syntax
  ```
  Print "Text"
  ```
  is allowed.

  If however the subroutines are stored as a so-called module (file extension: .BAS), the print instruction should be preceded by the name of a form which has the required print method. If, for example, there is a form with the name "Main", the associated print instruction is as follows:
  ```
  Main.Print "Text".
  ```

- **Access to funtions of GPIB.DLL**

  To create Visual Basic control applications the file GPIB.BAS (as from VB 6.0 VBIB-32.BAS) is added to a project so that the functions of the RSIB.DLL can be called. In addition, the file NIGLOBAL.BAS is added to the project. This file contains constants and definitions for the processing of errors, timeout values, etc.

- **Declaration of DLL functions as procedures**

  Since the functions all return an integer value, the functions in the file GPIB.BAS are all declared as follows:
  ```
  Declare Function xxx Lib "gpib.dll" ( ... ) As Integer
  ```
  The function value with the status variables `ibsta` should be allocated a variable when it is called up. Since this value is also returned via a reference parameter of the functions, the functions can be declared as procedures as follows:
  ```
  Declare Sub xxx Lib "rsib.dll" ( ... )
  ```

- **Generating a response buffer**

  Since the DLL returns zero-terminated strings in case of responses, a string of sufficient length should be generated prior to calling the functions `ibrd()` and `ilrd()`, since Visual Basic prefixes a length value to the strings which is not updated by the DLL.
  The following two possibilities are available to generate a length value for a string:

  - `Dim Rd as String * 100`
  - `Dim Rd as String`
    `Rd = Space$(100)`

Initialization and Default Status

Variables used by all subroutines should be stored at the beginning of every program.
Then the IEC/IEEE bus as well as the settings of the instrument are brought into a defined default status at the beginning of every program. Subroutines `"InitController"` and `"InitDevice"` are used to this effect.

Creating global variables

Global variables are placed in so-called "modules" (file extension: .BAS) in Visual Basic. Therefore, at least one module (z.B. "GLOBALS.BAS) should be created which contains the variables used by all subroutines, such as the device addresses used by the IEC/IEEE-bus driver.
The file should contain the following instructions for the programming examples below:

```
Global analyzer As Integer
Global boardId As Integer
```

Initiate Controller

```
REM ------------ Initiate controller ---------------------------------------
Public SUB InitController()

iecaddress% = 20                            'IEC/IEEE-bus address of the
                                            'instrument
CALL IBFIND("GPIB0", boardId%)              'Open port to the controller
CALL IBFIND("DEV1", analyzer%)              'Open port to the instrument
CALL IBPAD(analyzer%, iecaddress%)          'Inform controller on instrument
                                            'address
CALL IBTMO(analyzer%, 11)                   'Response time to 1 sec
END SUB
REM ***********************************************************************
```

Initiate Instrument

The IEC-bus status registers and instrument settings of the instrument are brought into the default status.

```
REM ------------ Initiate instrument ---------------------------------------
Public SUB InitDevice()

CALL IBWRT(analyzer%, "*CLS")           'Reset status registers
CALL IBWRT(analyzer%, "*RST")           'Reset instrument
END SUB
REM*************************************************************************
```

Configuring Power Save Function of Display

The results on the screen are often not required during IEC/IEEE-bus operation. Although the command "SYSTem:DISPlay:UPDate OFF" switches off the display of results which brings considerable advantages in terms of speed in the remote control mode, the display itself and in particular the backlighting remain switched on.

If required, the display should be switched off by means of the power-save function, the response time having to be set in minutes prior to activation.

Note: *The display is switched on as soon as a key is pressed on the instrument front panel.*

```
REM --------- Configure power save function ---------------------------------
Public SUB PowerSave()

CALL IBWRT(analyzer%, "SYSTem:PSAVe:HOLDoff 1") 'Set holdoff to 1 minute
CALL IBWRT(analyzer%, "SYSTem:PSAVe ON")        'Power save function on
END SUB
REM*************************************************************************
```

Transmission of Simple Instrument Setting Commands

Center frequency, span, and reference level of the instrument are set in this example.

```
REM -------- Instrument setting commands ----------------------------------
PUBLIC SUB SimpleSettings()

CALL IBWRT(analyzer%, "FREQUENCY:CENTER 128MHz")  'Center frequency 128 MHz
CALL IBWRT(analyzer%, "FREQUENCY:SPAN 10MHZ")     'Span 10 MHz
CALL IBWRT(analyzer%, "DISPLAY:TRACE:Y:RLEVEL -10dBm")
                                                  'Reference level -10dBm
END SUB
REM **********************************************************************
```

Return to manual control

```
REM -------- Switch instrument over to manual control --------------------
CALL IBLOC(analyzer%)                'Set instrument to Local state
REM **********************************************************************
```

Reading out Instrument Settings

The settings made in the above example are read out here. The abbreviated commands are used.

```
REM --------- Reading out instrument settings ----------------------------
PUBLIC SUB ReadSettings()

CFfrequency$ = SPACE$(20)            'Provide text variables (20 characters)
CALL IBWRT(analyzer%, "FREQ:CENT?")  'Request center frequency
CALL IBRD(analyzer%, CFfrequency$)   'Read value

CFspan$ = SPACE$(20)                 'Provide text variables (20 characters)
CALL IBWRT(analyzer%, "FREQ:SPAN?")  'Query span
CALL IBRD(analyzer%, CFspan$)        'Read value

RLevel$ = SPACE$(20)                 'Provide text variables (20 characters)
CALL IBWRT(analyzer%, "DISP:TRAC:Y:RLEV?")
                                     'Query reference level
CALL IBRD(analyzer%, RLevel$)        'Read value
```

```
REM ---------------- Display values on the screen -------------------------
PRINT "Center frequency: "; CFfrequency$,
PRINT "Span:              "; CFspan$,
PRINT "Reference level:  "; RLevel$,
REM************************************************************************
```

Positioning a Marker and Displaying Values

```
REM -------------- Examples of marker functions ---------------------------
PUBLIC SUB ReadMarker()

CALL IBWRT(analyzer%, "CALC:MARKER ON;MARKER:MAX")
            'Activate marker1 and start peak search
MKmark$ = SPACE$(30)             'Provide text variables (30 characters)
CALL IBWRT(analyzer%, "CALC:MARK:X?;Y?")    'Query frequency and level
CALL IBRD(analyzer%, MKmark$)               'Read value

REM --------------- Display values on the screen -------------------------
PRINT "Center frequency / level "; MKmark$,
REM ********************************************************************
```

Command synchronization

The possibilities for synchronization implemented in the following example are described in Chapter 5, Section "Command Order and Command Synchronization".

```
REM -------- Examples of command synchronization --------------------------
PUBLIC SUB SweepSync()


REM The command INITiate[:IMMediate] starts a single sweep if the command
REM INIT:CONT OFF was previously sent. It should be ensured that the next
REM command is only then executed when the entire sweep is complete.
CALL IBWRT(analyzer%, "INIT:CONT OFF")

REM -------- First possibility: Use of *WAI ------------------------------
CALL IBWRT(analyzer%, "ABOR;INIT:IMM; *WAI")


REM -------- Second possibility: Use of *OPC? ----------------------------
OpcOk$ = SPACE$(2)                     'Space for *OPC? - Provide response
CALL IBWRT(analyzer%, "ABOR;INIT:IMM; *OPC?")
REM -------- here the controller can service other instrument-------------
CALL IBRD(analyzer%, OpcOk$)                    'Wait for "1" from *OPC?


REM -------- Third possibility: Use of *OPC -----------------------------
REM In order to be able touse the service request function in conjugation
REM with a National Instruments GPIB driver, the setting "Disable
REM Auto Serial Poll" must be changed to "yes" by means of IBCONF!
CALL IBWRT(analyzer%, "*SRE 32")        'Permit service request for ESR
CALL IBWRT(analyzer%, "*ESE 1")         'Set event-enable bit for
                                        'operation-complete bit
CALL IBWRT(analyzer%, "ABOR;INIT:IMM; *OPC") 'Start sweep and
                                             'synchronize with OPC
CALL WaitSRQ(boardID%,result%)          'Wait for service request
REM Continue main program here.
END SUB
REM **************************************************************************
```

Service Request

The service request routine requires an extended initialization of the instrument in which the respective bits of the transition and enable registers are set.
In order to use the service request function in conjugation with National Instruments GPIB driver, the setting "Disable Auto Serial Poll" must be changed to "yes" by means of IBCONF.

