ROHDE&SCHWARZ

Test and Measurement
Division

Operating Manual

Test Receiver

FSET22

1080.3508.30
1080.3508.31
1080.3508.32

FSET7

1080.3508.07
1080.3508.17
1080.3508.27

Volume 1
This Operating Manual consists of 2 volumes

Printed in the Federal
Republic of Germany

Tabbed Divider Overview

Volume 1

Data Sheet

Safety Instructions
Certificate of quality
EC Certificate of Conformity
Support Center
List of R & S Representatives
List of Manuals

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2	**Chapter 2:**	**Getting Started**
3	**Chapter 3:**	**Manual Operation**
4	**Chapter 4:**	**Instrument Functions**
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Volume 2

Safety Instructions
List of Manuals

Tabbed Divider

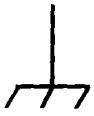
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Safety Instructions

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, only for indoor use, altitude max. 2000 m.

   The unit may be operated only from supply networks fused with max. 16 A.

   Unless specified otherwise in the data sheet, a tolerance of ±10% shall apply to the nominal voltage and of ±5% to the nominal frequency.

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. The outside of the instrument is suitably cleaned using a soft, lint-free dustcloth. Never use solvents such as thinners, acetone and similar things, as they may damage the front panel labeling or plastic parts.
15. Any additional safety instructions given in this manual are also to be observed.

Patent Information

This product contains technology licensed by Marconi Instruments LTD. under US patent 4609881 and under the corresponding patent in Germany and elsewhere.

ROHDE&SCHWARZ

EC Certificate of Conformity

CE

Certificate No.: 2001-28

This is to certify that:

Equipment type	Stock No.	Designation
FSET7	1080.3508.07	Test Receiver 100 Hz ... 7 GHz
FSET-Z2	1070.2009.07	Preselector and Preamplifier
FSET22	1080.3508.32	Test Receiver 100 Hz ... 22 GHz
FSETZ22	1070.2009.02	Preselector and Preamplifier

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

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

Conformity is proven by compliance with the following standards:

EN61010-1 : 1991
EN55011 : 1998 + A1 : 1999
EN61326-1 : 1997 + A1 : 1998

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

Affixing the EC conformity mark as from 1996

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

Munich, 2001-05-22

Central Quality Management FS-QZ / Becker

ROHDE&SCHWARZ

EC Certificate of Conformity

CE

Certificate No.: 9502052

This is to certify that:

Equipment type	Stock No.	Designation
FSE-B1	1073.4990.02	Color Display
FSE-B10	1066.4769.02	Tracking Generator
FSE-B11	1066.4917.02	Tracking Generator
FSE-B12	1066.5065.02	Output Attenuator
FSE-B13	1119.6499.02	1 dB Input Attenuator
FSE-B15	1073.5696.02/.03	Computer Function
FSE-B16	1073.5973.02/.03/.04	Ethernet Interface
FSE-B17	1066.4017.02	2nd IEC BUS Interface
FSE-B18	1088.6993.02	Removeable Harddrive
FSE-B19	1088.7248.xx	Second Harddisk
FSE-B2	1073.5044.02	7 GHz Frequency Extension
FSE-B21	1084.7243.02	External Mixer Output
FSE-B23	1088.7348.02	741,4 MHz Broadband Output
FSE-B24	1106.3680.02	44 GHz Frequency Extension
FSE-B3	1073.5244.02	TV Demodulator
FSE-B4	1073.5396.02	OCXO 10 MHz and Low Phase Noise
FSE-B7	1066.4317.02	Signal Vectoranalysis
FSE-B77	1102.8493.02	Signal Vectoranalysis
FSE-B8	1066.4469.02	Tracking Generator
FSE-B9	1066.4617.02	Tracking Generator
FSE-Z2	1084.7043.02	PS/2 Mouse

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

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

Conformity is proven by compliance with the following standards:

EN55011 : 1998 + A1 : 1999, Klasse B
EN61000-3-2 : 1995 + A1 : 1998 + A2 : 1998 + A14 : 2000
EN61000-3-3 : 1995
EN50082-1 : 1992

Affixing the EC conformity mark as from 1995

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

Munich, 2001-01-11

Central Quality Management FS-QZ / Becker

Contents of Manuals for Test Receiver FSET

Operating Manual FSET

The operating manual describes the following models and options:

- FSET7 100 Hz to 7 GHz
- FSET-Z2 100 Hz to 7 GHz
- FSET22 100 Hz to 22 GHz
- FSET-Z22 100 Hz to 22 GHz

- Option FSE-B15 Ethernet Adapter
- Option FSE-B17 Second IEC/IEEE Bus Interface

The present operating manual contains comprehensive information about the technical data of the instrument, the setup and putting into operation of the instrument, the operating concept and controls as well as the operation of the FSET via the menus and via remote control. Typical measurement tasks for the FSET are explained using the functions offered by the menus and a selection of program examples.

In addition the operating manual gives information about maintenance of the instrument and about error detection listing the error messages which may be output by the instrument. It is subdivided intothe data sheet plus 9 chapters:

Volume 1

The data sheet **i**nforms about guaranteed specifications and characteristics of the instrument.

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

Chapter 2 gives an introduction to typical measurement tasks of the FSET which are explained step by step.

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 FSET and contains a detailed description of all instrument functions and their application.

Volume 2

Chapter 5 describes the basics for programming the FSET, 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 FSET.

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

Chapter 8 gives a list of error messages that the FSET 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 (performance test) and on the self tests.

Service Manual

The service manual is not delivered with the instrument but may be obtained from your R&S service department using the order number 1080.3608.24.

The service manualinforms on instrument function, repair, troubleshooting and fault elimination. It contains all information required for the maintenance of FSET by exchanging modules.It contains information about the individual modules of FSET. This comprises the test and adjustment of the modules, fault detection within the modules and the interface description.

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1 Preparing for Operation

Chapter 1 presents the front and rear view of the instrument and explains step by step how to set up and connect the FSET.

Description of Front and Rear Panel Views

Front View

1

Display Screen	see Chap. 3 and 4

2

Softkeys	see Chap. 3 and 4

3 USER



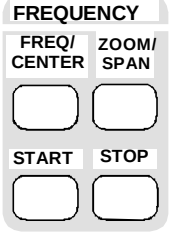
Writing Macros	see Chap. 4

4 MARKER



Select and set marker		see Chap. 4
NORMAL	Select and set the marker	
SEARCH	Set and start the peak/min search	
DELTA	Select and set the delta markers	
MKR	Set the active marker	

5 FREQUENCY



Define frequency axis in the active window		see Chap. 4
FREQ/ CENTER	Set receiver frequency etc. Center frequency	
ZOOM/ SPAN	Zoom frequency Set sweep span and zoom fequencies	
START	Set start frequency	
STOP	Set stop frequency	

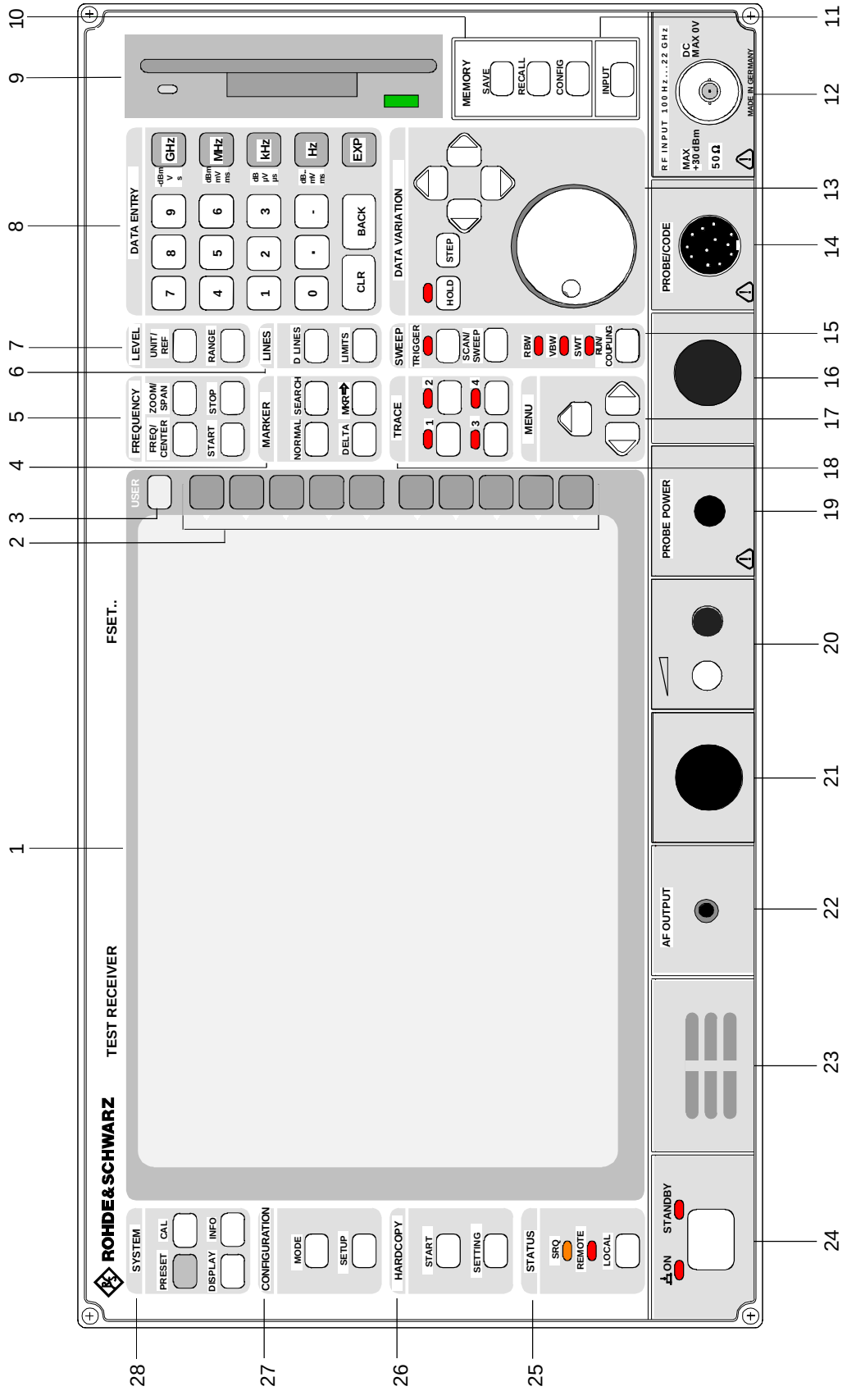
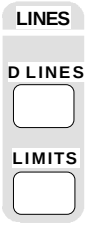


Fig. 1-1 Front View

6 LINES



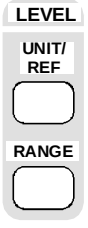
Setup evaluation lines and tolerance limits

D LINES Setup evaluation lines (display lines)

LIMITS Definition and recall of tolerance limits

see Chap. 4

7 LEVEL



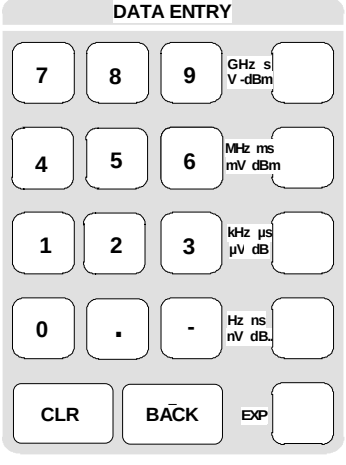
Define reference levels and display range in the active measurement window.

UNIT/ REF Set unit etc.
Set reference level (= max. display level)

RANGE Set range

see Chap.4

8 DATA ENTRY



Keypad for data input

0...9 input numbers

. input decimal point

– change sign

CLR
– 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)

BACK erase last character input

GHz s
V -dBm
MHz ms
mV dBm
kHz µs
µV dB..
Hz ns
nV dB

The units keys close the data input and define the multiplication factor for each basic unit. For dimension-less or alphanumeric inputs, the units keys have weight 1. They behave, in this case, like the ENTER key.

EXP Append an exponent

see Chap.4

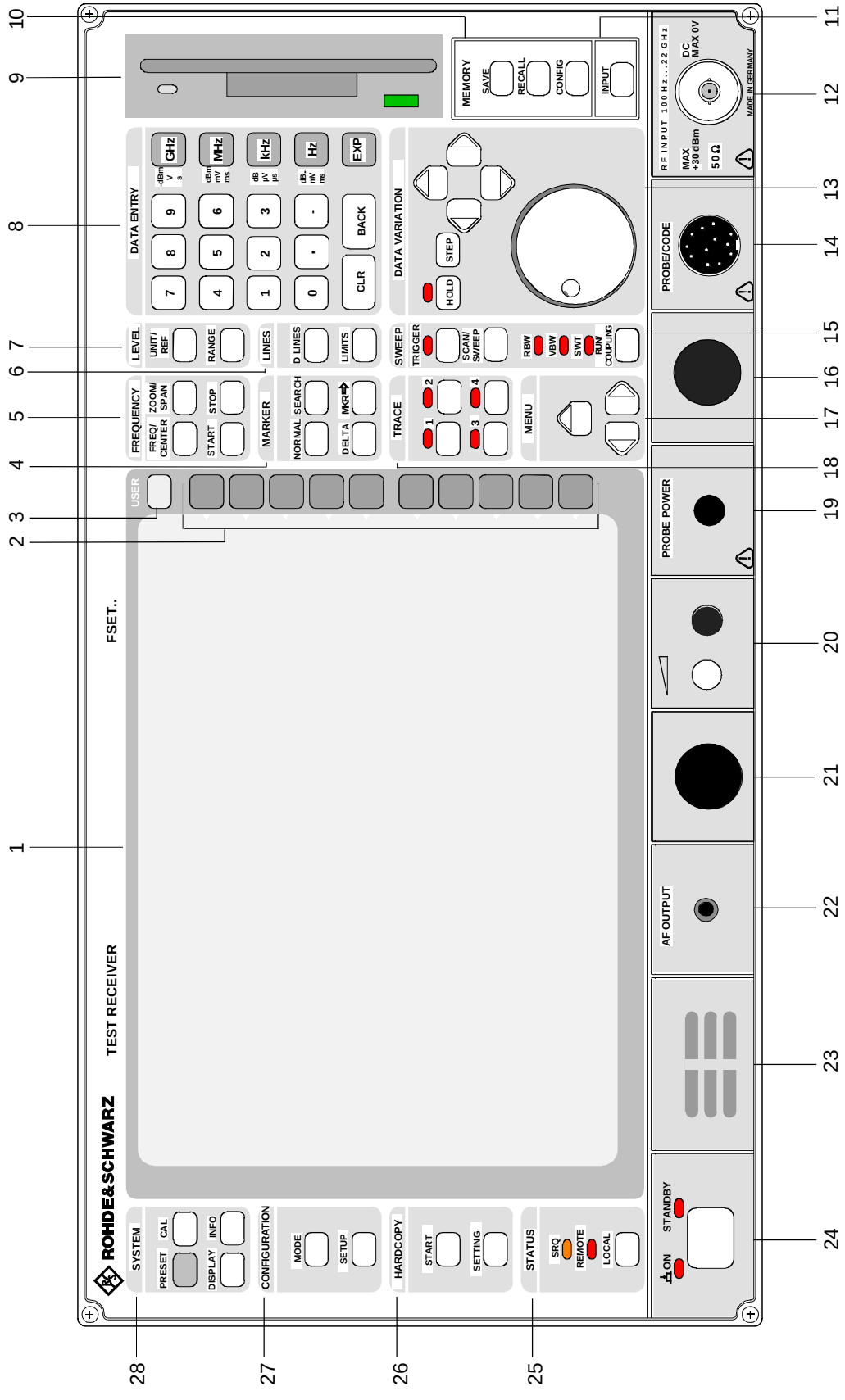
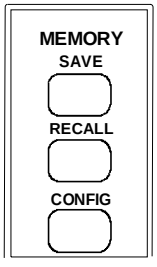


Fig. 1-1 Front View

9

3 1/2" diskette drive; 1.44 MByte

10 MEMORY

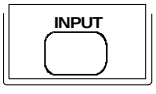


Memory media and file management

SAVE	Save instrument data
RECALL	Recall instrument data
CONFIG	Configuration of memory media and data

see Chap. 4

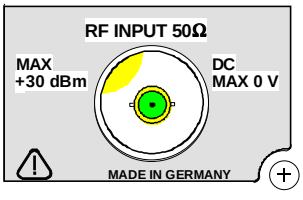
11 INPUT



Set impedance and attenuation at the RF input.

See Chap. 4

12 RF INPUT



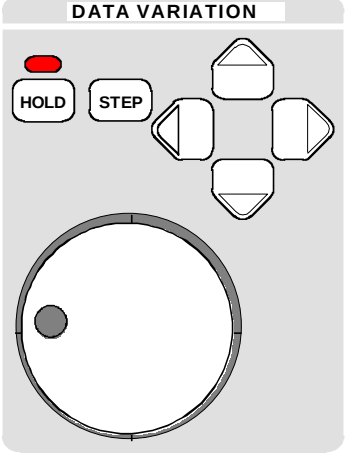
RF-Input (22 GHz model)



Caution:
The maximum DC voltage is 0 V, the maximum power is 1 W (≙ 30 dBm at ≥ 10 dB attenuation)

see Chap. 8

13 DATA VARIATION



Key group for entering data and for cursor movement

HOLD	Disable control elements / overall control. The LED indicates the hold condition.
STEP	Set step size for cursor keys and roll-key.
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

see Chap. 3

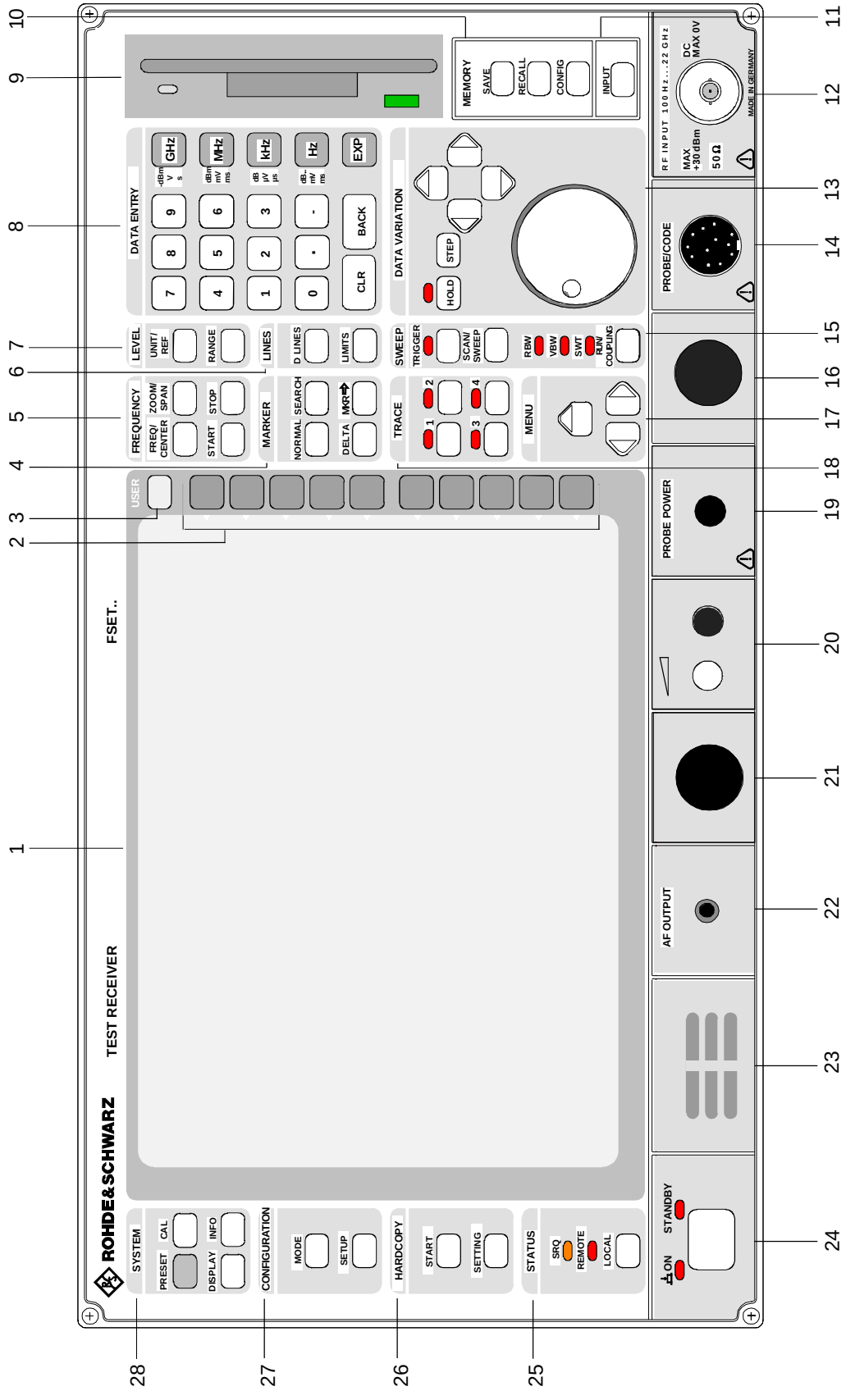
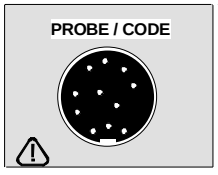


Fig. 1-1 Front View

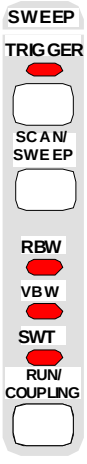
14 PROBE/CODE



Power supply and coded socket for R&S accessories.(12-pin Tuchel)

see Chap. 8

15 SWEEP



Input sweep/scan parameters

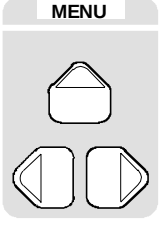
TRIGGER	Set trigger source. The LED illuminates on valid trigger.
SCAN/ SWEEP	Define the scan parameters (receiver)or define the sweep mode (analyzer and vector analyzer).
RUN/ COUPLING	Set coupled parameters in analyzer mode. resolution bandwidth (RBW), video bandwidth (VBW) and sweep time (SWT). The LEDs light indicating coupled parameters which are manually cancelled. Set analog bandwidth in vector analyzer mode. Start scan in receiver mode.

see Chap. 4

16

Reserved for options

17 MENU



Menu-change keys

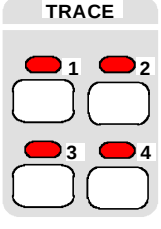

Call main menu


Change to left menu


Change to right menu

see Chap. 3

18 TRACE



Select and activate measurement traces (Trace 1...4).