Initiate Service Request

```
REM ---- Example of initialization of the SRQ in the case of errors --------
PUBLIC SUB SetupSRQ()

CALL IBWRT(analyzer%, "*CLS")                       'Reset status reporting system
CALL IBWRT(analyzer%,"*SRE 168")                    'Permit service request for
                                                    'STAT:OPER,STAT:QUES and ESR
                                                    'register
CALL IBWRT(analyzer%,"*ESE 60")                     'Set event-enable bit for
                                                    'command, execution, device-
                                                    'dependent and query error
CALL IBWRT(analyzer%,"STAT:OPER:ENAB 32767")        'Set OPERation enable bit for
                                                    'all events
CALL IBWRT(analyzer%,"STAT:OPER:PTR 32767")         'Set appropriate OPERation
                                                    'Ptransition bits
CALL IBWRT(analyzer%,"STAT:QUES:ENAB 32767")        'Set questionable enable bits
                                                    'for all events
CALL IBWRT(analyzer%,"STAT:QUES:PTR 32767")         'Set appropriate questionable
                                                    'Ptransition bits
CALL WaitSRQ(boardID%,result%)                      'Wait for Service Request
IF (result% = 1) THEN CALL Srq                      'If SRQ is recognized =>
                                                    'subroutine for evaluation
END SUB
REM ************************************************************************
```

Service request routine

A service request is then processed in the service request routine.
Note: the variables userN% and userM% must be pre-assigned usefully!

```
REM ------------ Service request routine -----------------------------------
Public SUB Srq()

ON ERROR GOTO noDevice                          'No user existing
CALL IBRSP(analyzer%, STB%)                     'Serial poll, read status byte
IF STB% > 0 THEN                                'This instrument has bits set
                                                'in the STB
     SRQFOUND% = 1
     IF (STB% AND 16)  > 0 THEN CALL Outputqueue
     IF (STB% AND 4)   > 0 THEN CALL ErrorQueueHandler
     IF (STB% AND 8)   > 0 THEN CALL Questionablestatus
     IF (STB% AND 128) > 0 THEN CALL Operationstatus
     IF (STB% AND 32)  > 0 THEN CALL Esrread
  END IF
noDevice:
END SUB                                             'End of SRQ routine
REM *************************************************************************
```

Reading out the status event registers, the output buffer and the error/event queue is effected in subroutines.

Read Out of Output Buffer

```
REM -------- Subroutine for the individual STB bits -------------------------
Public SUB Outputqueue()                        'Reading the output buffer

result$ = SPACE$(100)                           'Make space for response
CALL IBRD(analyzer%, result$)
PRINT "Contents of Output Queue : "; result$
END SUB
REM *************************************************************************
```

Read Out of Error Messages

```
REM -------- Subroutine for reading the error queue ----------------------
Public SUB ErrorQueueHandler()
ERROR$ = SPACE$(100)                    'Make space for error variable
CALL IBWRT(analyzer%, "SYSTEM:ERROR?")
CALL IBRD(analyzer%, ERROR$)
PRINT "Error Description : "; ERROR$
END SUB
REM ***********************************************************************
```

Evaluation of SCPI Status Registers

```
REM ------ Subroutine for evaluating Questionable Status-Register ---------
Public SUB Questionablestatus()
Ques$ = SPACE$(20)                    'Preallocate blanks to text variable
CALL IBWRT(analyzer%, "STATus:QUEStionable:EVENt?")
CALL IBRD(analyzer%, Ques$)
PRINT "Questionable Status: "; Ques$
END SUB
REM ***********************************************************************

REM ------ subroutine for evaluating Operation Status-Register ------------
Public SUB Operationstatus()
Oper$ = SPACE$(20)                    'Preallocate blanks to text variable
CALL IBWRT(analyzer%, "STATus:OPERation:EVENt?")
CALL IBRD(analyzer%, Oper$)
PRINT "Operation Status: "; Oper$
END SUB
REM ***********************************************************************
```

Evaluation of Event Status Register

```
REM ------ Subroutine for evaluating the Event Status Register -----------
Public SUB Esrread()
Esr$ = SPACE$(20)              'Preallocate blanks to text variable
CALL IBWRT(analyzer%, "*ESR?")                              'Read ESR
CALL IBRD(analyzer%, Esr$)
IF (VAL(Esr$) AND 1) > 0 THEN PRINT "Operation complete"
IF (VAL(Esr$) AND 2) > 0 THEN PRINT "Request Control"
IF (VAL(Esr$) AND 4) > 0 THEN PRINT "Query Error"
IF (VAL(Esr$) AND 8) > 0 THEN PRINT "Device dependent error"
IF (VAL(Esr$) AND 16) > 0 THEN
    PRINT "Execution Error; Program aborted"'  Output error message
    STOP                                       'Stop software
    END IF
IF (VAL(Esr$) AND 32) > 0 THEN
    PRINT "Command Error; Program aborted"'    Output error message
    STOP                                       'Stop software
    END IF
IF (VAL(Esr$) AND 64) > 0 THEN PRINT "User request"
IF (VAL(Esr$) AND 128) > 0 THEN PRINT "Power on"
END SUB
REM ************************************************************************
```

More Complex Programming Examples

Basic settings of the Analyzer

The following settings are an example of how to modify the default setting of FSU.
It should be noted that only some settings are necessary depending on the example of application. In particular, the settings for resolution bandwidth, video bandwidth and sweep time are often not needed since these parameters are automatically calculated in the default setting on modifying the frequency range (span). The insertion loss is also automatically calculated depending on the reference level. The level detectors are coupled to the selected trace mode in the default setting.
The settings which are automatically calculated in the default setting are marked by (*) in the following programming example.

Setting the IEC/IEEE Bus Status Register

```
REM ***********************************************************************
Public Sub SetupStatusReg()

'--------- IEEE 488.2 status register ---------------------------------------
CALL IBWRT(analyzer%,"*CLS")                'Reset Status Registers
CALL IBWRT(analyzer%,"*SRE 168")            'Enable service request
                                            'for STAT:OPER-,STAT:QUES- and
                                            'ESR registers
CALL IBWRT(analyzer%,"*ESE 61")             'Set Event-Enable bit for:
                                            'Operation Complete
                                            'Command-, Execution-,Device
                                            'Dependent- and Query Error
'--------- SCPI status register ---------------------------------------------
CALL IBWRT(analyzer%,"STAT:OPER:ENAB 0")    'Disable OPERation Status Reg
CALL IBWRT(analyzer%,"STAT:QUES:ENAB 0")    'Disable Questionable Status
                                            'Register
End Sub
REM ***********************************************************************
```

Default Setting for Measurements

```
REM ************************************************************************
Public Sub SetupInstrument()

'-------------------- Basic settings ---------------------------------------
CALL SetupStatusReg                                'Set status registers
CALL IBWRT(analyzer%,"*RST")                       'Reset instrument
CALL IBWRT(analyzer%,"SYST:DISP:UPD ON")           'ON: display indication on
                                                   'OFF: off(improved
                                                   '        performance)
CALL IBWRT(analyzer%,"DISP:FORM SINGle")           'Full screen
CALL IBWRT(analyzer%,"DISP:WIND1:SEL")             'Active screen A
CALL IBWRT(analyzer%,"INIT:CONT OFF")              'Single sweep
'--------- Set frequency -----------------------------------------------------
CALL IBWRT(analyzer%,"FREQUENCY:CENTER 100MHz")         'Center frequency
CALL IBWRT(analyzer%,"FREQ:SPAN 1 MHz")                 'Span
'--------- Set level ---------------------------------------------------------
CALL IBWRT(analyzer%,"DISP:WIND:TRAC:Y:RLEV -20dBm")    'Reference level
CALL IBWRT(analyzer%,"INP:ATT 10dB")                    'Input attenuation (*)
'--------- Scale y-axis ------------------------------------------------------
CALL IBWRT(analyzer%,"DISP:WIND:TRAC:Y:SPAC LOG")       'Log level axis
CALL IBWRT(analyzer%,"DISP:WIND:TRAC:Y:SCAL 100dB")     'Level range
CALL IBWRT(analyzer%,"DISP:WIND:TRAC:Y:SCAL:MODE ABS") 'Absolute scaling
CALL IBWRT(analyzer%,"CALC:UNIT:POW DBM")               'Unit of y-axis
'--------- Trace and detector settings ---------------------------------------
CALL IBWRT(analyzer%,"DISP:WIND:TRAC1:MODE AVER")       'Trace1 average
CALL IBWRT(analyzer%,"AVER:TYPE VID")                   'Average mode video;
                                                        '"LIN" for linear
CALL IBWRT(analyzer%,"SWE:COUN 10")                     'Sweep count
CALL IBWRT(analyzer%,"DISP:WIND:TRAC2:STAT OFF")        'Trace2 blank
CALL IBWRT(analyzer%,"DISP:WIND:TRAC3:STAT OFF")        'Trace3 blank
CALL IBWRT(analyzer%,"CALC:MATH:STAT OFF")              'Trace mathematics off
CALL IBWRT(analyzer%,"DETECTOR1 RMS")                   'Detector Trace1   (*)
CALL IBWRT(analyzer%,"DET2:AUTO ON")                    'Detector Trace2   (*)
CALL IBWRT(analyzer%,"DET3:AUTO ON")                    'Detector Trace3   (*)
'--------- Band width and sweep time -----------------------------------------
CALL IBWRT(analyzer%,"BAND:RES 100KHz")                 'Resolution BW (*)
CALL IBWRT(analyzer%,"BAND:VID 1MHz")                   'Video bandwidth   (*)
CALL IBWRT(analyzer%,"SWE:TIM 100ms")                   'Sweep time        (*)
END SUB
REM ************************************************************************
```

Using Marker and Delta Marker

Marker Search Functions, Limitation of Search Range

The example below is based on an AM-modulated signal at 100 MHz with the following characteristics:

- Carrier signal level: –30 dBm
- AF frequency: 100 kHz
- Modulation depth: 50 %

Marker 1 and delta marker 2 are set one after the other to the highest maxima of the measurement curve and then the frequency and level are read out. The default setting of the analyzer can be used for the following measurements (SetupInstrument).

```
REM ************************************************************************
Public Sub MarkerSearch()

result$ = Space$(100)
CALL SetupInstrument                          'Basic setting
'--------- Peak search without search limit --------------------------------
CALL IBWRT(analyzer%,"INIT:CONT OFF")         'Switch to single sweep
CALL IBWRT(analyzer%,"CALC:MARK:PEXC 6DB")    'Peak Excursion
CALL IBWRT(analyzer%,"CALC:MARK:STAT ON")     'Switch on Marker 1
CALL IBWRT(analyzer%,"CALC:MARK:TRAC 1")      'Assign marker1 to Trace 1
CALL IBWRT(analyzer%,"INIT;*WAI")             'Sweep with sync
CALL IBWRT(analyzer%,"CALC:MARK:MAX;X?;Y?")   'Marker to peak; read out
CALL IBRD(analyzer%, result$)                 'frequency and level
Print "Marker 1: ";result$
CALL IBWRT(analyzer%,"CALC:DELT2:STAT ON;MAX;MAX:LEFT")
                                              'Switch on delta marker 2
                                              'Peak and then Next Peak Left
CALL IBWRT(analyzer%,"CALC:DELT:MODE ABS")    'Delta marker 2 frequeny output
                                              'absolute
CALL IBWRT(analyzer%,"CALC:DELT2:X?;Y?")      'Delta marker 2 - Read out
                                              'frequency and level
CALL IBRD(analyzer%, result$)
Print "Delta 2: ";result$
```

```
'--------- Peak search with search limit in x-direction --------------------

CALL IBWRT(analyzer%,"CALC:DELT:MODE REL")   'Delta marker frequency output
                                             'relative

CALL IBWRT(analyzer%,"CALC:MARK:X:SLIM:STAT ON;LEFT 0Hz;RIGHt 100.05MHz")
                                             'Search limit on and set below
                                             'LF on the right side

CALL IBWRT(analyzer%,"CALC:DELT3:STAT ON;MAX;MAX:RIGHt")
                                             'Delta marker 3      on
                                             'Peak and then Next Peak Right
CALL IBWRT(analyzer%,"CALC:DELT3:X?;Y?")     'Delta marker 3; Read out
                                             'frequency und level, both must


CALL IBRD(analyzer%, result$)                'have the value 0

Print "Delta 3: ";result$


'--------- Peak search with search limit in y-direction --------------------

CALL IBWRT(analyzer%,"CALC:DELT:MODE REL")   'Deltamarker frequency output
                                             'relative

CALL IBWRT(analyzer%,"CALC:THR -35DBM;THR:STAT ON")
                                             'Threshold on and set above LF

CALL IBWRT(analyzer%,"CALC:DELT3:STAT ON;MAX;MAX:NEXT")
                                             'Delta marker 3 on
                                             'Peak and then Next Peak
                                             ' => is not found

CALL IBWRT(analyzer%,"CALC:DELT3:X:REL?;:CALC:DELT:Y?")
CALL IBRD(analyzer%, result$)                'Delta marker 3; Read out
                                             'Frequency und level, both must
CALL IBRD(analyzer%, result$)                'have the value 0

Print "Delta 3: ";result$


'---- Set center frequency and reference level by means of markers ---------

CALL IBWRT(analyzer%,"CALC:MARK2:FUNC:CENT") 'Delta marker 2 -> Marker and
                                             'center frequency = Marker 2

CALL IBWRT(analyzer%,"CALC:MARK2:FUNC:REF")  'Ref level = Marker 2

Call ibwrt(analyzer%,"INIT;*WAI")            'Sweep with sync

END SUB

REM ************************************************************************
```

Frequency Counting

The following example is based on a signal with a level of –30 dBm at 100 MHz. The default setting of the analyzer can also be used for this measurement (SetupInstrument). The objective of frequency counting is to determine the exact frequency of the signal at 100 MHz.

```
REM ************************************************************************
Public Sub MarkerCount()

result$ = Space$(100)
CALL SetupInstrument                                'Basic settings
'--------- Measure signal frequency with frequency counter -----------------
CALL IBWRT(analyzer%,"INIT:CONT OFF")               'Single sweep on
CALL IBWRT(analyzer%,"CALC:MARK:PEXC 6DB")          'Peak Excursion
CALL IBWRT(analyzer%,"CALC:MARK:STAT ON")           'Marker 1 on
CALL IBWRT(analyzer%,"CALC:MARK:TRAC 1")            'Assign marker1 to trace 1
CALL IBWRT(analyzer%,"CALC:MARK:X 100MHz")          'Set Marker1 to 100MHz
CALL IBWRT(analyzer%,"CALC:MARK:COUNT:RES 1HZ")     'Frequency counter 1Hz
CALL IBWRT(analyzer%,"CALC:MARK:COUNT ON")          'frequency counter on
CALL IBWRT(analyzer%,"INIT;*WAI")                   'Sweep with sync
CALL IBWRT(analyzer%,"CALC:MARK:COUNT:FREQ?")       'Read out frequency
Print "Marker Count Freq: ";result$
END SUB
REM ************************************************************************
```

Operation mit Fixed Reference Point (Reference Fixed)

The following example is based on a signal with a level of –20 dBm at 100 MHz. The harmonics of the signal lie at 200 MHz, 300 MHz, etc. In the presence of high-quality signal sources these harmonics may lie out of the dynamic range of FSU. In order to measure harmonic suppression, however, the level should be set to higher sensitivity for measuring the harmonics; the carrier has to be suppressed by a notch filter to avoid overloading the analyzer RF input.