The LEDs indicate traces turned on.

see Chap. 4

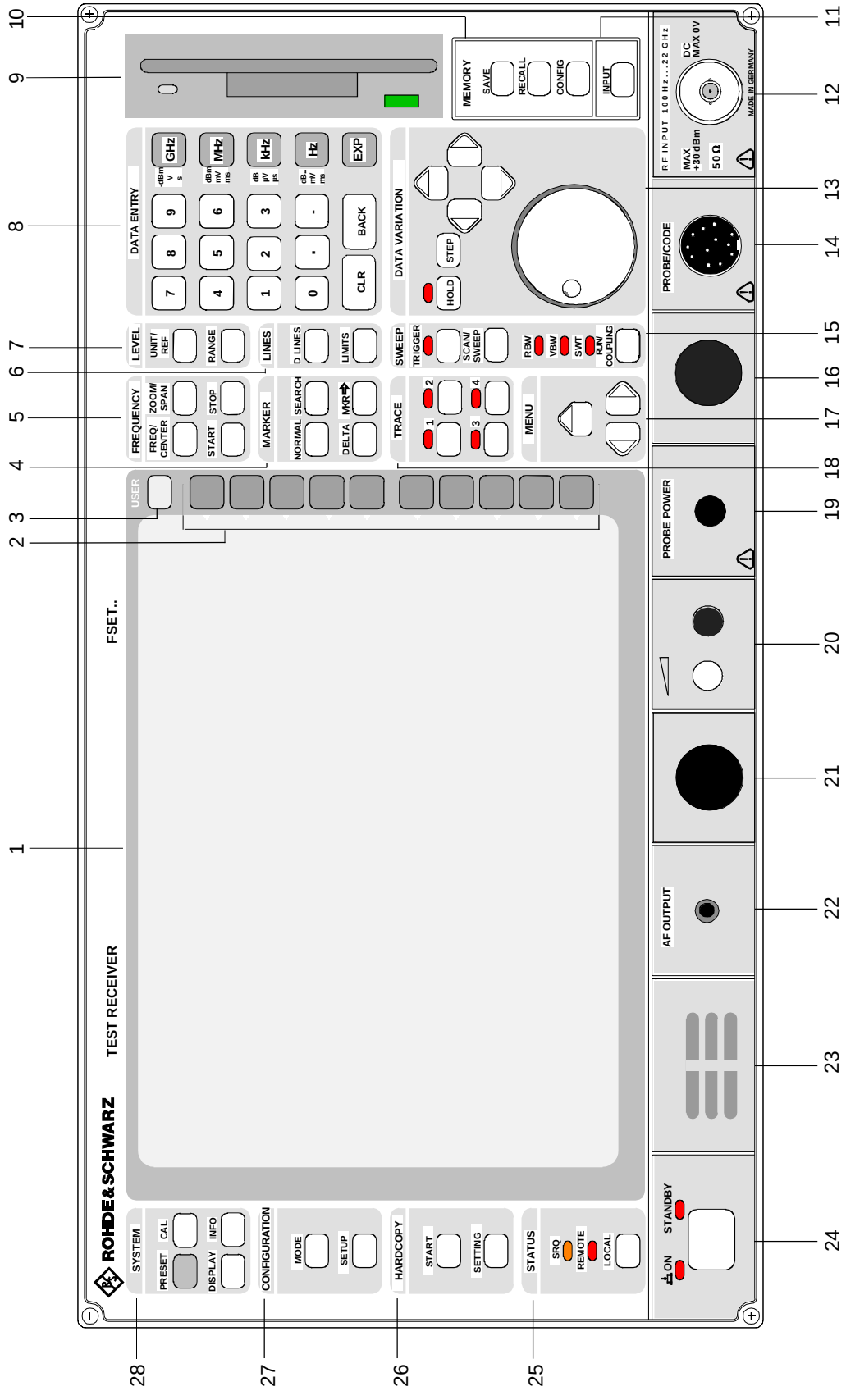
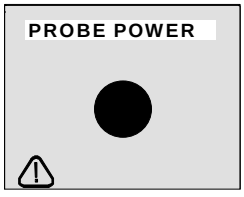


Fig. 1-1 Front View

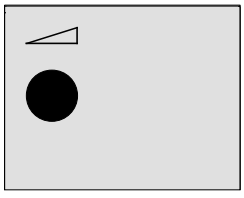
19 PROBE POWER



Power supply connector (+15V / - 12.6V) for measurement accessories (probes)

see Chap. 8

20

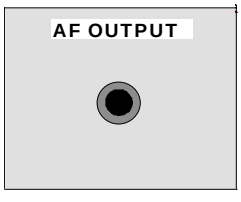


Volume control

21

Reserved for options

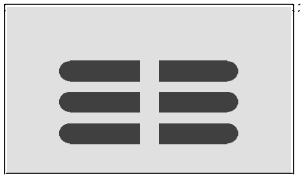
22 AF OUTPUT



AF output connector (head phones) (miniature phone jack)

see Chap. 8

23

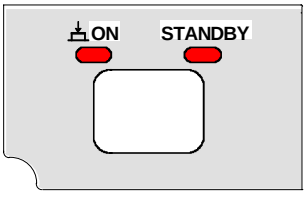


Internal loudspeaker

The loudspeaker is disabled when the phone jack is inserted in the AF output.

see Chap. 8

24



ON/STANDBY



Caution:
In standby mode, the AC line voltage is still present within the instrument.

see Chap. 1

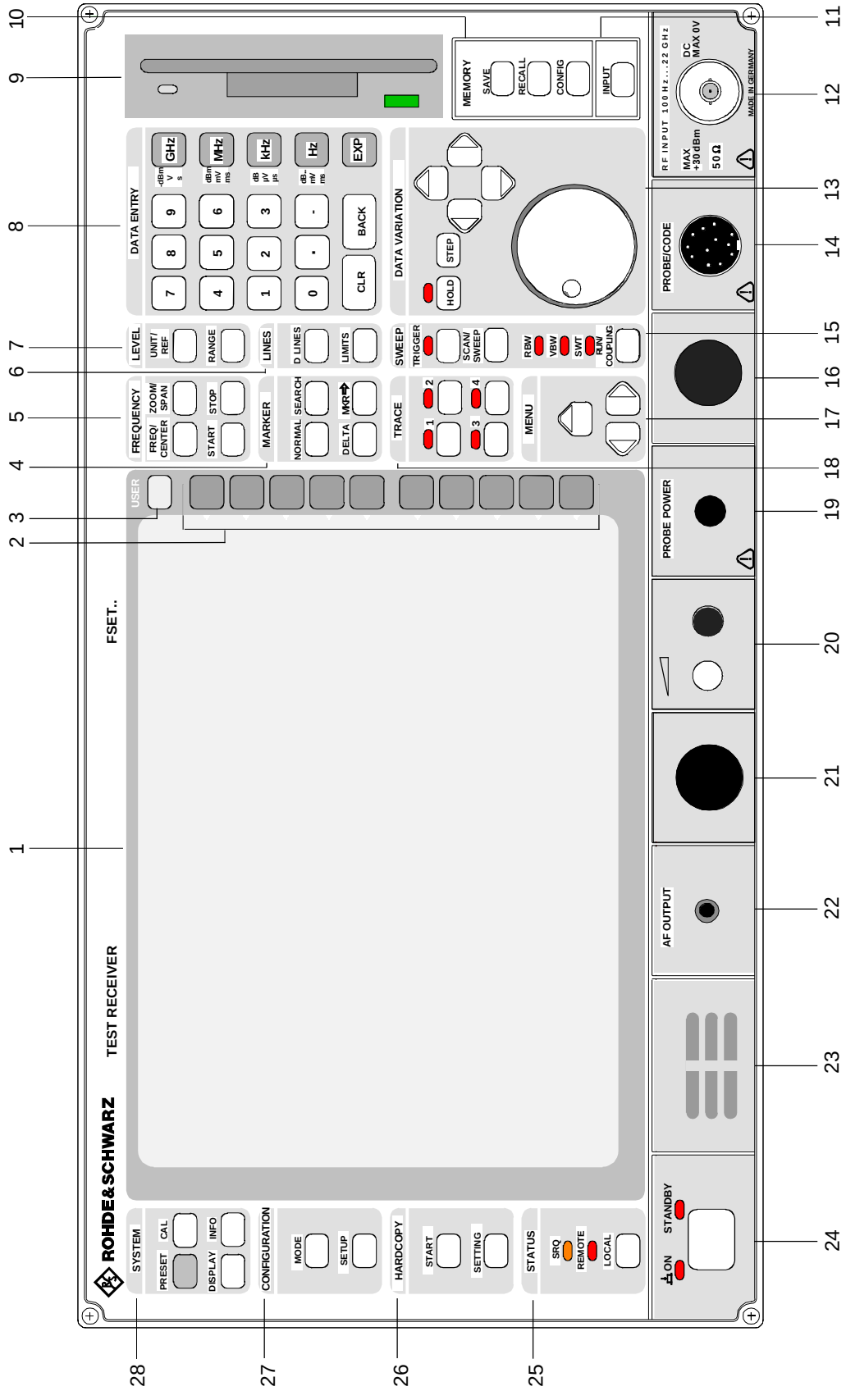
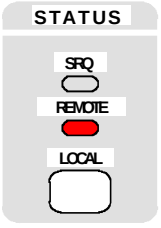


Fig. 1-1 Front View

25 STATUS



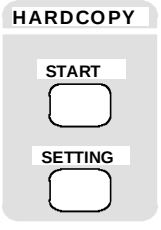
Indicators for remote control and switch for manual control.

LOCAL — Switch from remote to manual control.

The LED SRQ indicates that a service request from the instrument is active on the IEC Bus.
The LED REMOTE indicates that the instrument is under remote control.

see Chap. 4 and Chap. 5

26 HARDCOPY



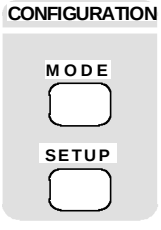
Printer control

START — Start a print job with the setup defined in the SETTING menu.

SETTING — Configure the diagram, parameter list and measurement protocol outputs on the various output media.

see Chap. 4

27 CONFIGURATION



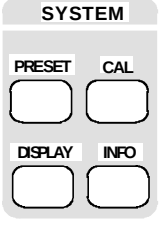
Select operational modes and define default settings

MODE — Select mode

SETUP — Define configurations

see Chap. 1 and Chap. 4

28 SYSTEM



General instrument default settings

PRESET — Recall instrument default settings

DISPLAY — Configure the display screen format

CAL — Calibrate the analyzer

INFO
- Information concerning instrument state and measurement parameters
- Call help functions

see Chap. 4

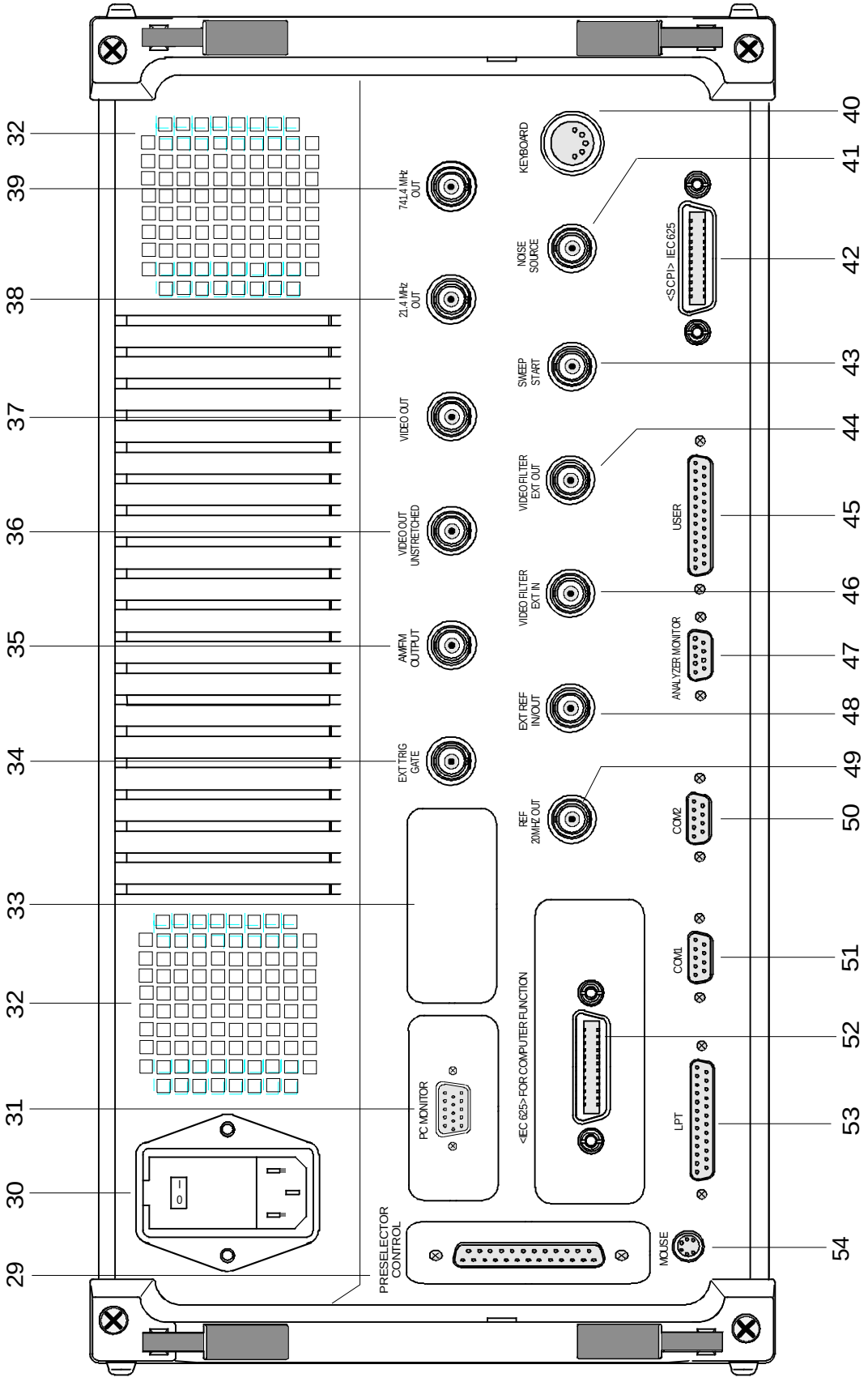
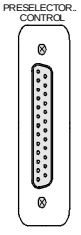


Fig. 1-2 Rear View

Rear View

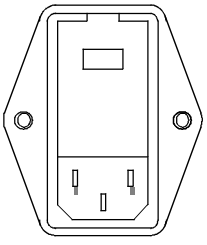
29 PRESELECTOR CONTROL



FSET-Z.. control

see Chap. 8

30



Power switch

Fuse holder

AC power connector

see Chap. 1

31 PC MONITOR



Connector for an external VGA monitor

see Chap. 8

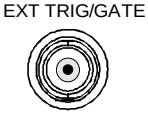
32

Power supply fans

33

Reserved for options

34 EXT TRIG/GATE



Input connector for an external trigger or an external gate signal

see Chap. 2
and
Chap. 8

35 AM/FM OUTPUT



Output connector for an AM or FM demodulated signal

see Chap. 8

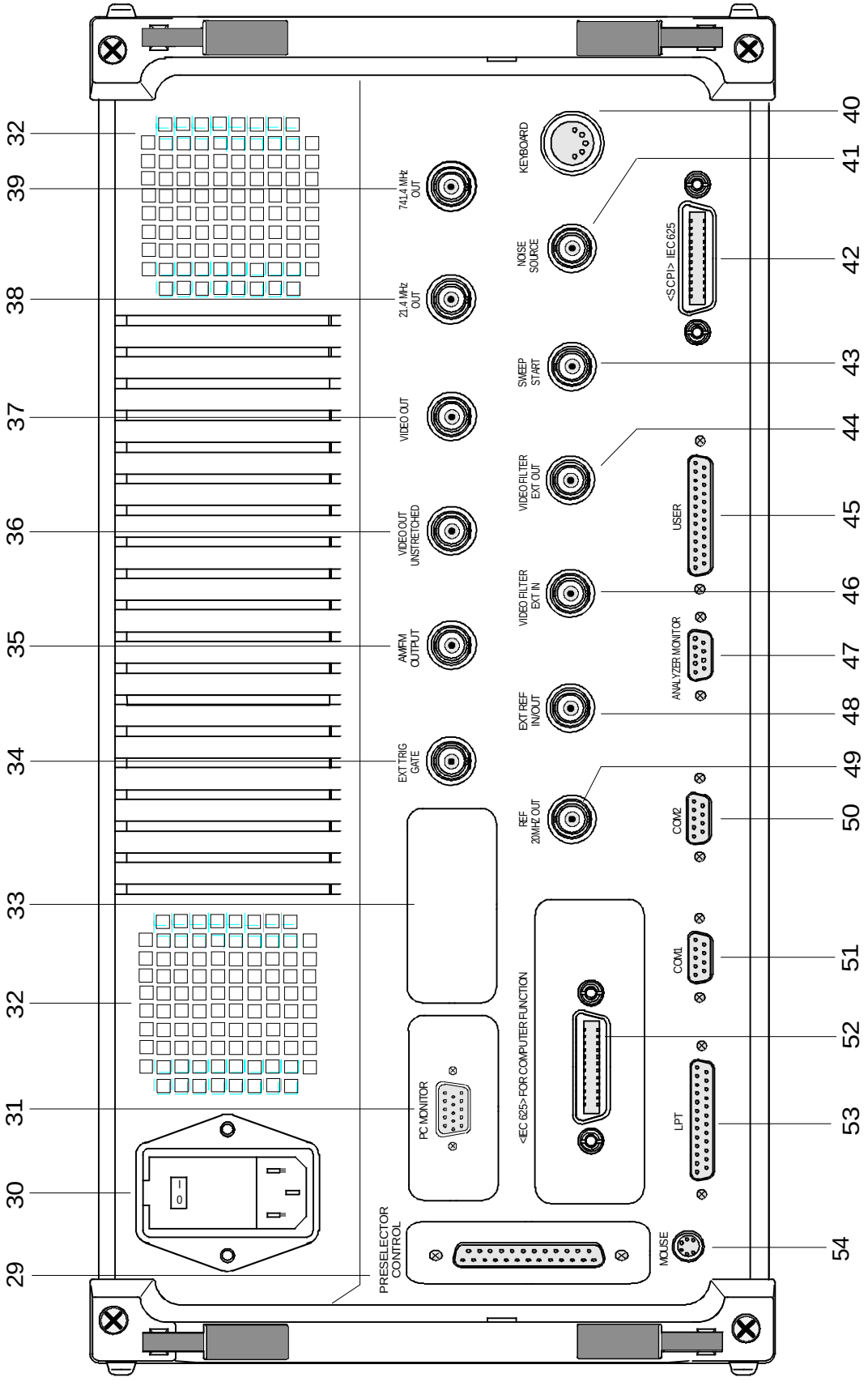


Fig. 1-2 Rear View

36 VIDEO OUT UNSTRECHED



Output connector for the unstretched video signal

37 VIDEO OUT



Output connector for the video signal (with pulse stretcher, if switched on)