In the following example two measurements are therefore performed with different level settings, first with a high reference level at the carrier frequency and then with a low reference level at the frequency of the 3rd harmonic.

The default setting of the analyzer for measurements (SetupInstrument) is used as starting point and adaptations are then made for the measurement.

```
REM ************************************************************************
Public Sub RefFixed()

result$ = Space$(100)
CALL SetupInstrument                                'Basic settings
'--------------- Measure the reference point ------------------------------
CALL IBWRT(analyzer%,"INIT:CONT OFF")               'Single sweep
CALL IBWRT(analyzer%,"CALC:MARK:PEXC 6DB")          'Peak Excursion
CALL IBWRT(analyzer%,"CALC:MARK:STAT ON")           'Marker1 on
CALL IBWRT(analyzer%,"CALC:MARK:TRAC 1")            'Assign marker1 to Trace 1
CALL IBWRT(analyzer%,"INIT;*WAI")                   'Sweep with sync
CALL IBWRT(analyzer%,"CALC:MARK:MAX")               'Set Marker1 to 100MHz
CALL IBWRT(analyzer%,"CALC:DELT:FUNC:FIX ON")       'Reference fixed
'-----Setting freq., level and bandw. for meas. of harmonic distortion ----
CALL IBWRT(analyzer%,"FREQ:CENT 400MHz;Span 1MHz" )'Set freq. of 3rd harmonic
CALL IBWRT(analyzer%,"BAND:RES 1kHz")                 'and appropriate RBW
CALL IBWRT(analyzer%,"SWEEP:TIME:AUTO ON")            'Couple sweep time
CALL IBWRT(analyzer%,"INP:ATT:AUTO ON")               'Optimize level
CALL IBWRT(analyzer%,"DISP:WIND:TRAC:Y:RLEV -50dBm")
CALL IBWRT(analyzer%,"INIT;*WAI")                   'Sweep with sync
CALL IBWRT(analyzer%,"CALC:DELT:MODE REL")          'Delta marker frequency
                                                    'relative
CALL IBWRT(analyzer%,"CALC:DELT:MAX;X?;Y?")         'Read out delta marker
Call ibrd(analyzer%, result$)                       'Read out frequency and level
Print "Deltamarker 1: "; result$
END SUB
REM ************************************************************************
```

Phase and Phase Noise Measurement

During phase noise measurement the noise power referred to 1 Hz is brought into proportion to the power of an adjacent carrier signal. The spacing often used between the measured frequency and the carrier frequency is 10 kHz.

For the noise measurement the measured absolute level is referred to a bandwith of 1 Hz.

The following example is again based on a signal with a level of –30 dBM at 100 MHz. Two markers are used to determine the noise and the phase noise at an offset of 10 kHz from the carrier signal.

```
REM ************************************************************************
Public Sub Noise()

result$ = Space$(100)
'--------- Basic settings ---------------------------------------------------
CALL SetupStatusReg                           'Configure status register
CALL IBWRT(analyzer%,"*RST")                  'Reset instrument
CALL IBWRT(analyzer%,"INIT:CONT OFF")         'Single sweep
'--------- Set frequency ----------------------------------------------------
CALL IBWRT(analyzer%,"FREQUENCY:CENTER 100MHz")       'Center frequency
CALL IBWRT(analyzer%,"FREQ:SPAN 100 kHz")             'Span
'--------- Set level --------------------------------------------------------
CALL IBWRT(analyzer%,"DISP:WIND:TRAC:Y:RLEV -20dBm")  'Reference level
CALL IBWRT(analyzer%,"INIT;*WAI")               'Sweep with sync
'--------- Set reference point ----------------------------------------------
CALL IBWRT(analyzer%,"CALC:MARK:PEXC 6DB")      'Peak Excursion
CALL IBWRT(analyzer%,"CALC:MARK:STAT ON")       'Marker1 on
CALL IBWRT(analyzer%,"CALC:MARK:TRAC 1")        'Assign marker1 to trace1
CALL IBWRT(analyzer%,"CALC:MARK:MAX")           'Set marker1 to 100MHz
CALL IBWRT(analyzer%,"CALC:DELT:FUNC:PNO ON")   'Phase Noise on
'--------- Measure phase noise ----------------------------------------------
CALL IBWRT(analyzer%,"CALC:DELT:X 10kHz")       'Set delta marker
CALL IBWRT(analyzer%,"CALC:DELT:FUNC:PNO:RES?") 'Read out result of
Call ibrd(analyzer%, result$)                   'Phase Noise meas.
Print "Phase Noise [dBc/Hz]: "; result$
'--------- Measure noise ----------------------------------------------------
CALL IBWRT(analyzer%,"CALC:MARK:X 99.96MHz")    'Set Marker 1
CALL IBWRT(analyzer%,"CALC:MARK:FUNC:NOIS:RES?")'Read out result
Call ibrd(analyzer%, result$)
Print "Noise [dBm/Hz]: "; result$
END SUB
REM ************************************************************************
```

Shape Factor Measurement (using n-dB down)

The n-dB-down function of the analyzer is used twice to determine the shape factor of a filter (ratio of bandwidths at 60 dB and 3 dB below the filter maximum).

The following example is again based on a signal with a level of –30 dBm at 100 MHz. The shape factor is determined for the 30 kHz resolution bandwidth. The default setting of the analyzer is used for measurements (SetupInstrument).

```
REM ************************************************************************
Public Sub ShapeFactor()

result$ = Space$(100)
'--------- Basic settings analyzer -----------------------------------------
CALL SetupInstrument                          'Basic settings
CALL IBWRT(analyzer%,"INIT:CONT OFF")         'Single sweep
'--------- Set frequency ---------------------------------------------------
CALL IBWRT(analyzer%,"FREQ:SPAN 1MHz")        'Span
CALL IBWRT(analyzer%,"BAND:RES 30kHz")        'Resolution bandwidth
CALL IBWRT(analyzer%,"INIT;*WAI")             'Sweep with sync
'--------- Measure 60 dB value ---------------------------------------------
CALL IBWRT(analyzer%,"CALC:MARK:PEXC 6DB")    'Peak Excursion
CALL IBWRT(analyzer%,"CALC:MARK:STAT ON")     'Marker1 on
CALL IBWRT(analyzer%,"CALC:MARK:TRAC 1")      'Assign marker1 to Trace 1
CALL IBWRT(analyzer%,"CALC:MARK:MAX")         'Set marker1 to 100MHz
CALL IBWRT(analyzer%,"CALC:MARK:FUNC:NDBD 60dB")'Bandbreite bei 60dB messen
CALL IBWRT(analyzer%,"CALC:MARK:FUNC:NDBD:RES?")'und auslesen
CALL IBRD(analyzer%,result$)
result60 = Val(result$)
'--------- Measure 3 dB Down value -----------------------------------------
CALL IBWRT(analyzer%,"CALC:MARK:FUNC:NDBD 3dB")'Read out bandwidth at 60dB
CALL IBWRT(analyzer%,"CALC:MARK:FUNC:NDBD:RES?")
CALL IBRD(analyzer%,result$)
result3 = Val(result$)
'--------- Read out shape factor--------------------------------------------
Print "Shapefaktor 60dB/3dB: ";result60/result3
END SUB
REM ************************************************************************
```

Measuring the Third Order Intercept Point

The intercept point of 3rd order is the (virtual) level of two adjacent useful signals at which the intermodulation products of 3rd order have the same level as the useful signals.