see Chap. 8

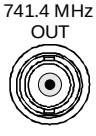
38 21.4 MHZ OUT



Output connector for 21.4 MHz

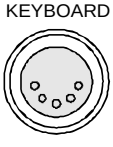
see Chap. 8

39 741.4 MHz OUT



Output connector for 741,4 MHz

40 KEYBOARD



Connector for an external keyboard (5-pin DIN socket)

see Chap. 1 and Chap. 8

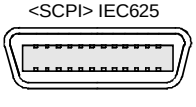
41 NOISE SOURCE



Output connector for a switchable noise source

see Chap. 8

42 <SCPI> IEC 625



IEC/IEEE- Bus-connector

see Chap. 8

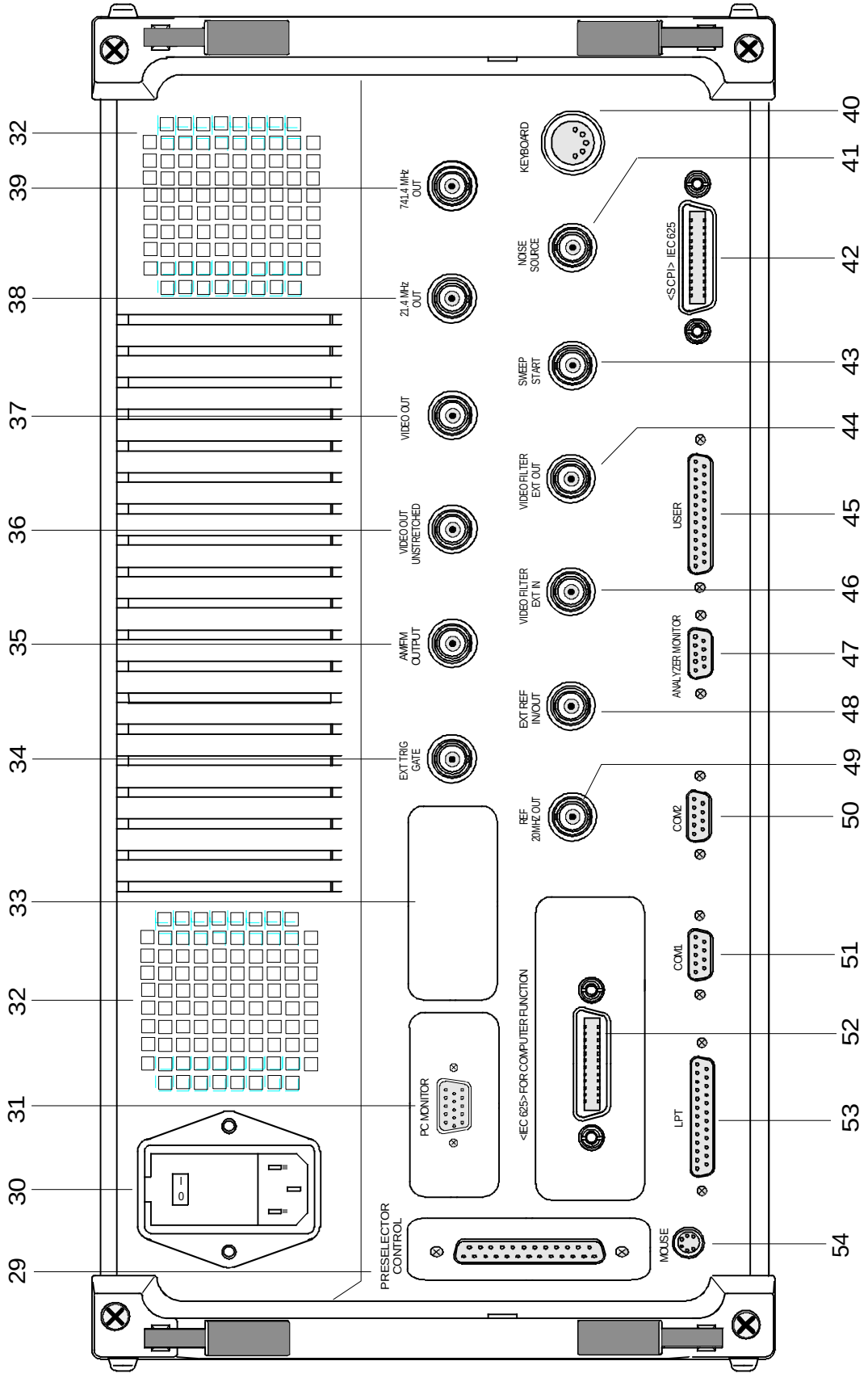


Fig. 1-2 Rear View

43 SWEEP START



Output connector

TTL level at sweep start.

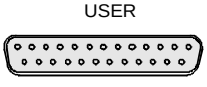
see Chap. 8

44 VIDEO FILTER EXT OUT



Output connector for an external video filter

45 USER



User interface connector with configurable inputs and outputs (USER-PORT A and USER-PORT B)

see Chap. 8

46 VIDEO FILTER EXT IN



Input connector for an external video filter

47 ANALYZER MONITOR



Connector for an external VGA monitor

see Chap. 8

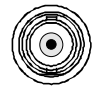
48 EXT REF IN/OUT



Input connector for an external reference (1 to 16 MHz) switchable to 10 MHz out put

see Chap. 8

49 REF 20 MHZ OUT



Output connector for FSET-Z.. (20 MHz reference)

see Chap. 8

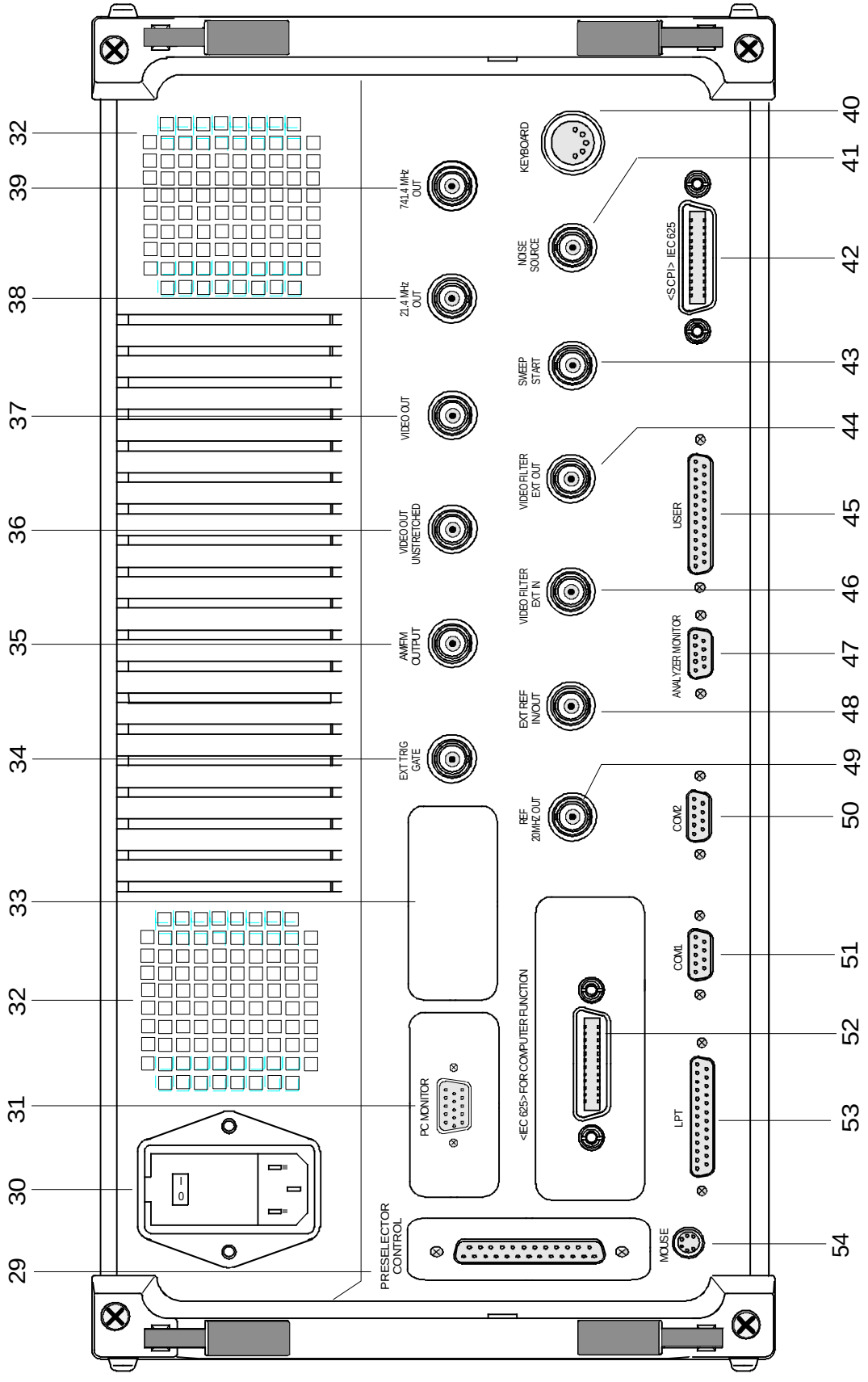


Fig. 1-2 Rear View

50 COM2



Connector for serial interface 2
(9-pin socket; COM2)

see Chap. 1
and
Chap. 8

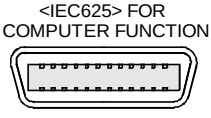
51 COM1



Connector for serial interface 1
(9-pin socket; COM1)

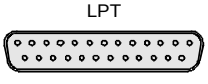
see Chap. 1
and
Chap. 8

52 <IEC625> FOR COMPUTER FUNCTION



Second IEC-bus connector

53 LPT



Parallel interface connector
(printer connector, Centronics compatible)

see Chap. 1

and
Chap. 8

54 MOUSE



Connector for a PS/2 mouse

see Chap.1
and
Chap. 8

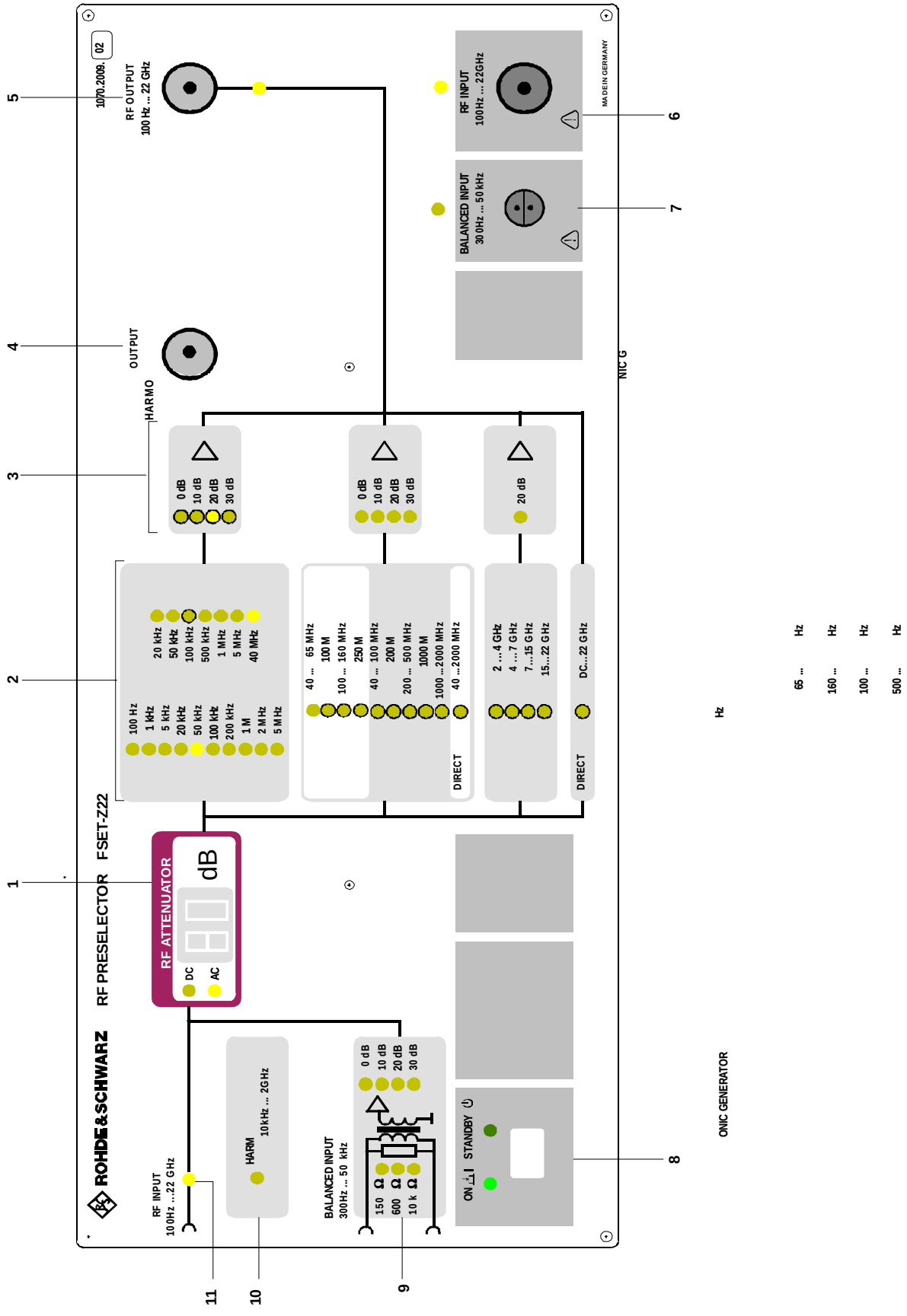


Fig. 1-3 Front view - FSET-Z22

Front View FSET-Z22

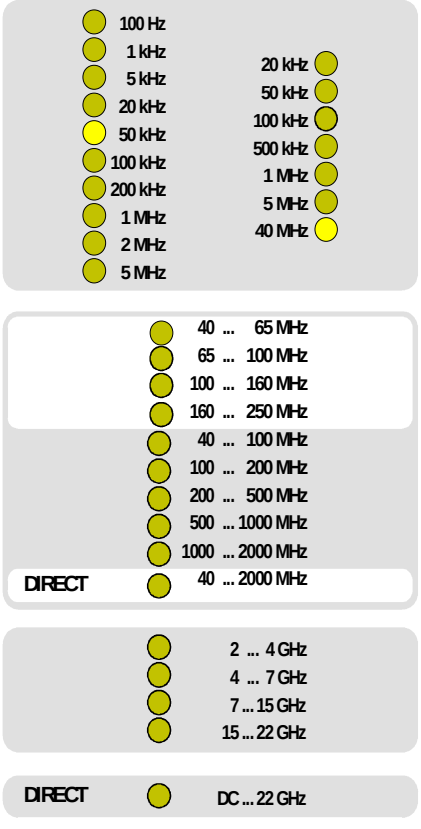
1 RF ATTENUATOR



Display of set RF attenuator and input coupling (AC/DC)

see Chap. 4

2



Display of active RF filter

see Chap. 4

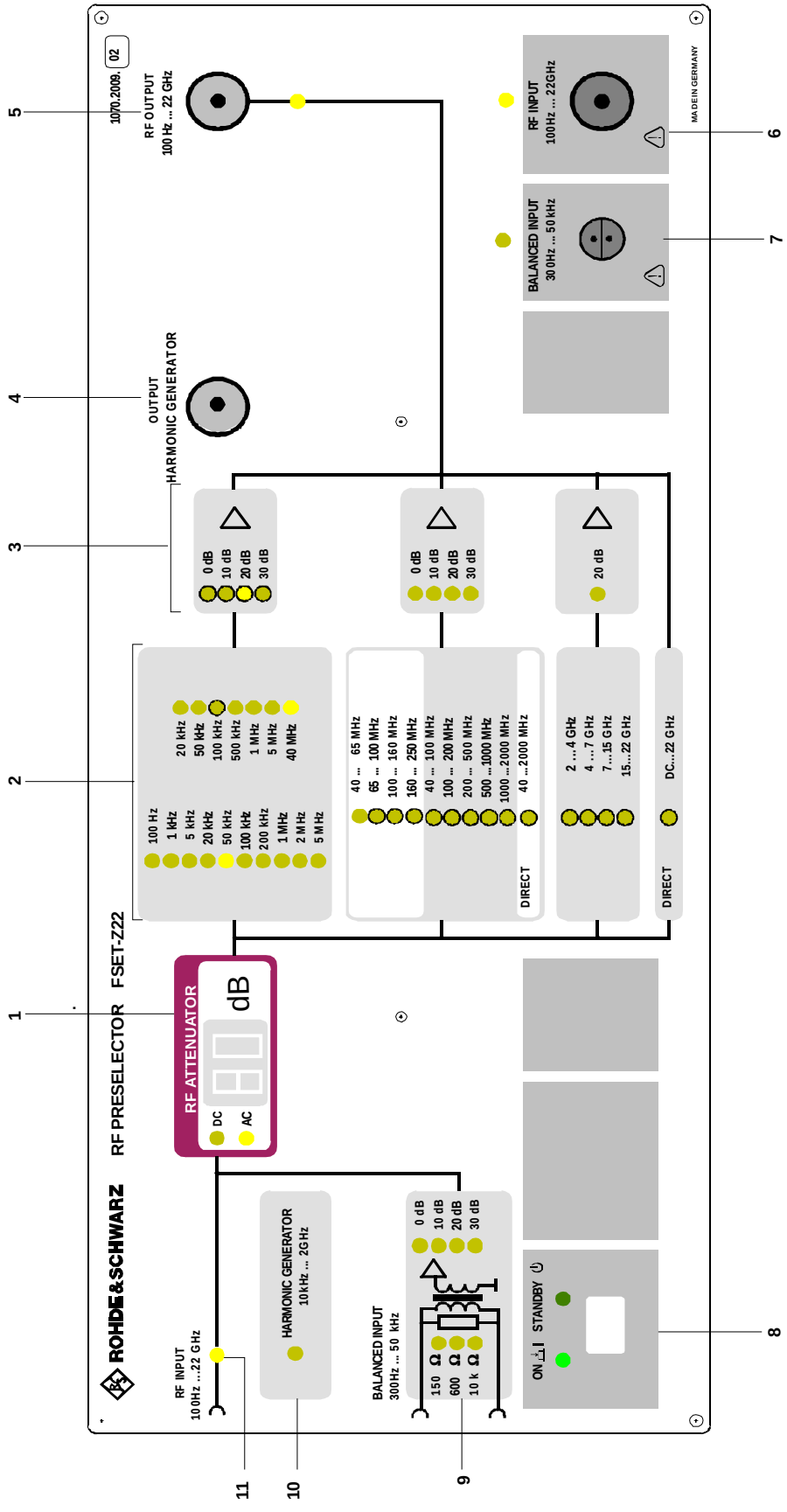
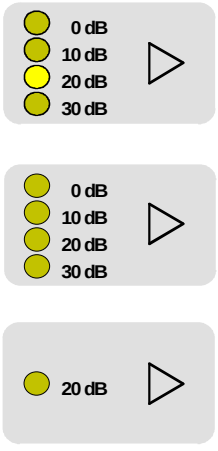


Fig.1-3 Front view - FSET-Z22

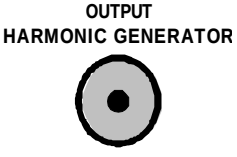
3



Display of active preamplifier

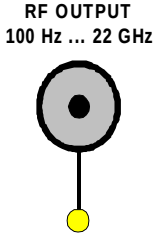
see Chap. 4

4 OUTPUT HARMONIC GENERATOR



Output connector of internal test signal

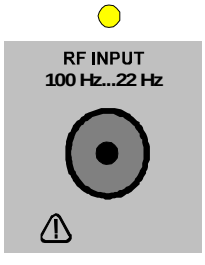
5 RF OUTPUT



Output connector of FSET-Z22 (connected with the RF input of FSET)

see Chap. 8

6 RF INPUT



RF input



Caution:
The maximum DC voltage for DC coupling is 0 V, the maximum power 1 W (≙30 dBm at ≥10 dB attenuation)

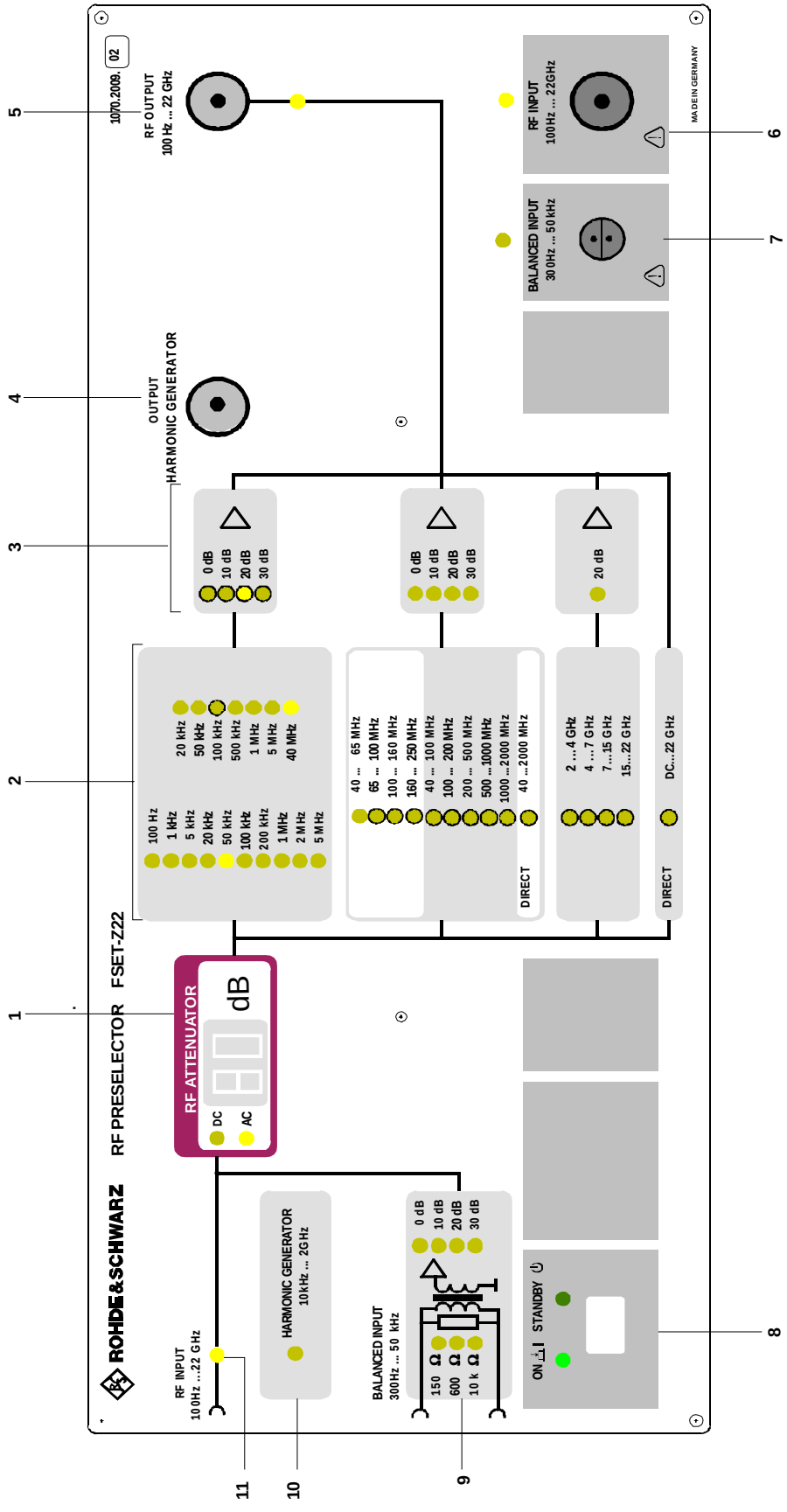
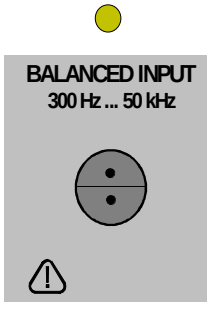


Fig. 1-3 Front view - FSET-Z22

7 BALANCED INPUT

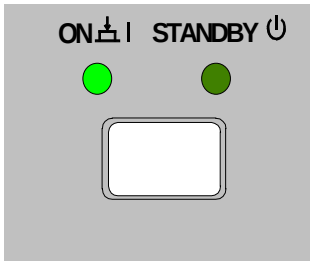


Balanced
RF input



Caution:
The maximum DC voltage is 0 V, the maximum power 1 W (≙30 dBm at ≥10-dB attenuation)

8 ON/STANDBY

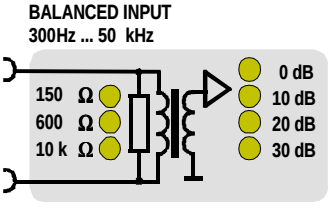


ON/STANDBY
switch



Warning:
In the standby mode the AC supply voltage is still applied to the unit.

9



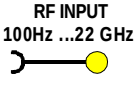
Display of the active balanced input, the input impedance and the gain.

10



Display for active test signal.

11



Display of active RF input.

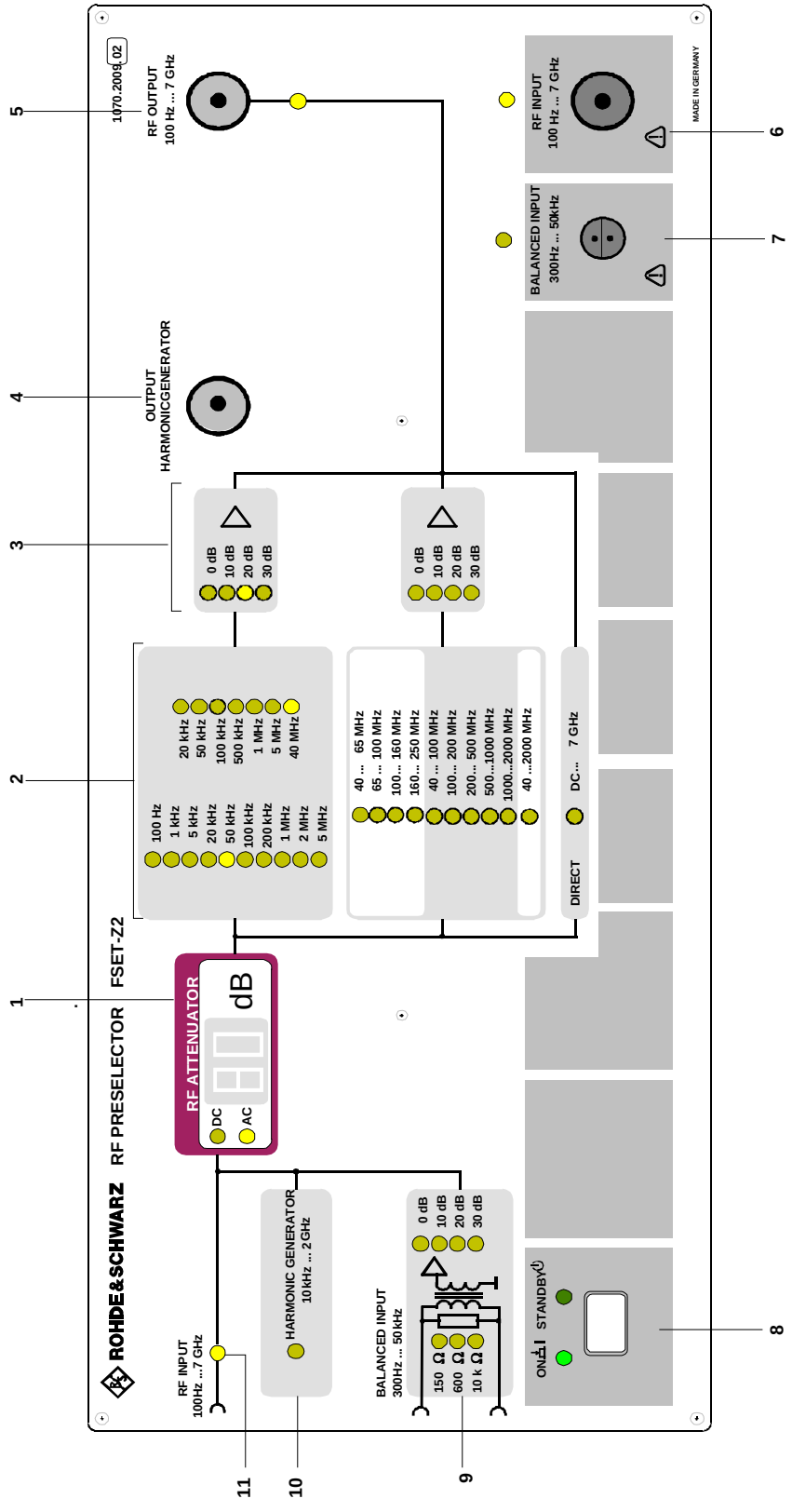


Fig. 1-4 Front view - FSET-Z2

Front View FSET-Z2

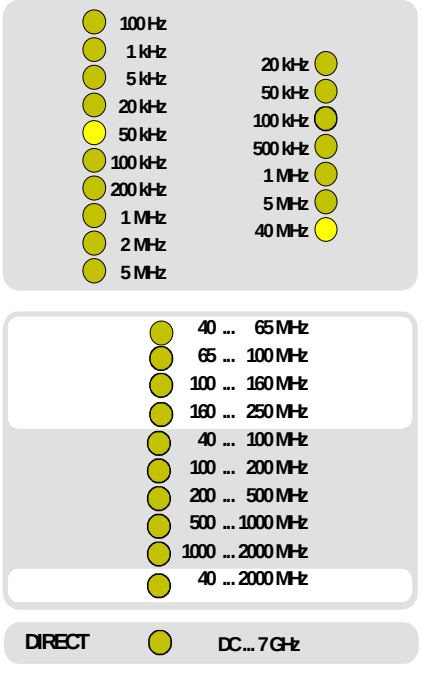
1 RF ATTENUATOR



Display of set RF attenuator and input coupling (AC/DC)

see Chap. 4

2



Display of active RF filter

see Chap. 4

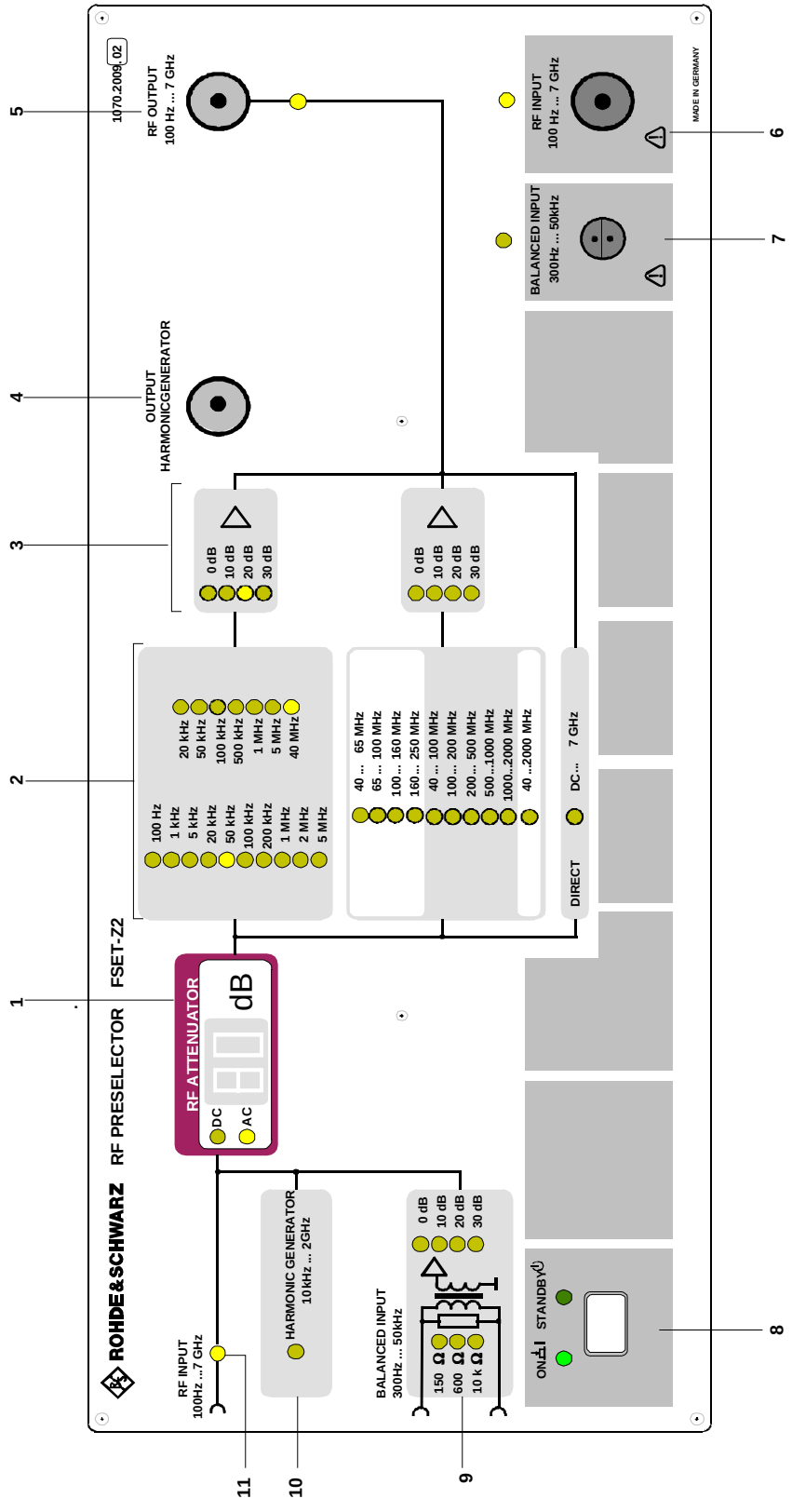
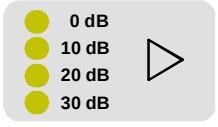


Fig. 1-4 Front view - FSET-Z2

3

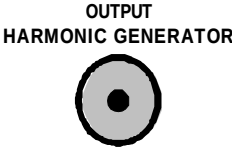




Display of active preamplifier

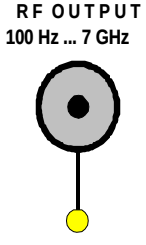
see Chap. 4

4 OUTPUT HARMONIC GENERATOR



Output connector of internal test signal

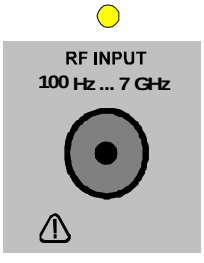
5 RF OUTPUT



Output connector of FSET-Z2 (connected with the RF input of FSET)

see Chap. 8

6 RF INPUT



RF input



Caution:
The maximum DC voltage for DC coupling is 0 V, the maximum power 1 W (≙30 dBm at ≥10-dB attenuation)

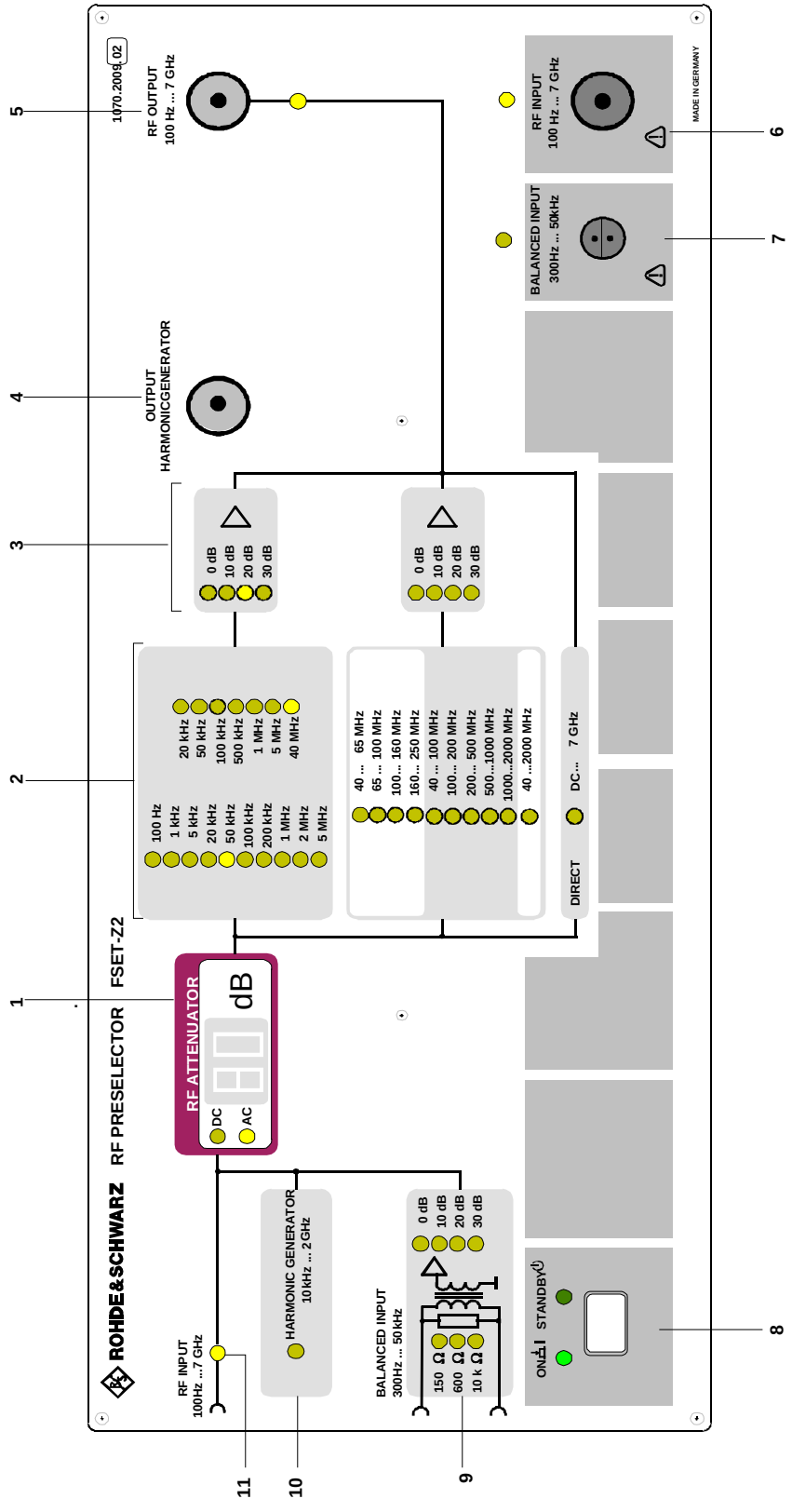
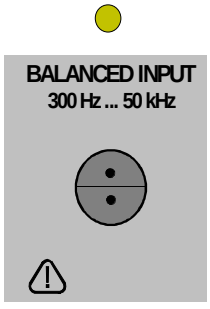


Fig. 1-4 Front view - FSET-Z2

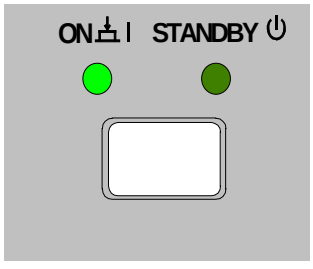
7 BALANCED INPUT



Balanced
RF input

Caution:
The maximum DC voltage is 0 V, the maximum power 1 W (≙30 dBm at ≥10-dB attenuation)

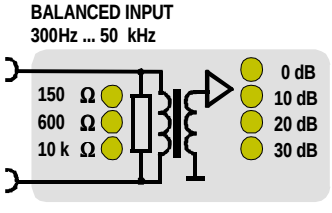
8 ON/STANDBY



ON/STANDBY
switch

Warning:
In the standby mode the AC supply voltage is still applied to the unit.