The intermodulation product at f_{S2} is obtained by mixing the first harmonic of useful signal P_{N2} with signal P_{N1}, the intermodulation product at f_{S1} by mixing the first harmonic of useful signal P_{N1} with signal P_{N2}.

$f_{s1} = 2 \times f_{n1} - f_{n2}$ (1)

$f_{s2} = 2 \times f_{n2} - f_{n1}$ (2)

The following example is based on two adjacent signals with a level of –30 dBm at 100 MHz and 110 MHz. The intermodulation products lie at 90 MHz and 120 MHz according to the above formula. The frequency set is in a way that the examined mixture products are displayed on the diagram. Otherwise the default setting of the analyzer is used for measurements (SetupInstrument).

```
REM ************************************************************************
Public Sub TOI()

result$ = Space$(100)
'--------- Basic settings ---------------------------------------------------
CALL SetupStatusReg                         'Set status registers
CALL IBWRT(analyzer%,"*RST")                'Reset instrument
CALL IBWRT(analyzer%,"INIT:CONT OFF")       'Single sweep
CALL IBWRT(analyzer%,"SYST:DISP:UPD ON")    'ON: display indication on
                                            'OFF: off
'--------- Set frequency ----------------------------------------------------
CALL IBWRT(analyzer%,"FREQ:STARt 85MHz;STOP 125 MHz") 'Span
'--------- Set level --------------------------------------------------------
CALL IBWRT(analyzer%,"DISP:WIND:TRAC:Y:RLEV -20dBm")  'Reference level
CALL IBWRT(analyzer%,"INIT;*WAI")                     'Sweep with sync
'--------- TOI measurement --------------------------------------------------
CALL IBWRT(analyzer%,"CALC:MARK:PEXC 6DB")            'Peak Excursion
CALL IBWRT(analyzer%,"CALC:MARK:FUNC:TOI ON")         'TOI on
CALL IBWRT(analyzer%,"CALC:MARK:FUNC:TOI:RES?") 'and read out results
CALL IBRD(analyzer%,result$)
'--------- Read out result --------------------------------------------------
Print "TOI [dBm]: ";result$
END SUB
REM ************************************************************************
```

Measuring the AM Modulation Depth

The example below is based on an AM-modulated signal at 100 MHz with the following characteristics:

- Carrier signal level: –30 dBm
- AF frequency: 100 kHz
- Modulation depth: 50 %

The default setting of the analyzer for measurements can be used for the measurements described below (SetupInstrument).

```
REM ************************************************************************
Public Sub AMMod()

result$ = Space$(100)
CALL SetupInstrument                            'Basic settings
'--------- Peak search ---------------------------------------------------
CALL IBWRT(analyzer%,"INIT:CONT OFF")           'Single sweep
CALL IBWRT(analyzer%,"INIT;*WAI")               'Sweep with sync
CALL IBWRT(analyzer%,"CALC:MARK:PEXC 6DB")      'Peak Excursion
CALL IBWRT(analyzer%,"CALC:MARK:STAT ON")       'Marker 1 on
CALL IBWRT(analyzer%,"CALC:MARK:TRAC 1")        'Assign marker1 to trace 1
'--------- Measure modulation depth-----------------------------------------
CALL IBWRT(analyzer%,"CALC:MARK:MAX;FUNC:MDEP ON") 'Marker to Peak;
CALL IBWRT(analyzer%,"CALC:MARK:FUNC:MDEP:RES?")   'Mod. Depth on
CALL IBRD(analyzer%, result$)                      'Read out result
'--------- Read out result ------------------------------------------------
Print "AM Mod Depth [%]: ";result$
END SUB
REM ************************************************************************
```

Limit Lines and Limit Test

The example below shows the definition and use of a new limit line 5 for trace 1 on screen A and trace 2 on screen B with the following characteristics:

- Upper limit line
- Absolute x axis in the frequency range
- 5 reference values: 120 MHz / -70 DB, 126 MHz/-40 dB, 127 MHz/-40 dB, 128 MHz/-10 dB, 129 MHz/-40 dB, 130 MHz/-40 dB, 136 MHz / - 70 dB
- Relative y axis with unit dB
- Absolute threshold at -75 dBm
- No margin

The signal of the integrated calibration source (128 MHz, -30 dBm) is used to check the limit test.

```
REM ************************************************************************
Public Sub LimitLine()

result$ = Space$(100)
'--------- Basic settings -----------------------------------------------------
CALL SetupInstrument                                   'Basic settings
CALL IBWRT(analyzer%,"FREQUENCY:CENTER 128MHz;Span 10MHz")'Span
Call ibwrt(analyzer%,"Diag:Serv:Inp Cal;CSO -30dBm")  'Cal signal on
'--------- Definition of limit lines ------------------------------------------
CALL IBWRT(analyzer%,"CALC:LIM5:NAME 'TEST1'")         'Define name
CALL IBWRT(analyzer%,"CALC:LIM5:COMM 'Upper limit'")   'Define comment
CALL IBWRT(analyzer%,"CALC1:LIM5:TRAC 1")       'Assign trace in screen A
CALL IBWRT(analyzer%,"CALC2:LIM5:TRAC 2")       'Assign trace in screen B
CALL IBWRT(analyzer%,"CALC:LIM5:CONT:DOM FREQ")'Define x-axis range
CALL IBWRT(analyzer%,"CALC:LIM5:CONT:MODE ABS")'Define x-axis scaling
CALL IBWRT(analyzer%,"CALC:LIM5:UNIT DB")       'Define y-axis unit
CALL IBWRT(analyzer%,"CALC:LIM5:UPP:MODE REL")  'Define y-axis scaling
'--------- Definition of data points and threshold ----------------------------
xlimit$ = "CALC:LIM5:CONT 120MHZ,126MHZ,127MHZ,128MHZ,129MHZ,130MHz,136MHz"
CALL IBWRT(analyzer%, xlimit$)                  'Set values for x-axis
CALL IBWRT(analyzer%,"CALC:LIM5:UPP -70,-40,-40,-20,-40,-40,-70")
                                                'Set values for y-axis


CALL IBWRT(analyzer%,"CALC:LIM5:UPP:THR -75DBM") 'Set y-threshold (only
                                                 'possible for relative
                                                 'y-axis)
'------------------------------------------------------------------------------
'A margin or an x-/y offset can be defined here.
'----------- Activate and evaluate the limit line in screen A -------------
CALL IBWRT(analyzer%,"CALC1:LIM5:UPP:STAT ON")  'Activate line 5 in screen A
CALL IBWRT(analyzer%,"CALC1:LIM5:STAT ON")      'Activate limit check in
                                                'screen A
CALL IBWRT(analyzer%,"INIT;*WAI")               'Sweep with sync
```

```
CALL IBWRT(analyzer%,"CALC1:LIM5:FAIL?")        'Query result of limit
                                                'check
CALL IBRD(analyzer%, result$)                   'Result: 1 (= FAIL)
'--------- Read out result ----------------------------------------------------
Print "Limit Result Line 5: ";result$

'------ Evaluate limit line in screen A by means of status registers -------
CALL IBWRT(analyzer%,"*CLS")                   'Reset status register
'--------- Measure ------------------------------------------------------------
CALL IBWRT(analyzer%,"INIT;*OPC")              'Sweep with sync
CALL WaitSRQ(boardID%,status%)                 'Wait for service request
'--------- Read out result ----------------------------------------------------
IF (status% = 1) THEN
   CALL IBWRT(analyzer%,"STAT:QUES:LIM1:COND?") 'Read out STAT:QUES:LIMit
   CALL IBRD(analyzer%, result$)                'register
   IF ((Val(result$) And 16) <> 0) THEN
      Print "Limit5 failed"
   ELSE
      Print "Limit5 passed"
   END IF
END IF
END SUB
REM ***************************************************************************
```

Measuring the Channel and Adjacent Channel Power

In the following example the channel and adjacent channel power is first measured on a signal with a level of 0 dBm at 800 MHz to IS95. Then the channel and adjacent channel power is measured on a GSM signal at 935.2 MHz with fast ACP measurement (FAST ACP).