9



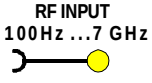
Display of the active balanced input, the input impedance and the gain.

10



Display for active test signal.

11



Display of active RF input.

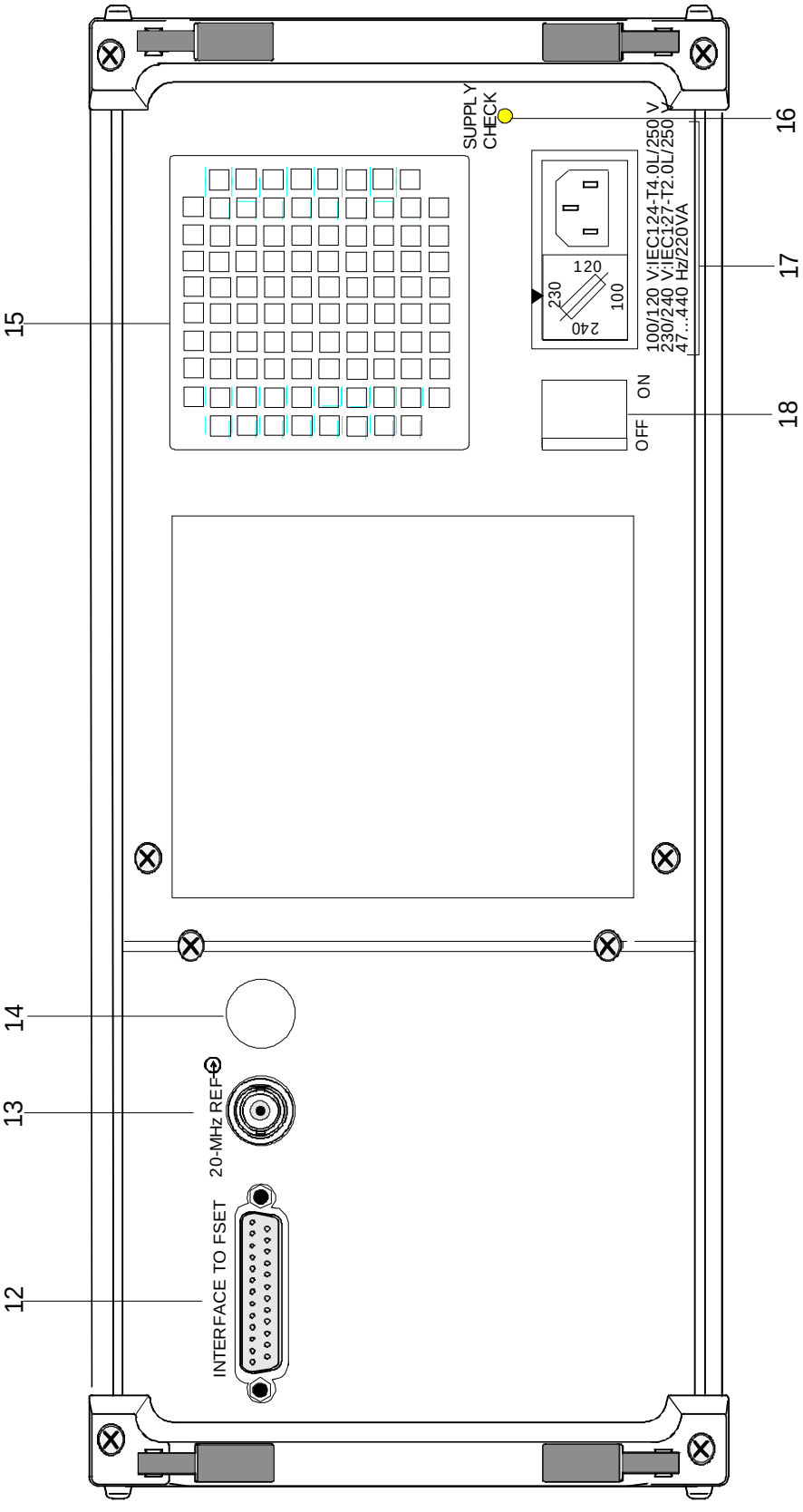
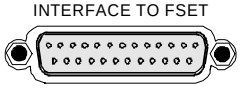


Fig. 1-5 Rear view FSET-Z..

Rear View FSET-Z..

12 INTERFACE TO FSET



see Chap. 8

13 20-MHz REF



Reference frequency of FSET

see Chap.8

14



Opening, provided for options

15

Blower

see Chap. 8

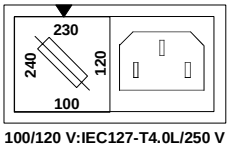
16



Status display of power supply

- ✸ power supply operates correctly
- ● power supply out of order or overloaded

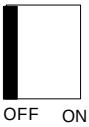
17



100/120 V:IEC127-T4.0L/250 V
230/240 V:IEC127-T2.0L/250 V
47 ...440 Hz/220VA

Power plug with fuse holder

18



Power switch

see Chap. 1

Start-Up

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

Important Note:

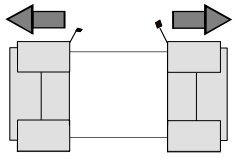
Before turning the instrument on, check the following:

- *instrument covers are in place and screwed down,*
- *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.*

***The instrument may be damaged if the above conditions are not observed**.*

Note: *The following description is based on the precondition that Test Receiver FSET is equipped with option RF Preselector FSET-Z...*

Unpacking the Instrument



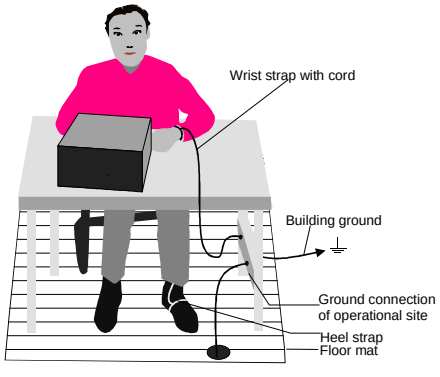
remove protective caps

- Take the instrument out of its transport container and check whether the items listed in the packing list and in the lists of accessories are all there.
- Remove the two protective covers from the front and rear of the FSET and carefully check the instrument for damage.
- Should the instrument be damaged, immediately notify the carrier which shipped the instrument to you and keep the container and packing material.
- For further transport or shipment of the FSET the original packing should also be used. It is recommended to keep at least the two protective covers for the front and rear to prevent damage to the controls and connectors.

Setting up the Instrument

Mechanical connection of the two units " "Stand-alone Operation

The instruments are designed for use under general laboratory conditions. The ambient conditions must be as follows:



- The ambient temperature must be in the range recommended 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 from the wall should be at least 10 cm.
- The FSET should be placed on a level surface.
- In order to avoid damage of electronic components of the instrument or of the device under test due to electrostatic discharge on manual touch, protection of the operational site against electrostatic discharge is recommended.

The two units are mechanically connected to each other.

- Position FSET onto FSET-Z.. so that FSET feet lock into rail of the FSET-Z.. front frame.
- Remove caps (total of 8) at sides of units.
- Screw the two units together with the 4 fasteners supplied (8 knurled screws).

Electrical Connection of the Two Units

Once the two units are joined mechanically, the electrical connections are made using the cables supplied.

- Connect RF-INPUT of FSET with RF-OUTPUT of FSET-Z.. using the RF cable.
- Connect FSET-Z.. CONTROL of FSET with INTERFACE TO FSET of FSET-Z.. using the control cable. For mechanical protection of this connection use the two locking screws at each connector.
- Connect REF 20MHz OUT of FSET with 20-MHz REF of FSET-Z.. using the coaxial cable." "For applications in the laboratory or on a work bench, it is recommended that the support feet on the bottom of the instrument be extended. For the LCD display, this provides the optimum viewing angle which typically ranges from perpendicular to the display front to approximately 30° below.

19" Rack Installation



Important Note:

When the instrument is rack-mounted, ensure that the air flow through the side-panel holes and the air outlet in the rear panel are not obstructed.

The instruments may be mounted in a 19" rack by using the rack adapter kit ZZA-95 (order number: see data sheet). The installation instructions are included in the adapter kit.

EMI Protection Measures

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

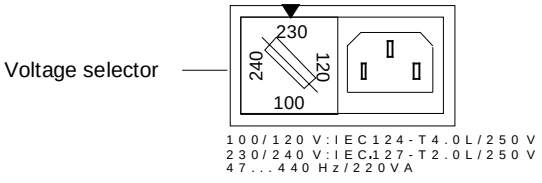
Connecting to AC Supply

The FSET features automatic AC-line voltage selection (range: see power supply name-plate). The AC power connector is located on the rear panel (see below).

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

FSET" "FSET-Z.. is factory-set to an AC supply voltage of 220 V. If the local AC supply voltage differs from this value by more than ±10%, the voltage selector is to be adjusted and the fuse at the rear of FSET-Z.. replaced according to the type plate.

Setting the AC supply voltage and replacing the fuse





Caution:

Disconnect low-power connector prior to setting the AC supply voltage.

- Lift off plastic cover of voltage selector (see above) from line filter using a screwdriver.
- Use appropriate fuse according to type plate.
- Put back plastic cover so that the arrow on the frame points to the required voltage value.
- Connect FSET-Z.. to AC supply using the power cable provided.

AC Power Line Fuses

The FSET is protected by two fuses as specified on the power supply name-plate. The fuses are located in a removable fuse holder which is located between the AC power switch and the AC power connector (see below).

FSET-Z.. is fused according to the type plate of the power supply unit. The fuses are located in the fuse holder below the plastic cover of the voltage selector (see above). Spare uses are contained in the unit.

Switching the Instrument on/off

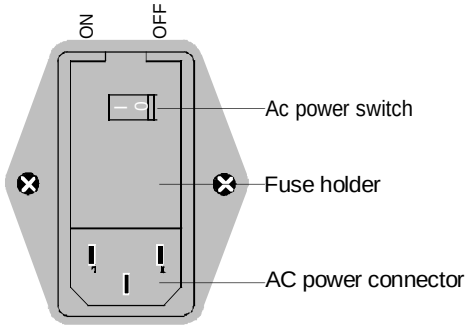
Caution:

Do not power down during booting. *This may corrupt harddisk files.*

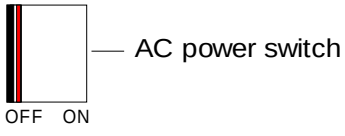
Note: *On power-up, the drive should contain no disk, since otherwise the instrument will try to boot from the disk.*

AC power switch on the rear panel

FSET:



FSET-Z..:



Power switch

After turn-on (position ON), the instruments are in the ready state (STANDBY) or in operation dependent upon the position of the ON/STANDBY switch located on the instrument front panel (see below).

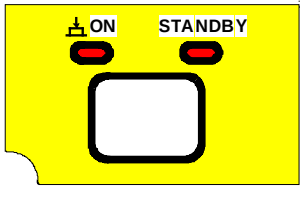
Note: *The AC power switchs can be left ON all the time.. Switching to OFF is only required when the instruments has to be completely disconnected from the AC power source.*

Switching to OFF (position OFF) disconnects the FSET completely from the AC power source.

.

ON/STANDBY switch on the front panel

FSET:



Standby

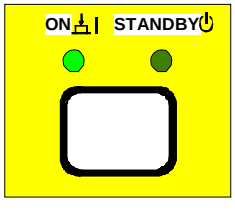
➢ ON/STANDBY switch is not depressed.

The yellow LEDs (STANDBY) are on. Only the FSET‘s internal power is connected to the AC line. The crystal oven is maintained at the normal operating temperature.

Caution:

In standby mode, the FSET *is still live.*

FSET-Z..:



Operation

➢ ON/STANDBY is pressed.

The green LEDs (ON) are on. The instruments are ready for operation. All modules within the instrument are supplied with power.

Switching on the Instrument

- To switch on the FSET, set the power switch on the rear panel to position I.
- Pressing the *ON/STANDBY* key on the front panel. The green LED ahould come on.

Startup Menu and Booting

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

Windows NT is booted first and then the instrument firmware. As soon as boot up is over, 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 *AUTO RECALL* in the *MEMORY* menu.

Switching off the Instrument

- Remove the disk, if any, from the drive before switching off.
- Press the ON/STANDBY key on the front panel. The yellow LED should come on.

Only when completely disconnecting the FSET from the AC power source:

- Set the power switch on the rear panel to position 0.

Energy Saving Mode

The FSET offers an energy saving mode for the screen display. The screen goes blank if no entries have been made from the front panel (key, softkey or hotkey and rollkey) for a selectable period of time.

To switch on the energy saving mode:

1. Call the *SYSTEM DISPLAY - CONFIG DISPLAY* submenu to configure the screen display:
   - Press the *DISPLAY* key
   - Press the *CONFIG DISPLAY* softkey
2. Activate the save mode
   - Press the *SCR. SAVER ON* softkey.
     The softkey is highlighted, indicating that the energy saving mode is on. At the same time the data entry for the shutdown time opens.
3. Enter the shutdown time
   - Press the *SCR. SAVER TIME* softkey.
   - Enter the shutdown time in minutes and confirm the entry using the *ENTER* key.
     The screen will go blank when the shut down time elapsed.

Battery Backed-up Memory

The FSET has a battery-powered read/write memory (CMOS-RAM) for backing up instrument settings on power-off. After each power-on, the FSET 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 AUTO RECALL (see Chapter 4 "Saving and Recalling Data Sets").

A lithium battery powers the CMOS-RAM. When the battery goes flat (after approx. 5 years), any data stored in the CMOS-RAM will be lost. If this happens, the factory setup is loaded on power up. As the FSET has to be opened to replace the battery, please contact the representative of our company responsible for you for changing batteries.

Function Test

On power up, the FSET displays the following message on the screen:

Receiver BIOS
Rev.x.y

Copyright
Rohde & Schwarz
Munich

Booting

A self-test of the digital hardware is then performed. If the self-test finds no faults, Windows NT is booted up and the instrument starts measuring.

Any errors which occur in self-test are transferred as ASCII text to the printer interface (LPT). Therefore, an error diagnosis can be carried out, even for serious failures.

A check of the data contents of the instrument is performed in system error correction (*CAL*, *CAL TOTAL* key) The individual results of the correction (PASSED / FAILED) can be displayed in the calibration menu.
With the aid of the built-in self-test functions (*INFO* key, *SELFTEST* soft key), the functional integrity of the instrument can be verified and/or defective modules can be localized.

Controller Function - Windows NT



Caution:

The drivers used in the integrated controller function are specially configured for the instrument. To prevent functions crashing, only the settings described below should be used. Only the update software released by Rohde&Schwarz should be used to update the drivers. Only programs authorized by Rohde&Schwarz for use on the instrument may be run on the instrument.

Do not power down during booting. *This may corrupt the harddisk files.*

The instrument has an integrated Windows-NT controller. The user can switch between the measurement screen and the controller screen. When an external monitor is connected, the measurement function and the controller function can be displayed simultaneously (see section "Connecting an External Monitor"). The controller function is automatically booted on power-up.
Windows NT operation is described in the supplied manual or in the online help of Windows NT.

Login

The user has to login to Windows NT by entering his name and password. As a factory default, the instrument is configured for *Auto Login*, i.e. the login is performed automatically and in the background. The user name used is then "instrument" and the password is also "instrument" (lower case).

To login under another name, call up the logout window in the task bar with START - SHUT DOWN. Mark the item "Close all programs and log on as a different user?" in the window and click YES while holding the SHIFT key down until the login window is displayed to enter the user identification. The password should be entered in the correct syntax including lower-case and upper-case characters.

Administrator identification

Some of the installations (eg CD-ROM drive) described below require the administrator login. This is indicated in the relevant window.
The administrator is an identification which in particular allows system settings which are disabled for the standard user.

The password for the administrator is 894129 for the instrument.

After an installation under the administrator identification, the "Service Pack X" of Windows NT has to be re-installed, see section "Installation of Windows NT Software".
On power-up following an installation under the administrator identification, the NT login window is displayed (no autologin). The user name "Administrator" is indicated in the window. This entry is to be replaced by "instrument" and then "instrument" as password entered. An autologin is then possible.

Changeover between measurement screen and controller screen

To call up the controller screen use key combination <ALT><SYSREQ> (US keyboard).
To return to the measurement screen, activate the window "R&S Analyzer Interface" on the controller.

Logout

The instrument can be switched off (standby mode). Logging out of Windows NT is not necessary.

Connecting a Mouse

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

A mouse can be connected to the PS/2 (MOUSE) connector on the rear panel of the instrument to make it easier to use.

MOUSE



During measurements, softkeys, tables and data input fields may also be controlled by mouse. For computer function, the mouse has the usual functions.

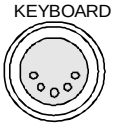
The control functions for the mouse during measurement operation are described in Chapter 3 in the section "Mouse Control of Further Display Elements". This section contains a list in which the screen display elements for mouse control of the corresponding softkeys and push buttons of the instrument are described. Chapter 8 describes the connector interface.

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

Connecting an External Keyboard

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.

The instrument is fitted with a rear-panel 5-contact DIN connector (KEYBOARD) for the connection of an external PC keyboard.



During measurements, the keyboard makes it easier to enter comments, filenames, etc. For computer function, the keyboard has the usual functions.

Chapter 3, in section "External Keyboard Control", contains a list which describes the assignment of the instrument front-panel key functions to the key codes of the external keyboard as well as special key combinations used for quick operations. Chapter 8 describes the interface for the connector.

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

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) as this would cause a malfunction.

Notes:
- *When connecting the monitor to the PC MONITOR connector, the display of controller function can be adapted to the external screen (eg higher resolution) in the NT menu START-SETTING - CONTROL PANEL - DISPLAY PROPERTIES.*
- *CHIPS (setting = both) should not be modified since otherwise switching between the external monitor and the instrument screen is not possible.*

The instrument is fitted with a rear-panel connector PC MONITOR or ANALYZER MONITOR for an external monitor.





Chapter 8 describes the connector interface.

With an external monitor it is possible to have an enlarged display of the measurement screen (ANALYZER MONITOR connector) or of the controller screen (PC MONITOR connector). The measuring instrument and the Windows NT controller can be operated in parallel. The mouse and the keyboard are allocated to only one mode.

Display of the measurement screen - Connection to ANALYZER MONITOR connector

Connection
After connecting the external monitor the measurement screen is displayed on both the external monitor and the instrument. Further settings are not necessary.

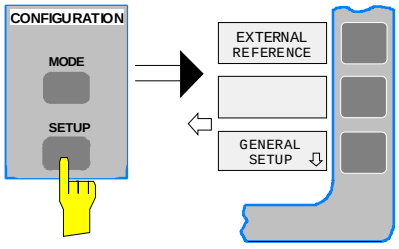
Operation
The instrument is operated as usual via its softkeys, the mouse and keyboard, etc..

Toggle between measurement screen and controller screen
Key combination <ALT><SYSREQ> is used to call up the controller. After call up, the mouse and keyboard are allocated to the controller function.
By activating the window "R&S Analyzer Interface" the user returns to the measurement screen and the mouse and keyboard are allocated to this screen.

Display of the controller screen - Connection to PC MONITOR connector

Connection
After connecting the monitor external monitor operation should be selected.

Setting is performed in the *SETUP-GENERAL SETUP* menu (key group: *CONFIGURATION*, see in Chapter 4, the section "Presettings and Interface Configuration"):



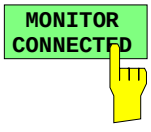
Call SETUP-GENERAL SETUP menu

➢ Press the *SETUP* key in the *CONFIGURATION* field.

The *SETUP* menu is opened.

➢ Press the *GENERAL SETUP* softkey.

The *GENERAL SETUP* submenu is opened and the current settings of the instrument parameters are displayed on the screen in the form of tables.



Selecting the external monitor mode

➢ Press the *MONITOR CONNECTED* softkey.

The softkey is in color to indicate that the external monitor mode is activated. The external monitor displays the controller screen.

Operation

The controller function is operated as usual with the mouse and keyboard. The measuring instrument (displayed on the instrument screen) can be operated with both the softkeys and keys of the instrument.

Toggle between screens

By activating (clicking) the window "R&S Analyzer Interface" at the controller the mouse and keyboard are allocated to the measurement screen. The mouse and keyboard are allocated to the controller when the window is deactivated.

Connecting a Printer



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

Notes:
- *The installation of some printer drivers is possible only under the administrator identification (see section "Controller Function").*
- *After the installation, the "Service Pack X" of Windows NT is to be re-installed, see "New Installation of Windows NT Software".*
- *To ensure that the instrument performs an autologin, the user identification is to be reset to "instrument" after the next power-up, see section "Controller Function".*
- *If bad printouts are produced after installing the printer driver, it is recommended to obtain the latest drivers from the printer manufacturer (eg via Internet). Experience has shown that printer problems are thus solved in most cases.*

The instrument provides an option for connecting up to three different printers to provide screen hardcopy.
The interfaces can also be used for printing in the controller mode. The output formats "WMF" (Windows Metafile) and "Clipboard" are preset. A large number of output devices can be connected under Windows NT after installing suitable printer drivers.
The output devices supported by the instrument can be found in the selection box *DEVICE/LANGUAGE* in the *HARDCOPY –SETTINGS DEVICE1/2* menu (see in Chapter 4, the section "Documentation of Measurement Results"). To print out via the COM interface, the latter must be assigned the controller function in the *SETUP - GENERAL SETUP* menu (owner = OS).
Chapter 8 describes the connector interfaces.

The interface connectors are located on the rear panel:



After the printer has been connected 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 the keyboard and mouse

Ti install and configure of printer drivers on the FSET, it is necessary to connect a keyboard to the front panel and a PS/2 mouse to the rear panel (see sections "Connecting a Mouse" and "Connecting a Keyboard").

2. Configuring of the interface

LPT1 — The LPT1 needs no configuration.

Note: *An external CM-ROM drive can be connected to this interface. If this is the case, one of the serial interfaces can be used for the printout.*

COM1/COM2 — The COM interfaces have to be assigned to the controller function (*OWNER = OS*) in the *SETUP - GENERAL SETUP* menu. The configuration of serial interfaces COM1 and COM2 can then be performed in the Windows NT menu START - SETTINGS - CONTROL PANEL - PORTS. The parameters *COM PORTS BAUDRATE*, *BITS*, *PARITY, STOPBITS, HW/SW-HANDSHAKE* must be those specified for the printer in question (see the operating manual for the output device).

Note: *The serial interfaces can be used for remote control when the analyzer is made the owner (Owner = Instrument). 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.

3. 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.

4. Configuration of the connected output device

The printer connected to the instrument is configured in the *HARDCOPY DEVICE–SETTINGS DEVICE1/2* menu (key group: *HARDCOPY*, see Chapter 4, Section "Selection and Configuration of the Output Device "). The configuration of one or two output devices (DEVICE1 and DEVICE2) can be entered, at least one of which must be activated for printing.

- The parameter *DEVICE/LANGUAGE* determines which printer is used.
- The parameter *PRINT TO FILE* determines if the output is written to a file.
- The parameter *ORIENTATION* sets the page format to horizontal or vertical (landscape or portrait).

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

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

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

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

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

Parameter	**Parameter name**	***DEVICE 1 settings***	***DEVICE 2 settings***
Output device	DEVICE	WINDOWS METAFILE	CLIPBOARD
Output	PRINT TO FILE	YES	---
Paper orientation	ORIENTATION	---	---

In the following example, an HP DeskJet 660C printer is connected to interface LPT1 and configured as *DEVICE2* for hardcopies of the screen.

Switch off FSET***.***

Connect printer to the LPT1 interface .

Switch on both the FSET ***and the printer.***

Select printer driver under Windows NT

➢ Press key combination <ALT> <SYSREQ>

The Windows NT screen is displayed.

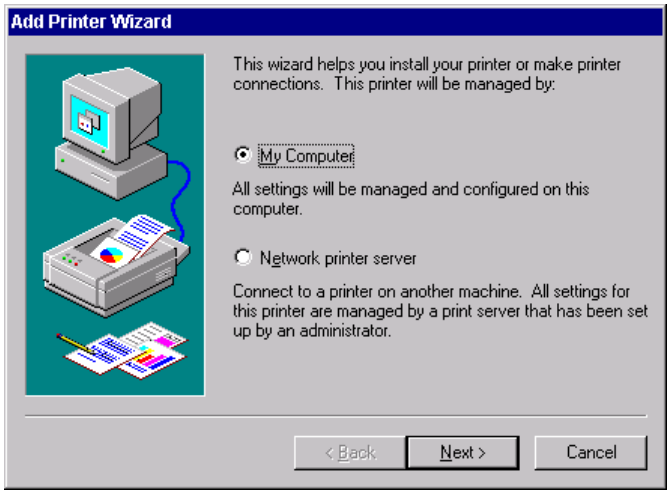


➢ In the Start menu click on "Settings" and then "Printers".

The printer window is opened.

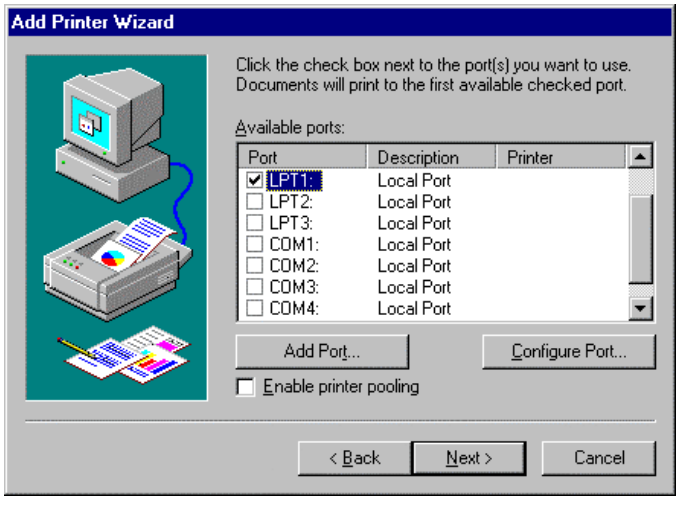
➢ Double-click "Add Printer".

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



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

The available ports are displayed.

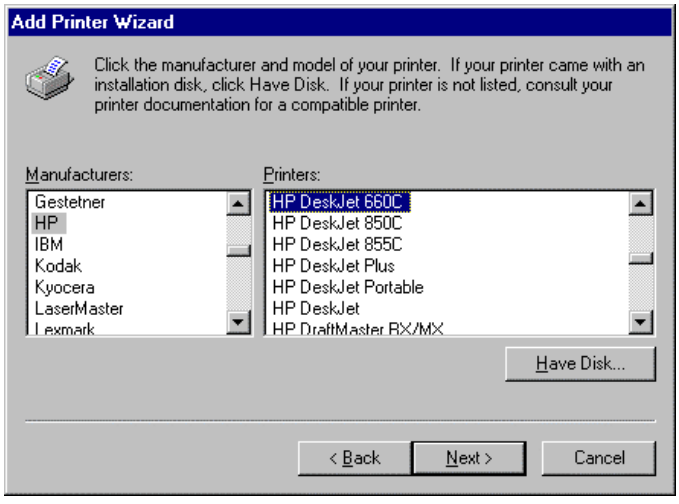


➢ Select LPT1 port.

The selection is indicated 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.

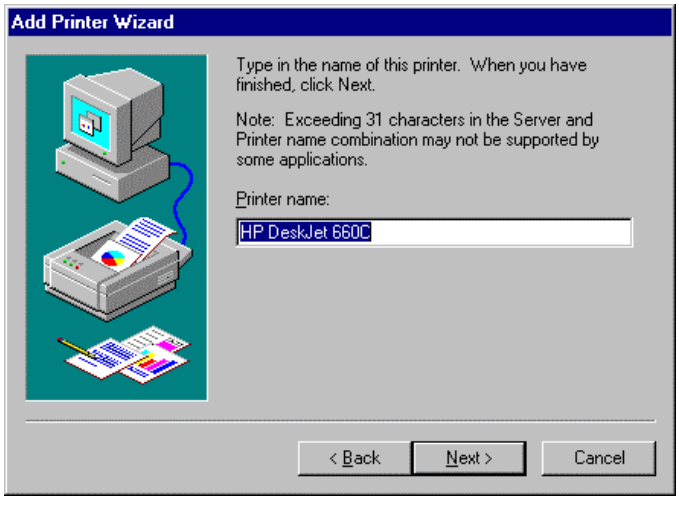


➢ Mark "HP" in the "Manufacturers" selection table and "HP DeskJet 660C" in the "Printers" selection table .

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

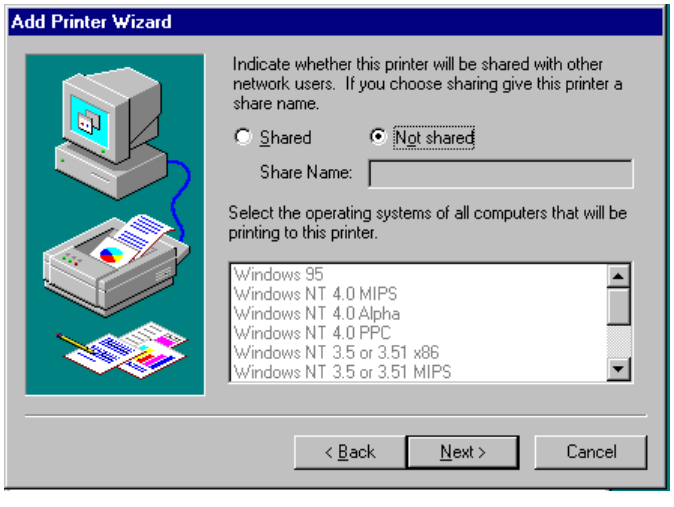
➢ Click "Next".

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 have already been installed, a query is displayed in this window to ask if the printer last installed as the default printer should be selected for the Windows NT applications (Do you want your Windows-based programs to use this printer as default printer?) "No" is preset.

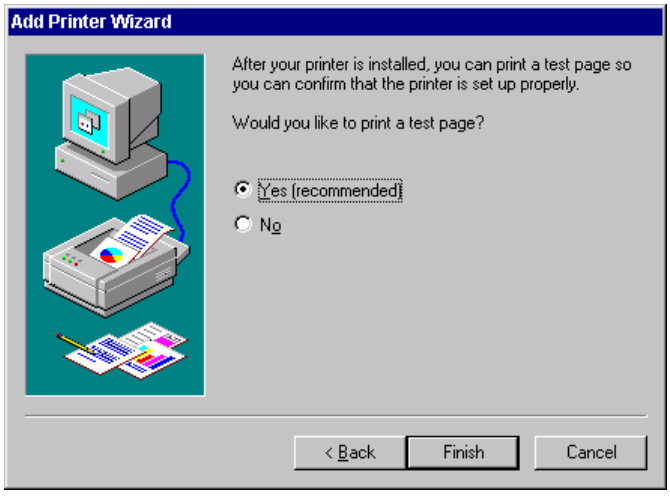


➢ Click "Next".

A query is displayed whether the printer is to be shared with other network users.. This query is irrelevant when installing a local printer. The answer "Not shared" is preset.

➢ Click "Next".

The window for printing a test page is displayed. The test page is for checking if the installation was successful.



- Switch on printer.
- Click Yes (recommended)".
- Click "Finish".

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

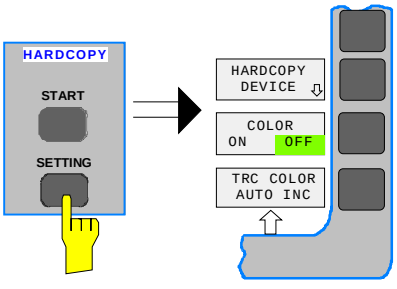
Note:
If a request for the printer driver path appears after clicking "Finish", this printer installation should be performed under the administrator identification (see section "Controller Function".

Now, the instrument needs to be configured so that hardcopies of the measurement screen can be printed out on this printer.

Configuring HP DeskJet 660C.

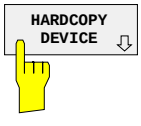
- Click the "R&S Analyzer Interface" button.

  The measurement screen is displayed.



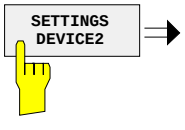
- Press the *SETTINGS* key in the *HARDCOPY* field.

  The *SETTING* menu is opened.



- Press the *HARDCOPY DEVICE* softkey.

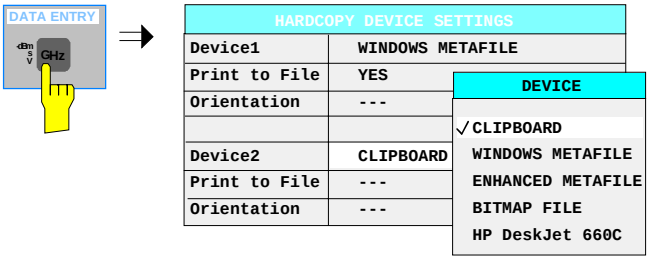
  The *HARDCOPY DEVICE* submenu is opened and the current settings of the two possible output devices are displayed in *HARDCOPY DEVICE SETTINGS*-table.



HARDCOPY DEVICE SETTINGS	
Device1	WINDOWS METAFILE
Print to File	YES
Orientation	---
Device2	CLIPBOARD
Print to File	---
Orientation	---

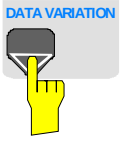
- Press the *SETTING DEVICE2* softkey.

  Line *DEVICE2* is marked with the selection bar.

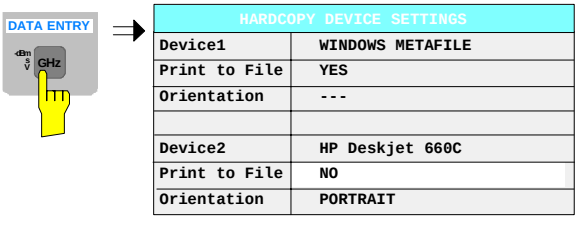


➢ Press one of the unit keys.

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



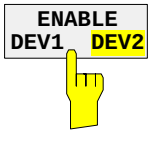
➢ Press the cursor key ⓘ until the entry *HP DeskJet 600C* is highlighted by the selection bar.



➢ Press one of the unit keys.

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

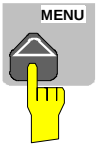
Note:
Selecting the printertype automatically sets the parameters PRINT TO FILE and ORIENTATION to standard mode values for this printer. Other printer-dependent parameters such as PAPERSIZE, can be modified under Windows NT in the printer properties window (START/SETTINGS/PRINTER/SETTINGS)..



Start printing.

➢ Press the ENABLE softkey until *DEV2* is marked on the second softkey line.

Printing can then be started with the START key in the *HARDCOPY* menu.

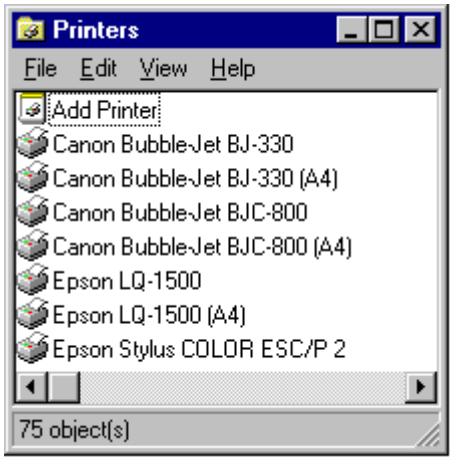


Return to main menu

➢ Press the menu key several times.

Note: *After the installation, the "Service Pack X" of Windows NT is to be re-installed, see "New Installation of Windows NT Software".*

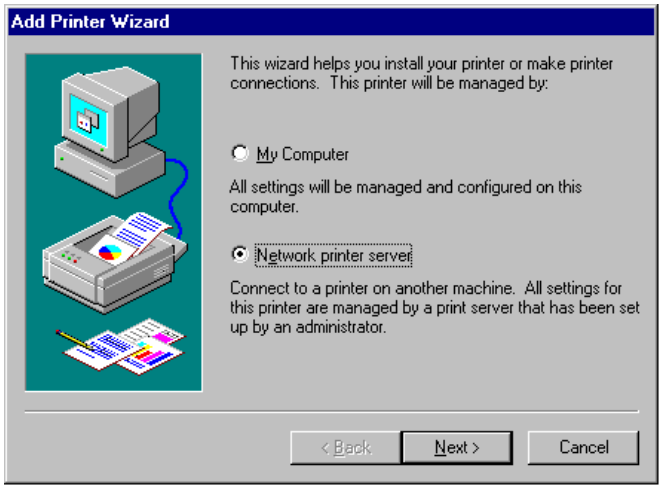
Installation of a Network Printer (with option FSE-B16 only)



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

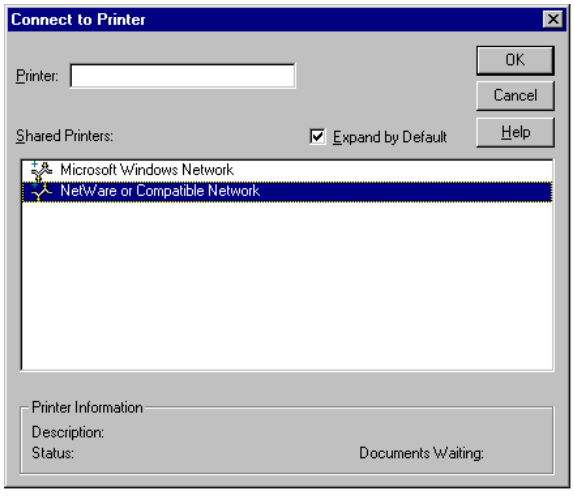
➢ Double-click the "Add Printer" line.

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



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

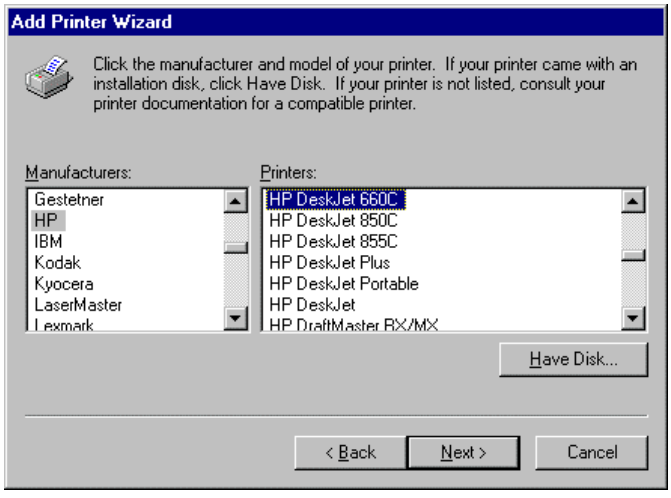
A window to set the path to the printer server is displayed.



➢ Set the path to the desired printer server, mark it 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.

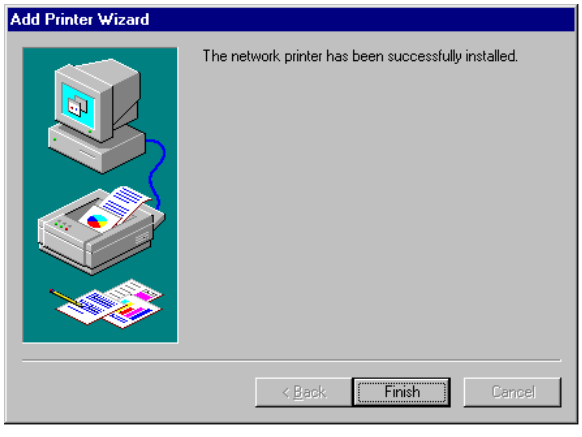


➢ Select the manufacturer in the "Manufacturers" window and then the printer driver in the "Printers" window.

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.

➢ 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").

After installation, the instrument has to be configured for printout with this printer in the *HCOPY - SETTINGS* menu.

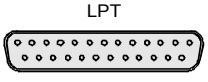
Finally, Service Pack x must be re-installed (see section "Installing Windows NT Software").

Connecting a CD-ROM Drive

Caution:
The CD-ROM may only be connected when the instrument is switched off (STANDBY). If this is not observed correct operation of the CD-ROM and the instrument cannot be guaranteed.

Notes:
- *The installation of a CD-ROM is possible only under the administrator identification (see section "Controller Function").*
- *After the installation, the "Service Pack X" of Windows NT is to be re-installed, see "New Installation of Windows NT Software".*
- *To ensure that the instrument performs an autologin, the user identification is to be reset to "instrument" after the next power-up, see section "Controller Function",*

The instrument is fitted with a rear-panel interface LPT1 for the connection of a CD-ROM drive.