In addition, the limit test is activated.

```
REM ************************************************************************
Public Sub ACP()

result$ = Space$(100)
'--------- Basic settings ---------------------------------------------------
CALL SetupStatusReg                            'Set status register
CALL IBWRT(analyzer%,"*RST")                   'Reset instrument
CALL IBWRT(analyzer%,"INIT:CONT OFF")          'Single sweep
CALL IBWRT(analyzer%,"SYST:DISP:UPD ON")       'ON: display indication on
                                               'OFF: off
'--------- Set frequency ----------------------------------------------------
CALL IBWRT(analyzer%,"FREQ:CENT 800MHz")          'Set frequency
'--------- Set level --------------------------------------------------------
CALL IBWRT(analyzer%,"DISP:WIND:TRAC:Y:RLEV 10dBm")    'Reference level

'--------- Example 1: Configure CP/ACP for CDMA ---------------------------
CALL IBWRT(analyzer%,"CALC2:MARK:FUNC:POW:SEL ACP")    'ACP measurement on
CALL IBWRT(analyzer%,"CALC:MARK:FUNC:POW:PRES F8CDMA") 'Select CDMA800 FWD
CALL IBWRT(analyzer%,"SENS:POW:ACH:ACP 2")        'Select 2 adjacent channels
CALL IBWRT(analyzer%,"SENS:POW:ACH:PRES ACP")     'Optimize settings
CALL IBWRT(analyzer%,"SENS:POW:ACH:PRES:RLEV")    'Optimize reference level
CALL IBWRT(analyzer%,"SENS:POW:ACH:MODE ABS")     'Absolute measurement
CALL IBWRT(analyzer%,"SENS:POW:HSP ON")           'Fast ACP measurement
'--------- Measure and query result -----------------------------------------
CALL IBWRT(analyzer%,"INIT;*WAI")                 'Sweep with sync
CALL IBWRT(analyzer%,"CALC2:MARK:FUNC:POW:RES? ACP")   'Query result
CALL IBRD(analyzer%, result$)
'--------- Read out result --------------------------------------------------
Print "Result (CP, ACP low, ACP up, Alt low, Alt up): "
Print result$
```

```
'--------- Example 2: Configure CP/ACP manually für GSM ------------------
result$ = Space$(100)
CALL IBWRT(analyzer%,"FREQ:CENT 935.2MHz")      'Set frequency
CALL IBWRT(analyzer%,"CALC:MARK:FUNC:POW:SEL ACP")  'ACP measurement on
CALL IBWRT(analyzer%,"SENS:POW:ACH:ACP 1")          '1 adjacent channel
CALL IBWRT(analyzer%,"SENS:POW:ACH:BAND 200KHZ")    'Channel band width
CALL IBWRT(analyzer%,"SENS:POW:ACH:BAND:ACH 200KHZ")'Adjacent channel bandw.
CALL IBWRT(analyzer%,"SENS:POW:ACH:SPAC 200KHZ")    'Channel spacing
CALL IBWRT(analyzer%,"SENS:POW:ACH:PRES ACP")   'Optimize settings
CALL IBWRT(analyzer%,"SENS:POW:ACH:PRES:RLEV")  'Optimize reference level
CALL IBWRT(analyzer%,"SENS:POW:ACH:MODE ABS")   'Absolute measurement
'--------- Start measurement and query result ------------------------------
CALL IBWRT(analyzer%,"INIT;*WAI")               'Sweep with sync
CALL IBWRT(analyzer%,"CALC:MARK:FUNC:POW:RES? ACP")   'Query result
CALL IBRD(analyzer%, result$)
'--------- Read out result -------------------------------------------------
Print "Result (CP, ACP low, ACP up): "
Print result$
'--------- Active limit check ----------------------------------------------
result$ = Space$(100)
CALL IBWRT(analyzer%,"CALC:LIM:ACP:ACH 30DB, 30DB")   'Set relative limit
CALL IBWRT(analyzer%,"CALC:LIM:ACP:ACH:ABS -35DBM,-35DBM")
                                                      'Set absolute limit
CALL IBWRT(analyzer%,"CALC:LIM:ACP:ACH:STAT ON")      'Rel. limit check on
CALL IBWRT(analyzer%,"CALC:LIM:ACP:ACH:ABS:STAT ON")  'Abs. limit check on
CALL IBWRT(analyzer%,"CALC:LIM:ACP ON")               'Limit check on
'--------- Start measurement and query result ------------------------------
CALL IBWRT(analyzer%,"INIT;*WAI")                     'Sweep with sync
CALL IBWRT(analyzer%,"CALC:LIM:ACP:ACH:RES?")         'Query result of
CALL IBRD(analyzer%, result$)                         'limit check
'--------- Read out result -------------------------------------------------
Print "Result Limit Check: ";result$
END SUB
REM ***********************************************************************
```

Occupied Bandwidth Measurement

In the following example, the bandwidth is to be found in which 95% of the power of a GSM signal is contained. Signal frequency is 935,2 MHz; channel bandwidth is 200 kHz.

```
REM ************************************************************************
Public Sub OBW()

result$ = Space$(100)
'--------- Basic settings ---------------------------------------------------
CALL SetupStatusReg                             'Set status register
CALL IBWRT(analyzer%,"*RST")                    'Reset instrument
CALL IBWRT(analyzer%,"INIT:CONT OFF")           'Single sweep
CALL IBWRT(analyzer%,"SYST:DISP:UPD ON")        'ON: display indication on
                                                'OFF: off
'--------- Configure analyzer for OBW for GSM  ----------------------------
CALL IBWRT(analyzer%,"FREQ:CENT 935.2MHz")             'Set frequency
CALL IBWRT(analyzer%,"CALC:MARK:FUNC:POW:SEL OBW")  'OBW measurement on
CALL IBWRT(analyzer%,"SENS:POW:ACH:BAND 200KHZ")     'Channel bandwidth
CALL IBWRT(analyzer%,"SENS:POW:BWID 95PCT")     'Percentage of power
CALL IBWRT(analyzer%,"SENS:POW:ACH:PRES OBW")   'Set frequency and
CALL IBWRT(analyzer%,"SENS:POW:ACH:PRES:RLEV") 'optimize level settings
CALL IBWRT(analyzer%,"SENS:POW:NCOR OFF")       'Noise correction
'--------- Measure and query result ----------------------------------------
CALL IBWRT(analyzer%,"INIT;*WAI")               'Sweep with sync
CALL IBWRT(analyzer%,"CALC:MARK:FUNC:POW:RES? OBW")   'Query result
CALL IBRD(analyzer%, result$)
Print result$
END SUB
REM ************************************************************************
```

Time Domain Power Measurement

In the following example the mean carrier power of a signal with 300 kHz bandwith at 100 MHz is to be determined. In addition, the peak power, the rms value and the standard deviation are measured. To do this, the time-domain-power measurement functions are used.

```
REM ************************************************************************
Public Sub TimeDomainPower()

result$ = Space$(100)
'--------- Basic settings --------------------------------------------------
CALL SetupStatusReg                              'Set status register
CALL IBWRT(analyzer%,"*RST")                     'Reset instrument
CALL IBWRT(analyzer%,"INIT:CONT OFF")            'Single sweep
CALL IBWRT(analyzer%,"SYST:DISP:UPD ON")         'ON: display indication on
                                                 'OFF: off
'--------- Configure analyzer for time domain power measurement -----------
CALL IBWRT(analyzer%,"FREQ:CENT 100MHz;SPAN 0Hz")   'Set frequency
CALL IBWRT(analyzer%,"BAND:RES 300kHz")             'Resolution bandwidth
CALL IBWRT(analyzer%,"SWE:TIME 200US")              'Sweep time

CALL IBWRT(analyzer%,"CALC:MARK:FUNC:SUMM:PPE ON")  'Pos. Peak measurement
CALL IBWRT(analyzer%,"CALC:MARK:FUNC:SUMM:MEAN ON") 'Mean measurement
CALL IBWRT(analyzer%,"CALC:MARK:FUNC:SUMM:RMS ON")  'RMS measurement
CALL IBWRT(analyzer%,"CALC:MARK:FUNC:SUMM:SDEV ON") 'Standard deviation
'------------------- Measure and query results ----------------------------
CALL IBWRT(analyzer%,"INIT;*WAI")                   'Sweep with sync

                                                    'Query results:
query$ =          " CALC:MARK:FUNC:SUMM:PPE:RES?;"  'Pos. Peak measurement
query$ = query$ + ":CALC:MARK:FUNC:SUMM:MEAN:RES?;" 'Mean measurement
query$ = query$ + ":CALC:MARK:FUNC:SUMM:RMS:RES?;"  'RMS measurement
query$ = query$ + ":CALC:MARK:FUNC:SUMM:SDEV:RES?"  'Standard deviation
Call IBWRT(analyzer%, query$)

CALL IBRD(analyzer%, result$)

Print result$

END SUB

REM ************************************************************************
```