The following CD-ROM drives are supported:

– MICROSOLUTIONS BACKPACK External CD-ROM.
– FREECOM IQ DRIVE
– ADAPTEC Parallel SCSI Adapter + SCSI CD-ROM

After connection, the CD-ROM drive is to be installed under Windows NT.

Switch off FSET.

Connect CD-ROM drive to interface LPT1 of the instrument and to AC power source.

Switch on FSET.

Administrator identification

➢ Press key combination <ALT> <SYSREQ>

The Windows NT screen is displayed.

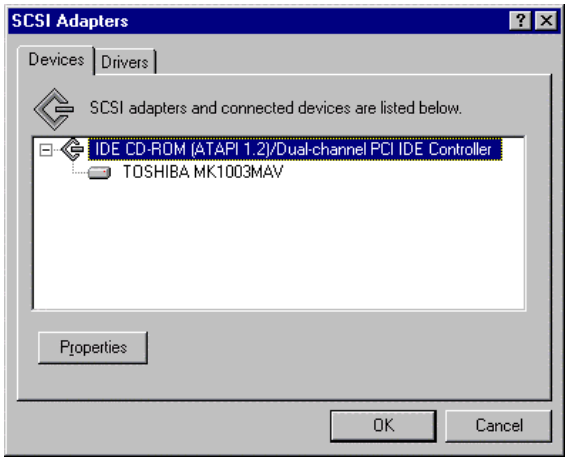
➢ Call the logout window with "Shut Down" in the "Start" menu.

➢ Mark entry "Shut down and log on as a different user".

➢ Press the "Shift" key and click button "Yes" at the same time.

The login window is displayed.

➢ Enter "administrator" under "name" and "894129" under "password", confirm entry with "OK".



Select driver under Windows NT

➢ In the Start menu press first "Setting" and then "Control Panel".

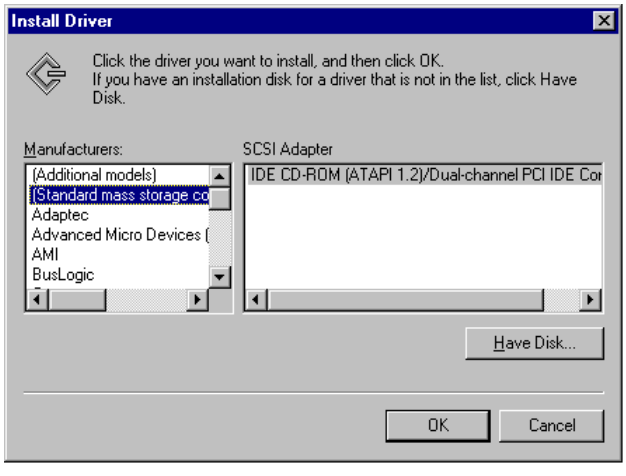
The system control window is opened.

➢ Double-click "SCSI Adapters".

The "SCSI Adapters" window is opened.

➢ Click the "Driver" index card and then button "Add".

The list of installed drivers is displayed.



➢ Click "Have Disk".

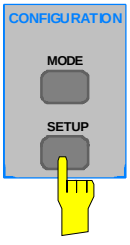
This window leads through the following installation.

Note: *After the installation, the "Service Pack X" of Windows NT is to be re-installed, see "New Installation of Windows NT Software.*

Firmware Update

The installation of a new firmware version can be performed using the built-in diskette drive and does not require opening the analyzer. The firmware update kit contains several diskettes.
The installation program is called up in the *CONFIGURATION - SETUP* menu.

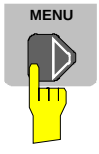
Insert diskette 1 into the drive.



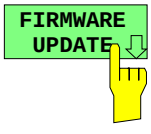
Call SETUP-GENERAL SETUP menu

➢ Press the *SETUP* key in the *CONFIGURATION* field.

The *SETUP* menu is opened.

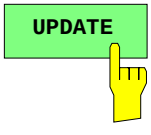


➢ Change to the right-hand menu using the menu key.



➢ Press the *FIRMWARE UPDATE* softkey.

The submenu is opened.



➢ Press the *UPDATE* softkey.

The installation program starts and leads the user through the remaining steps of the update.

The installation can be cancelled.



➢ Press the *RESTORE* softkey.

The previous firmware version is restored.

Installing Windows NT Software

The driver software and the Windows NT system settings are exactly adapted to the measurement functions of the instrument. Correct operation of the instrument can, therefore, be guaranteed only if the software and hardware used is released or provided by Rohde & Schwarz.
The use of other software or hardware may cause the FSET to malfunction.
The latest list of software authorized for use on the FSET can be obtained from your nearest Rohde&Schwarz agency (see list of addresses).

After each software installation requiring the administrator identification, "Service Pack X" of Windows NT must be re-installed (also with administrator identification; see section "Controller Function"):

Re-installing Service Pack X

- In the Start menu click "Run".

  The entry window opens.

- Enter "C:\SPX\I386\UPDATE" into the command line and start installation with "OK".

  The following window leads through the installation.

Options

This section describes options FSE-B17, Second IEC/IEE Interface, and FSE-B16, Ethernet Interface.

Note: *- Option FSE-B13, 1 dB Attenuator, is described in Chapter 4, Section 'Level Display/RF Input'*

Option FSE-B17 – Second IEC/IEEE Interface

Notes: *- The installation of option FSE-B17 is possible only under the administrator identification (see section "Controller Function").*

- After the installation, the "Service Pack X" of Windows NT is to be re-installed, see "New Installation of Windows NT Software".

- To ensure that the instrument performs an autologin, the user identification is to be reset to "instrument" after the next power-up, see section "Controller Function".

- Interface "COM2" is no longer available after installation of option FSE-B17.

Besides the instrument external devices can also be controlled via the IEC/IEEE bus using the optional 2nd bus interface FSE-B17 and the computer function for instrument. The interface software permits IEC/IEEE-bus commands to be included in user programs. The installation instructions are enclosed with the option.

Installing the software

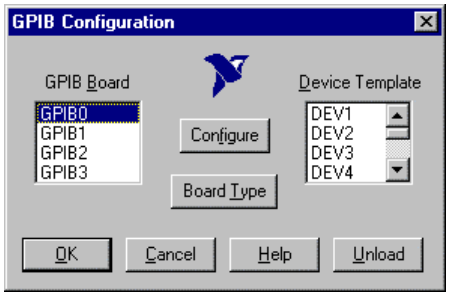
The operating software is already installed and need not be loaded from the driver diskettes which serve as backup diskettes.

The driver must be loaded on the start-up of Windows NT. To do this, enter the type of board, configure the board and enter the parameters for the connected equipment. If the option is factory fitted, all this has been done in the factory.

The following parameters may not be changed after selection on configuration of the board:

```
Board Type ...................AT-GPIB/TNT
Base I/O Address .............02C0h
Interrupt Level ..............3
DMA Channel ..................5
Enable Auto Serial Polling ...No
```

For further parameters, refer to manual for the board.



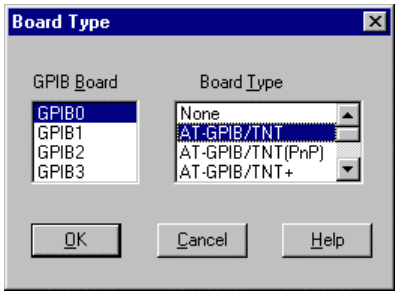
Selecting the board type

- Click "Start" in the task bar.
- Click consecutively "Settings", "Control Panel" and "GPIB" in this sequence.

  The "GPIB Configuration" menu for selecting the board type and configuring the board is opened.

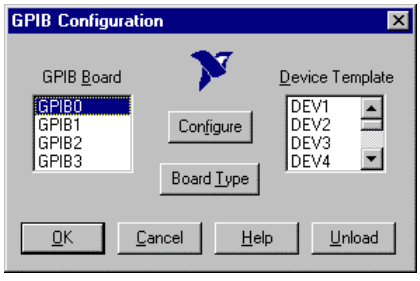
- Click button "Board Type".

  The "Board Type" menu for selecting the board type is opened.



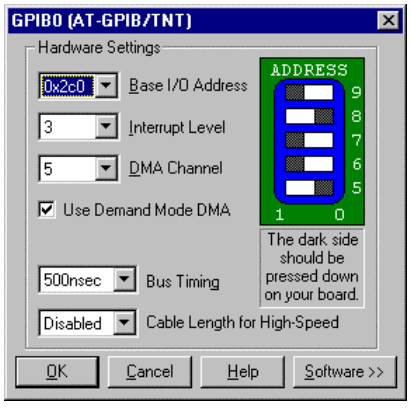
- Mark "GPIB0" in the "GPIB Board" list.
- Mark "AT-GPIB/TNT" in the "Board Type" list.
- Confirm the selection with "OK".

  The "GPIB Configuration" menu is displayed again.



- Click button "Configure".

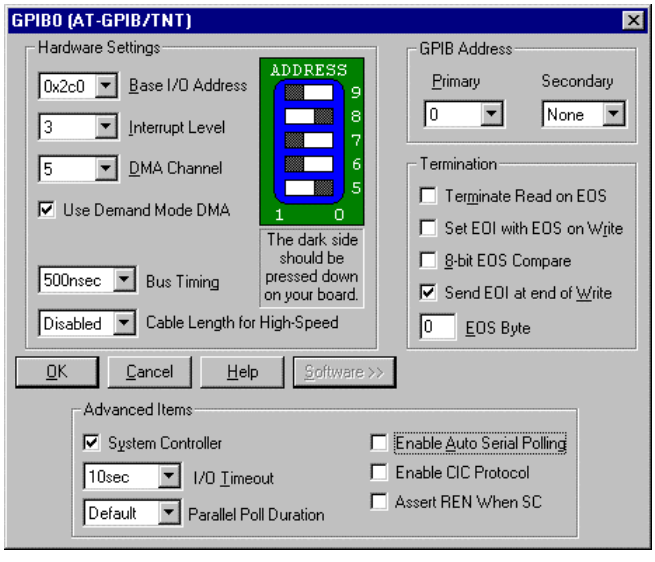
  The "GPIB0 (AT-GPIB/TNT)" menu for configuring the board is opened.



Configuring the board

- Set "3" in the "Interrupt Level" list.
- Click button "Software".

The menu is extended.



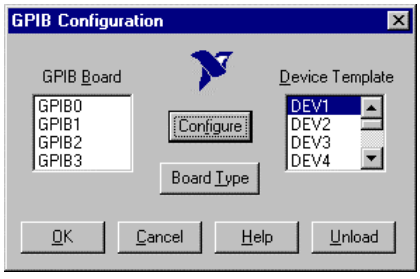
- Deactivate (= no tick) "Enable Auto Serial Polling" in the "Advanced Items" field.
- Quit the menu with "OK".

The "GPIB Configuration" menu is displayed again.

Note:

The settings of the following parameters should not be no longer modified.

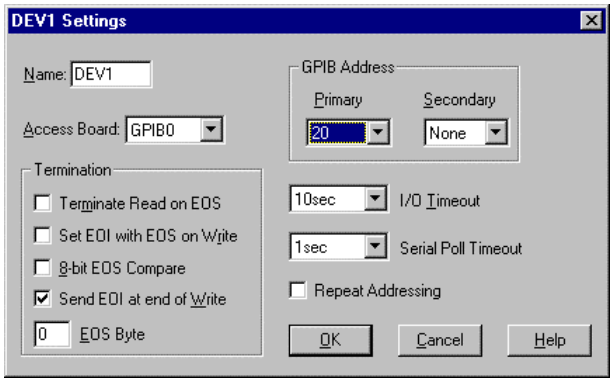
```
Board Type ......... AT-GPIB/TNT
Base I/O Address ......... 02C0h
Interrupt Level ............... 3
DMA Channel ................... 5
Enable Auto Serial Polling .. No
```



Setting the parameters for the connected equipment

➢ Mark the instrument in the "Device Template" list and confirm selection with "OK".

The "DEV.. Settings" menu is opened.



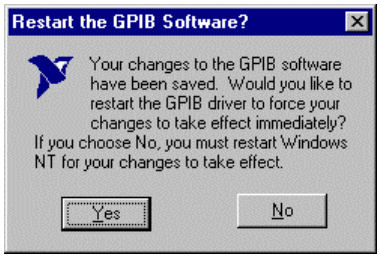
➢ Perform the settings for the selected unit in the "DEV.. Settings" menu.

The logic name for the instrument is preset with DEV1 and address 20. See board manual for further units.

Note: *When assigning logic names to connected equipment note that these names do not correspond to the directory names under DOS.*

➢ Terminate setting with "OK".

The query asking if the GPIB software should be re-started is displayed.



➢ Select "No".

➢ Re-start controller with Start-Restart in the task bar.

After the controller has been re-started, the settings for the GPIB interface are effective.

Note: *After the installation, the "Service Pack X" of Windows NT is to be re-installed, see "New Installation of Windows NT Software".*

Use of DOS Programs

When using DOS programs, driver GPIB-NT.COM should be loaded. For this to take place, the line `device=C:\PROGRA~1\NATION~1\GPIB\NI488\DosWin16\Gpib-nt.com` has to be activated in the file `C:\WINNT\SYSTEM32\CONFIG.NT`. If the option is factory fitted, this line will have been entered in the factory.

Operation

The second IEC/IEEE-bus interface corresponds physically to that of the instrument (see Chapter 8).
If the instrument is to be controlled via the IEC/IEEE bus, a bus cable must be plugged to both bus connectors. The interface can be driven under DOS/WINDOWS3.1/95/NT by R&S software (FS-K3, Order No. 1057.3028.02, etc.) or by user-written software. The handling of IEC/IEEE-bus commands in user programs is described in the manual for the card.

The files are in directory `C:\Program Files\National Instrument\GPIB\NI488`.

Option FSE-B16 – Ethernet Adapter

With the option Ethernet Adapter FSE-B16, the device can be connected to an Ethernet-LAN (local area network). It is possible to transmit data via the network and to use the network printer. The adapter operates with a 10 MHz Ethernet in line with standards IEEE 802.3 10Base2 (Thin Ethernet, CheaperNet, BNC-Net) (B16 model 03) or 10Base5 (Thick Ethernet) (B16 model 02).

Hardware Installation



Caution:
Prior to installation contact the network administrator, especially in case of complex LAN installations since mistakes in cabling might have influence the whole network.

If the adapter is installed at the factory, it is preconfigured. In case of retrofitting, refer to the installation instructions. The hardware settings must not be modified since the functions of the device could otherwise be impaired.

The following parameters are factory-set:

```
I/O Addr. 300,     IRQ 5,     MEM D0000
```

The connection with the network depends on the connectors used in the network.

BNC (Thin Ethernet, CheaperNet; FSE-B16 Var. 03)

Connection

The device is looped into the LAN segment via rear-panel 2 BNC connectors.
If a cable is not connected to one of the BNC connectors, this BNC connector has to be terminated with 50 Ohm. BNC T connectors must not be used.

Network traffic



Note that the network traffic is disturbed if a segment is interrupted.

Requirements

Thin Ethernet segment requirements have to be complied with:
- maximum segment length of 185 m
- minimum distance between the connectors of 0.5 m
- maximum of 30 connectors per segment.

If components that comply with enhanced requirements are exclusively used (Ethernet Adapter FSE-B16 complies with the enhanced requirements):
- maximum length of segment of 300 m
- maximum number of connectors of 100

With repeaters used:
- maximum total length of the network of 900 m containing a
- maximum of 3 segments
- maximum of two repeaters between two connectors

AUI (Thick Ethernet; FSE B16 Var. 02)

Connection	The device is connected to the LAN segment using a transceiver cable (DB-15 AUI connector, not part of the equipment supplied) which is connected to the rear panel and to the transceiver.
Network traffic	The connection does not conflict with the network traffic. The device can also be disconnected from the network without any problems but make sure that data are not being transmitted.
Requirements	The Thick Ethernet segment requirements have to be taken into account. - The maximum segment length should be 500 m and the - distance between the connectors should at least be 2.5 m. - A maximum of 100 connectors may be used in a segment. With repeaters used, - the total length of the network must not be more than 2500 m containing - a maximum of 3 segments. - There should be no more than two repeaters between two connectors. If other network components are used, these conditions may vary.

RJ45 (UTP, 10BaseT, Western Connector)

Connection	The device is connected to the LAN segment using a RJ45 cable (not part of the equipment supplied) which is connected to the rear panel and to the network hub of the LAN segment.
Network traffic	This connection does not conflict with the network traffic. The device can also be disconnected from the network without any problems but make sure that data are not being transmitted.
Requirements	Since RJ45 is not a bus but a star topology no special requirements have to be taken into account for the connection. The LAN requirements should be considered in the installation.

Software Installation

Data transmission within the network is by means of data blocks, the so-called packets. Besides user data other information, the so-called protocol data (transmitter, receiver, type of data, order) are transmitted. The drivers corresponding to the protocol have to be installed to process protocol information. A network operating system is required for network services (data transmission, directory services, printing in the network) and thus has to be installed.

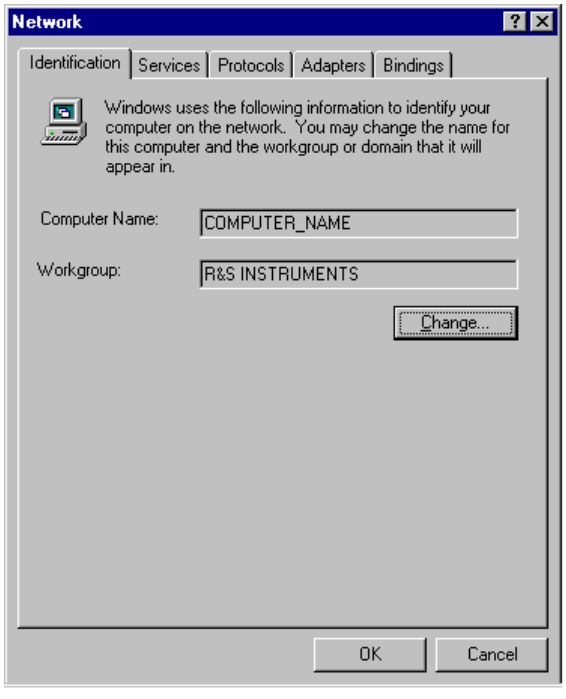
Calling up Configuration Menu for Network Settings

- Click "Start" in the task bar.
- Click consecutively "Settings", "Control Panel" and "Network".

  The "Network" configuration menu for network settings is opened.

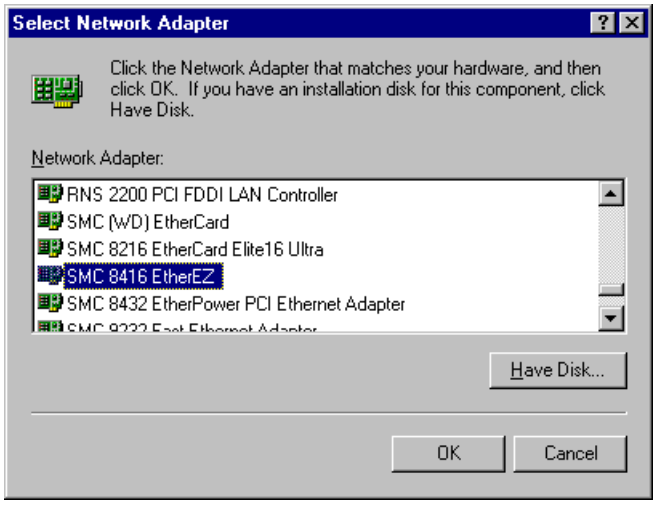
Registering the Identification

Note: *It is important for the computer name to be unique in the network..*



- Select "Identification".
- Confirm computer and workgroup names with "OK" or enter new names in submenu "Change".

Installation and Configuration of the Driver for the Network Adapter



- Select "Adapter".
- Click "Add" and mark network driver "SMC 8416 EtherEZ" and select with "OK".

  The query "Files.." is displayed.

- Answer it by clicking "Continue".

  The "SMCEthernet Card Setup" window is displayed.

- Close the window with "OK".

  Some files are copied and the network adapter is displayed under "Network Adapters".
  The entry "MS Loopback Adapter" refers to a driver which ensures instrument control and should not be modified.

Note: *The network adapter settings must not be modified since this may cause problems to the instrument.*

Installation of Network Protocols

Note: *The network administrator knows which protocols are to be used..*

- Select "Protocol".
- Click "Add", mark the desired protocol and select with "OK".

  This operation has to be performed several times when several protocols are selected.

- Execute the installation by clicking "Continue".