Reading Trace Data

In the following example the trace data recorded together at the default setting are read out of the instrument and displayed on the screen in the form of a list. Reading is performed consecutively in the binary format and in the ASCII format, at span > 0 and also at span = 0.

In the binary format the message header is evaluated with the length indication and used to calculate the x axis values.

In the ASCII format only the list of level values is output.

The binary data are read out in 3 steps:

1. Reading the number of digits of the length indication
2. Reading the length indication
3. Reading trace data

This procedure is necessary with programming languages that support only structures with similar data types (arrays) (such as Visual Basic) since the data types of header and data differ in binary data.

Note:
The dimensions of the arrays for the trace data are chosen in a way that reserves enough space for both FSP trace data (501 points) and FSU trace data (625 points).

```
REM ************************************************************************
Public Sub ReadTrace()

'--------- Define variables -----------------------------------------------
Dim traceData(1250) As Single              'Buffer for floating point
                                           'binary data
Dim digits As Byte                         'Number of digits of
                                           'length indication
Dim traceBytes As Integer                  'Length of trace data in bytes
Dim traceValues As Integer                 'Number of values in buffer
asciiResult$ = Space$(25000)               'Buffer for ASCII trace data
result$ = Space$(100)                      'Buffer for simple results
startFreq$ = Space$(100)                   'Buffer for start frequency
span$ = Space$(100)                        'Buffer for span
'--------- Basic settings -------------------------------------------------
CALL SetupInstrument                       'Basic settings
CALL IBWRT(analyzer%,"INIT:CONT OFF")      'Single sweep
CALL IBWRT(analyzer%,"INIT;*WAI")          'Sweep with sync
'--------- Define span for read out ---------------------------------------
Call ibwrt(analyzer%,"FREQ:STARt?")        'Read out start frequency
Call ibrd(analyzer%,startFreq$)
startFreq = Val(startFreq$)
Call ibwrt(analyzer%,"FREQ:SPAN?")         'Read out span
Call ibrd(analyzer%,span$)
span = Val(span$)
```

```
'--------- Read out in binary format ---------------------------------------
Call ibwrt(analyzer%, "FORMAT REAL,32")       'Select binary format
Call ibwrt(analyzer%, "TRAC1? TRACE1")        'Read out Trace 1
Call ilrd(analyzer%, result$, 2)              'Read out and store
digits = Val(Mid$(result$, 2, 1))             'number of digits of
                                              'length indication
result$ = Space$(100)                         'Initialize buffer again
Call ilrd(analyzer%, result$, digits)         'Read out
traceBytes = Val(Left$(result$, digits))      'and store indication of length
Call ibrd32(analyzer%, traceData(0), traceBytes) 'Read trace data into buffer
Call ilrd(analyzer%, result$, 1)              'Read the terminator <NL>
'--------- Read out binary data as pairs of frequency/level values ---------
traceValues = traceBytes/4                    'Single precision = 4 bytes
stepsize = span/traceValues                   'Calculate frequeny step width
For i = 0 To traceValues - 1
  Print "Value["; i; "] = "; startFreq+stepsize*i; ", "; traceData(i)
Next i
'--------- Basic settings time domain --------------------------------------
Call ibwrt(analyzer%,"FREQ:SPAN 0Hz")         'Zero span on
CALL IBWRT(analyzer%,"INIT;*WAI")             'Sweep with sync
'--------- Read out in ASCII format ----------------------------------------
Call ibwrt(analyzer%,"FORMAT ASCII")          'Select ASCII format
CALL ibwrt(analyzer%,"TRAC1? TRACE1")         'Read out Trace 1
CALL ibrd(analyzer%, asciiResult$)
Print "Contents of Trace1: ",asciiResult$
END SUB
REM ************************************************************************
```

Storing and Loading Device Settings

Storing Instrument Settings

In the following example the settings/measurement data to be stored are determined; only the hardware settings are stored. The selection commands for the other settings are indicated with the status OFF for the sake of completeness.

```
REM ************************************************************************
Public Sub StoreSettings()

'This subroutine selects the settings to be stored and creates
'the data set "TEST1" in directory D:\USER\DATA. It uses
'the default setting and resets the instrument after storage
'of the setting.
'--------- Basic settings ---------------------------------------------------
Call SetupInstrument
CALL IBWRT(analyzer%,"INIT:CONT OFF")        'Single sweep
CALL IBWRT(analyzer%,"INIT;*WAI")            'Sweep with sync
'--------- Select items to store --------------------------------------------
CALL IBWRT(analyzer%,"MMEM:SEL:HWS ON")      'Select hardware settings to
                                             'store
CALL IBWRT(analyzer%,"MMEM:SEL:TRAC OFF")    'Disable traces to store
CALL IBWRT(analyzer%,"MMEM:SEL:LIN:ALL OFF") 'Select active limit lines to
                                             'store
'--------- Define comment ---------------------------------------------------
CALL IBWRT(analyzer%,"MMEM:COMM 'Test Setup'")
'--------- Store selected items ---------------------------------------------
CALL IBWRT(analyzer%,"MMEM:STOR:STAT 1,'D:\USER\DATA\TEST1'")
'--------- Reset instrument -------------------------------------------------
CALL IBWRT(analyzer%,"*RST")
END SUB
REM ************************************************************************
```

Loading Device Settings

In the following example data set "TEST1" stored under D:\USER\DATA is reloaded into the isnstrument:

```
REM ************************************************************************
Public Sub LoadSettings()

'This subroutine loads data set "TEST1" in directory D:\USER\DATA.
'--------- Set status registers -------------------------------------------
Call SetupStatusReg                              'Set status register
'--------- Load data set ---------------------------------------------------
CALL IBWRT(analyzer%,"MMEM:LOAD:STAT 1,'D:\USER\DATA\TEST1'")
'----Start measurement with the settings of the loaded data set ------------
CALL IBWRT(analyzer%,"DISP:TRAC1:MODE WRITE")  'Set trace to Clr/Write
CALL IBWRT(analyzer%,"INIT;*WAI")              'Start the sweep
END SUB
REM ************************************************************************
```

Setting the Data Set for Startup Recall

In the following example the analyzer is first reset. Then the data set TEST1 stored under D:\USER\DATA is selected for the function STARTUP RECALL, ie the data set is set for every *RST, PRESET and every device startup. For illustration, the command *RST is executed again.

```
REM ************************************************************************
Public Sub StartupRecallSettings()
'--------- Reset analyzer --------------------------------------------------
CALL IBWRT(analyzer%,"*RST")
'--------- Set status registers -------------------------------------------
Call SetupStatusReg                              'Set status register
'--------- Select startup recall data set----------------------------------
CALL IBWRT(analyzer%,"MMEM:LOAD:AUTO 1,'D:\USER\DATA\TEST1'")
'--------- Activate startup recall data set -------------------------------
CALL IBWRT(analyzer%,"*RST")
END SUB
REM ************************************************************************
```

Reading and Writing Files

Reading a File from the Instrument

In the following example file TEST1.SET stored under D:\USER\DATA is read from the instrument and stored in the controller.

```
REM ************************************************************************
Public Sub ReadFile()
'--------- Variables --------------------------------------------------
Dim digits As Byte                          'Number of digits of
                                            'length indication
Dim fileBytes As Long                       'Length of file with trace data
                                            'in bytes
result$ = Space$(100)                       'Buffer for simple results
'--------- Basic settings status registers --------------------------------
Call SetupStatusReg                         'Set status register
'--------- Read out file ---------------------------------------------------
Call ibwrt(analyzer%, "MMEM:DATA? 'D:\USER\DATA\TEST1.SET'")
                                            'Select file
Call ilrd(analyzer%, result$, 2)            'Read and store number of
                                            'digits in length
digits = Val(Mid$(result$, 2, 1))           'indication
Call ilrd(analyzer%, result$, digits)       'Read and store length
fileBytes = Val(Left$(result$, digits))     'indication
FileBuffer$ = Space$(fileBytes)             'Buffer for file
Call ilrd(analyzer%, FileBuffer, fileBytes) 'Read file into buffer
Call ilrd(analyzer%, result$, 1)            'Read terminator <NL>
'--------- Store file to controller ---------------------------------------
Open "TEST1.SET" For Output As #1
Print #1, FileBuffer;                       ' ; to avoid linefeed at
                                            '   end of file
Close #1
END SUB
REM ************************************************************************
```

Creating a File in the Instrument

In the following example file TEST1.SET available on the controller is stored in the instrument under D:\USER\DATA\DUPLICAT.SET.

```
REM ************************************************************************
Public Sub WriteFile()
'--------- Variables ------------------------------------------------------
FileBuffer$ = Space$(100000)                'Buffer for file
Dim digits As Long                          'Number of digits of
                                            'length indication
Dim fileBytes As Long                       'Length of file in bytes
fileSize$ = Space$(100)                     'Length of file in a string
result$ = Space$(100)                       'Buffer for simple results
'--------- Basic settings status registers --------------------------------
Call SetupStatusReg                         'Set status register
'--------- Prepare the definite length block data -------------------------
fileBytes = FileLen("H:\work\vb\test1.set")  'Determine length of file
fileSize$ = Str$(fileBytes)
digits = Len(fileSize$) - 1                 'Determine number of digits of
fileSize$ = Right$(fileSize$, digits)       'length indication
FileBuffer$ = "#" + Right$(Str$(digits), 1) + fileSize$
                                            'Put length indication into
                                            'file buffer
'--------- Read file from controller --------------------------------------
Open "H:\work\vb\TEST1.SET" For Binary As #1
FileBuffer$ = FileBuffer$ + Left$(Input(fileBytes, #1), fileBytes)
Close #1
'--------- Write file -----------------------------------------------------
-
Call ibwrt(analyzer%, "SYST:COMM:GPIB:RTER EOI")      'Set receive
                                                      'terminator in the
                                                      'instrument
Call ibwrt(analyzer%, "MMEM:DATA 'D:\USER\DATA\DUPLICAT.SET'," +
           FileBuffer$)                               'Select file
END SUB
REM ************************************************************************
```

Configuring and Starting a Printout

The following example shows the configuration of the output format and output device for printing out a measurement mask.
The procedure is in the following order:

1. Set the measurement required for the printout
2. Query available output devices
3. Select an output device
4. Select the output interface
5. Configure the output format
6. Start printout with synchronization to the end

It is assumed that the setting required is a signal with a power of –20 dBm at 100 MHz and also that the printer required is the 6th of the available printers. The printout is first performed to the selected printer, then to a file.

```
REM ***************************************************************************
Public Sub HCopy()

DIM Devices(100) as string                          'Buffer for printer name
FOR i = 0 TO 49
  Devices$(i) = Space$(50)                          'Preallocate buffer for
                                                    'printer name
NEXT i
'--------- Basic settings -----------------------------------------------------
CALL SetupStatusReg                                 'Set status register
CALL IBWRT(analyzer%,"*RST")                        'Reset instrument
CALL IBWRT(analyzer%,"INIT:CONT OFF")               'Single sweep
CALL IBWRT(analyzer%,"SYST:DISP:UPD ON")            'Display indication on
'--------- Configure measurement ----------------------------------------------
CALL IBWRT(analyzer%,"FREQ:CENT 100MHz;SPAN 10MHz")      'Set frequency
CALL IBWRT(analyzer%,"DISP:WIND:TRAC:Y:RLEV -10dBm")     'Reference level
CALL IBWRT(analyzer%,"INIT;*WAI")                        'Start measurement
'--------- Query available output devices -------------------------------------
CALL IBWRT(analyzer%,"SYST:COMM:PRIN:ENUM:FIRSt?")       'Read out first
CALL IBRD(analyzer%,Devices$(0))                         'printer and indicate
PRINT "Drucker 0: "+Devices$(0)                          'printer name
For i = 1 to 99
  CALL IBWRT(analyzer%,"SYST:COMM:PRIN:ENUM:NEXT?")      'Read out the next
  CALL IBRD(analyzer%,Devices$(i))                       'printer name
  IF Left$(Devices$(i),2) = "''" THEN GOTO SelectDevice  'Abort at end of
                                                         'list
  PRINT "Drucker"+Str$(i)+": " Devices$(i)               'Indicate printer name
NEXT i
```

```
SelectDevice:
'------------ Select device, printer language and interface ----------------
CALL IBWRT(analyzer%,"SYST:COMM:PRIN:SEL "+ Devices(6))'Select printer #6
8 CALL IBWRT(analyzer%,"HCOP:DEST 'SYST:COMM:PRIN'")  'Configuration:
                                                     '"Print out to
                                                     'printer interface"
CALL IBWRT(analyzer%,"HCOP:DEV:LANG GDI")           'Output language 'GDI'
'----- Select orientation (portrait/landscape) and color/BW ----------------
CALL IBWRT(analyzer%,"HCOP:PAGE:ORI PORTrait")      'Portrait
CALL IBWRT(analyzer%,"HCOP:DEV:COL OFF")            'Black and white
'----- Configure and start print out ---------------------------------------
 CALL IBWRT (analyzer%,"HCOP:ITEM:ALL")        'Select complete screen
'CALL IBWRT (analyzer%,"HCOP:ITEM:WIND1:TRAC:STAT ON") 'alternative: only
'CALL IBWRT (analyzer%,"HCOP:ITEM:WIND2:TRAC:STAT ON") 'traces in
                                                       'screen A/B
CALL IBWRT (analyzer%,"*CLS")                  'Reset status registers
CALL IBWRT (analyzer%,"HCOP:IMMediate;*OPC")   'Start print out
CALL WaitSRQ(boardID%,result%)                 'Wait for service request
IF (result% = 1) THEN CALL Srq                 'If SRQ is recognized =>
                                               'Subroutines for evaluation
'---- Print out into file in WMF format (BMP format) ----------------------
CALL IBWRT(analyzer%,"HCOP:DEST 'MMEM'")       'Configuration:
                                               '"Print to file"
 CALL IBWRT(analyzer%,"HCOP:DEV:LANG WMF")     'File format WMF
'CALL IBWRT(analyzer%,"HCOP:DEV:LANG BMP")     'File format BMP
CALL IBWRT(analyzer%,"MMEM:NAME 'D:\USER\DATA\PRINT1.WMF'") 'Determine
                                                            'file name
CALL IBWRT (analyzer%,"*CLS")                  'Reset status registers
CALL IBWRT (analyzer%,"HCOP:IMMediate;*OPC")   'Start print out
CALL WaitSRQ(boardID%,result%)                 'Wait for service request
IF (result% = 1) THEN CALL Srq                 'If SRQ is recognized  =>
                                               'Subroutines for evaluation
END SUB
REM ************************************************************************
```