Note: *If a protocol requires further settings, they can be performed with "Properties" after marking the corresponding entry. If further settings are not possible, this field is gray.*

Installation of Network Services

To utilize the resources of the network it is necessary to install the corresponding services.

Note: *The network administrator knows which services are to be used.*

- Select "Services".
- Click "Add", mark the desired service and select with "OK".

  This operation has to be performed several times when several services are selected.
  Some services are pre-installed and can be cleared with "Remove" if they are not needed.

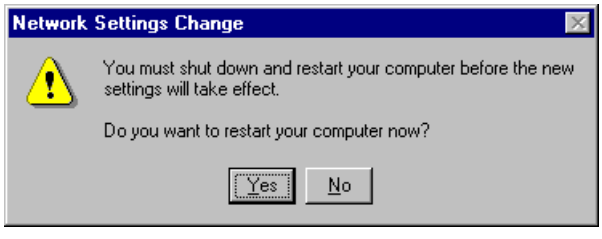
- Execute the installation by clicking "Continue".

Note: *If a service requires further settings, they can be performed with "Properties" after marking the corresponding entry. If further settings are not possible, this field is gray.*

Terminating the Installation

- Quit the "Network" configuration menu for network settings with "OK".

  The settings are checked and processed. Missing information is queried.



- Answer the query "You must shutdown..." with "Yes".

  The settings are valid after computer restart.

Note: *After the installation, the "Service Pack X" of Windows NT is to be reinstalled, see "New Installation of Windows NT Software".*

Examples of Configurations

Network	Protocols	Services	Notes
NOVELL Netware	NWLink IPX/SPX Compatible Transport	Client Service for NetWare	The "Frame Type" used under "Protocols - Properties" should be set.
IP networks (FTP, TELNET, WWW, GOPHER, etc.)	TCP/IP Protocol	Simple TCP/IP Services	An "IP Address" unambiguous in the network should be set under "Protocols - Properties".
MICROSOFT network	NetBEUI Protocol or TCP/IP Protocol	Workstation Server	A name unambiguous in the network should be registered under "Identification - Computer Name".

Operation

After installing the network operating system it is possible to transfer data between the device and other computers and to use printers in the network. A precondition for network operation is the authorization to use network resources. Resources may be access to the file directories of other computers or the use of a central printer. The network or server administrator will grant the authorizations. The network name of the resource and the corresponding authorization are required. Passwords protect the resources against improper use. A user name is normally assigned to every authorized user. The user also has a password. Resources may then be assigned to the user. The type of access, i.e. whether data are only read or also written as well as a shared access to data has to be defined. Other types are possible depending on the network operating system.

NOVELL

Operating system NETWARE from NOVELL is as server-supported system. Data transfer between the individual workstations is not possible. Data transfer is between workstation computers and a central computer, the server. This server provides storage capacity and the connection to the network printers. Like under DOS, the data on a server are organized in directories and are offered to the workstation as virtual drives. A virtual drive on a workstation is like a hard disk and data can be processed accordingly. This is called drive mapping. Also network printers can be addressed as normal printers.
Network operating system NOVELL is available in two forms: NETWARE 3 and NETWARE 4 NDS. In the previous version NETWARE 3, each server manages its own resources itself and is independent. A user has to be managed separately on each server. For NOVELL 4 NDS, all resources are managed in the NDS (NOVELL DIRECTORY SERVICE). The user only has to log in once and gains access to the resources released for him. The individual resources and the user are managed as objects in a hierarchical tree (NDS TREE). The position of the object in the tree is called CONTEXT for NETWARE and must be known in order to access the resources.

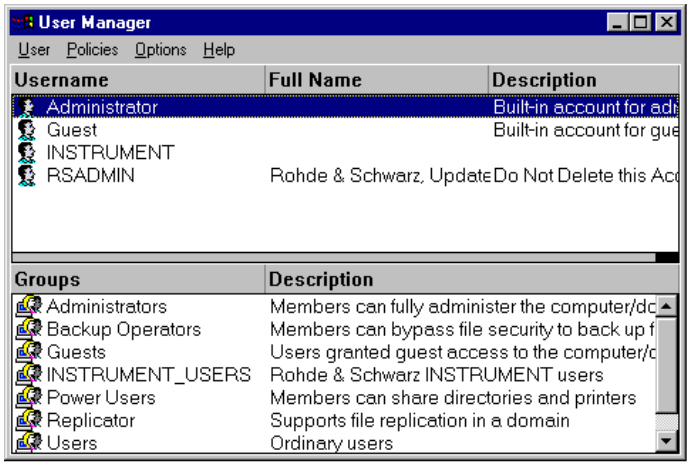
MICROSOFT

For MICROSOFT, data can be transferred between workstations (peer-to-peer) but also between workstations and servers. The servers can provide access to individual files as well as the connection to network printers. Like under DOS, the data on a server are organized in directories and are offered to the workstation as virtual drives. A virtual drive on a workstation is like a hard disk and data can be processed accordingly. This is called drive mapping. Also network printers can be addressed as normal printers. A connection to DOS, WINDOWS FOR WORKGROUPS, WINDOWS95, WINDOWS NT is possible.

Installing a user

After the network software has been installed, the instrument logs with an error message during the next start-up since there is no user "Instrument" (= user identification for NT autologin) in the network. It is therefore necessary to install a user which should be the same for Windows NT and for the network. The network administrator is responsible for the installation of new users in the network.

Note: *The installation of new users is possible only under the administrator identification (see section "Controller Function").*

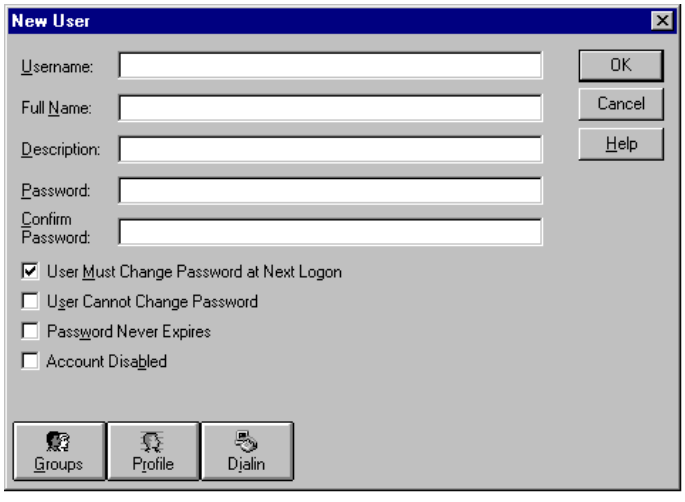


- Click "Start" in the task bar.
- Click consecutively "Programs" "Administrative Tools (Common)" and "User Manager" .

  The "User Manager" menu is opened.

- Click "User" and select "New User".

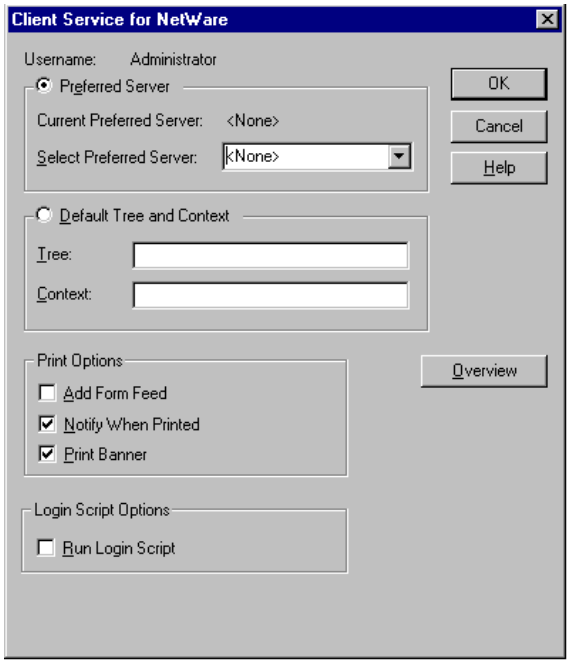
  The menu "New User" for entering user data is opened.



- Fill in the lines "Username", "Password" and "Confirm Password" and confirm the entry with OK.

  The user data should correspond to the network settings.

Only NOVELL network:
Configure NOVELL Client



- Click "Start" in the task bar.
- Click consecutively "Settings", "Control Panel", "CSNW".

NOVELL 3.x

- Click "Preferred Server".
- Under "Select Preferred Server" select the NOVELL server for which the user has been installed.

NOVELL 4.x

- Click "Default Tree and Context" .
- Enter the NDS Tree under "Tree" and, under "Context", the hierarchical path for which the user has been installed.

Note: *These specifications can be obtained from the network administrator.*

Login in the Network

Network login is automatically performed with the operating system login. A prerequisite is that the user name and the password are the same under Windows NT and in the network.

Use of Network Drives

- Click "Start" in the task bar.
- Click consecutively "Programs" and "Windows NT Explorer".
- Click "Network" line in the "All Directories" list.

  A list of available network drives is displayed.

- Click "Tools" and "Map Network Drive".

  In the list "Shared Directories:" the network paths available in the network are displayed.
- Mark the desired network path.

- Select the drive under "Drive:"
- Activate "Reconnect at Logon:" if the link is to be automatically established at each unit start.
- Connect the network path to the selected drive with "OK".

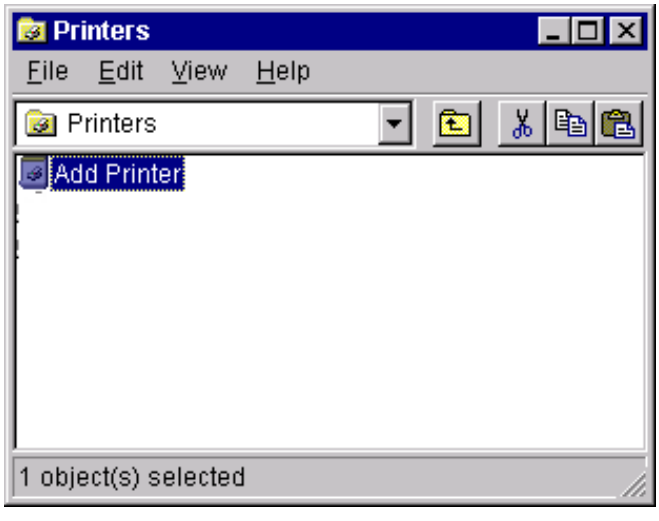
  The user name and the password are queried. The drive is then displayed in the "All Directories" list of Explorer.

  Note: *Only drives for which an authorization is available may be connected.*

Disconnect link:

- Click "Tools" and "Disconnect Network Drive" in Explorer.
- Select under "Drive:" the drive whose connection is to be removed.
- Disconnect link with "OK". The query should be answered with "Yes".

Printing on a Network Printer



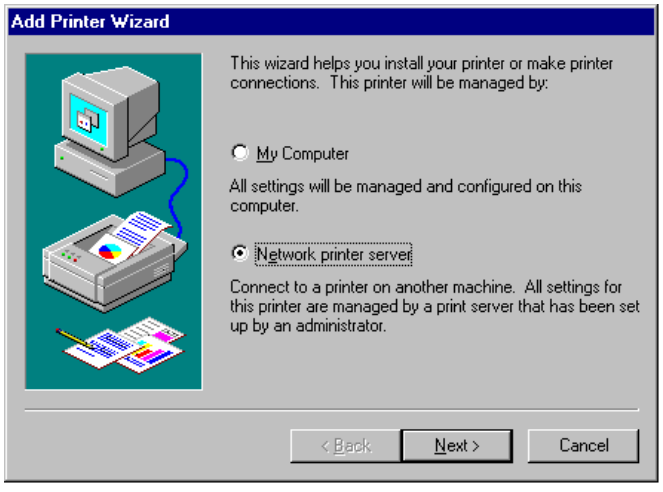
Select printer driver under Windows NT

- Press key combination <ALT> <SYSREQ>

  The Windows NT screen is displayed.

- In the Start menu press first "Setting" and then "Printers".

  The printer window is opened.



➢ Double-click line "Add Printer".

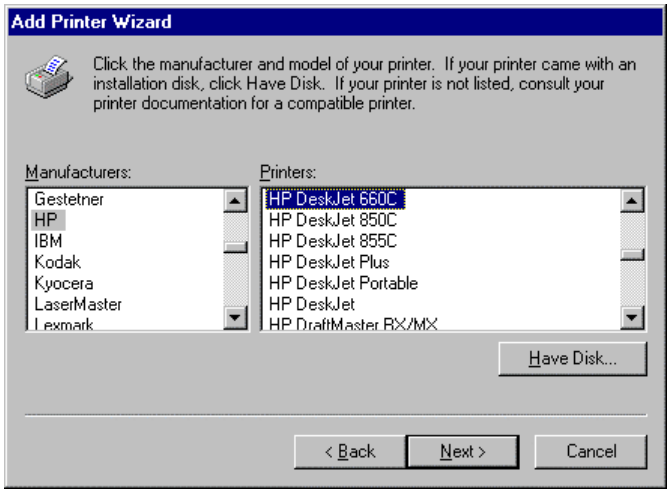
The "Add Printer Wizard" window is opened. This window leads through the following printer driver installation.

➢ Click first "Network Printer Source" and then "Next".

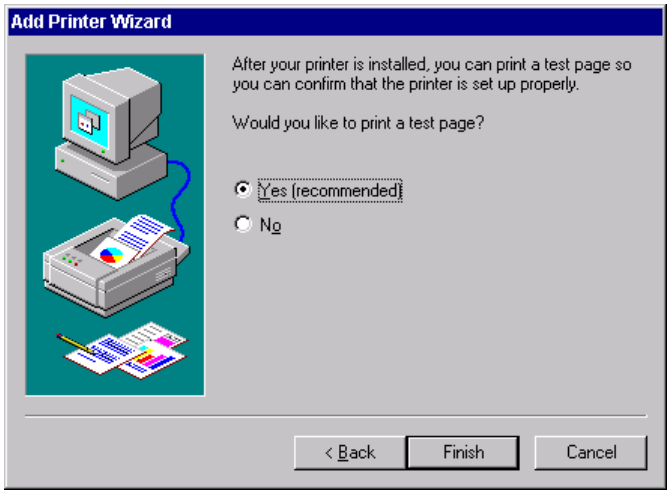
The list of available network printers is displayed.

➢ Mark the printer and select with "OK".

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



➢ Mark the manufacturer in selection table "Manufacturers" and then the printer driver in selection table "Printers".



- Click "Next".

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

- Switch on printer.
- Click Yes (recommended)".
- Click "Finish".

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

The instrument has to be configured with this printer for the printout of the measurement screen. This configuration is described in this chapter in the section "Connecting an Output Device".

Server Function

With the server function data can be provided on the instrument for use in other computers. This is possible only in the MICROSOFT network. The server function is released after network installation as standard. If this is not required, it should be deactivated, see "Installation of Network Services".

The availability of instrument data in the network is controlled by releases. The release is a property of a file or of a directory. To grant a release, the object is to be marked in "Windows NT Explorer" and pressed by the right-hand mouse key. The release is performed under Properties -> Sharing by selecting "Shared As". Other computers can then access these objects with the names allocated under "Share Name". The online help gives further information on the network operation.

TCP/IP

The TCP/IP protocol allows files to be transmitted between different computer systems. A program running on both computers is required to control the data transfer. The same operating or file system need not be used by the two partners. A file transfer is possible between DOS/WINDOWS and UNIX, for example. One partner has to be configured as host the other as client or vice versa. The system performing several processes at the same time (UNIX) will normally be the host. The usual file transfer program used for TCP/IP is FTP (File Transfer Protocol). An FTP host is installed as standard on most of the UNIX systems.

After installing the TCP/IP services, a terminal link can be established with "Start" - "Programs" - "Accessories" - "Telnet" or a data transmission with FTP using "Start" - "Run" "ftp" - "OK". Thus, all controller systems can be accessed which support these universal protocols (UNIX, VMS, ...).

Further information is given in the NT online help which can be called up with "Help".

FTP

For a complete description of the functions and commands see the FTP documentation.

Establishing a connection

➢ Click "Start" and then "Run" in the task bar.

The program is started with the DOS command

`FTP`

The following command sets up the connection:

`OPEN <xx.xx.xx.xx>`

xx.xx.xx.xx = IP address, e.g. 89.0.0.13

File transmission

To transmit a file to the target system, the following command is used:

`PUT <file name>`

file name = name of file e.g. DATA.TXT.

To call a file from the target system, the following command is used:

`GET<file name>`

file name = name of file e.g. SETTING.DAT.

`TYPE B`

allows the transmission of files in the BINARY format, no conversion is performed.

`TYPE A`

allows the transmission of files in the ASCII format. Thus, control characters are converted so that the text files can be read on the target system, too.

Examples:

`PUT C:\AUTOEXEC.BAT`

sends the AUTOEXEC.BAT file to the target system.

`LCD DATA`

changes to subdirectory DATA in the computer function.

`CD SETTING`

changes to the subdirectory SETTING on the target system.

Changing directories

The command

`LCD <path>`

changes the directory as the corresponding DOS command.

`LDIR`

lists the directory.

These commands refer to the computer function of the instrument. If the 'L' preceding the commands is omitted, they apply to the target system.

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2 Getting Started

Chapter 2 presents basic measurements performed by a spectrum analyzer to provide fast and easy access to the operation of the instrument.

Before starting any measurement with the FSET, please note the instructions given in chapter 1 for putting the instrument into operation. In chapters 3 you will find detailed information on customizing the instrument and the display.

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

In the following description, each step is explained in detail using the FSET so that the instrument can be immediately used without the need for learning all of the available functions. The described measurement applications are:

- Measurement of the level and frequency of a sine wave signal.
- Measurement of harmonics.
- Measurement of third order intermodulation and determination of the intercept point.
- Zero span measurement of a pulsed signal.

All of the following examples assume the standard settings for the analyzer. These are set with the *PRESET* key in the *SYSTEM* key field. The most important standard settings are shown in Table 2-1. A complete listing of standard settings can be found in chapter 4.

Table 2-1 Important PRESET settings

Parameter	Parameter name	Settings without FSET-Z..	Settings with FSET-Z..
Mode	Mode	Analyzer	Analyzer
Center frequency	Center Frequency	1,02 GHz	1 GHz
Active Freq. Meas. Range	Span	1,96 GHz	2 GHz
Reference Level	Ref Level	– 20 dBm	– 20 dBm
RF Attenuation	RF ATT	35 dB	10 dB
Level Display Range	Level Range	100 dB	100 dB
Resolution Bandwidth	Res Bw	2 MHz	2 MHz
Video Bandwidth	Video Bw	2 MHz	2 MHz
Sweep Time	Sweep Time	5 ms	5 ms
Trigger	Trigger	free run	free run

Level and Frequency Measurements

Measurement Task

The determination of the level and frequency of a signal is one of the most frequently encountered measurement tasks typically performed by a spectrum analyzer. Usually, for the measurement of an unknown signal, the PRESET settings are initially selected. If levels above +30 dBm are expected or possible, then a power attenuator must be inserted ahead of the analyzer input. Without attenuation, these signal levels might damage or destroy the input attenuator or the input mixer.

Important Spectrum Analyzer Functions

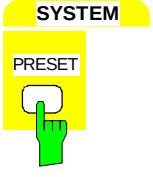
Important parameters for level and frequency measurements are the settings for the *CENTER FREQUENCY*, the selection of the active measurement frequency range (*SPAN*) and the *MARKER* functions.

Sweep, Level and Frequency Measurements – Example 1

In this example, a signal with a frequency of 200 MHz and a level of -10 dBm are applied to the RF INPUT of the analyzer. The selection of the center frequency and the active frequency range takes place manually.
The necessary setup functions are performed almost without exception by the fixed-function keys. The menus which appear with a key can, for the most part, be ignored. In this manner, fast, key-oriented operation is possible.

The following setup steps are performed:

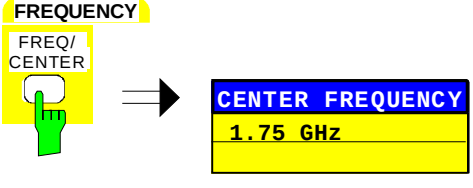
1. Reset the instrument.
2. Apply the test signal.
3. Set the center frequency to 200 MHz.
4. Reduce the active measurement frequency range (SPAN) to 1 MHz.
5. Measure the level and frequency using the marker.
6. Optimize the measurement dynamic range and reduce the level measurement error.
7. Measure the frequency with the internal frequency counter



1. Reset the instrument.

➢ Press the *PRESET* key.

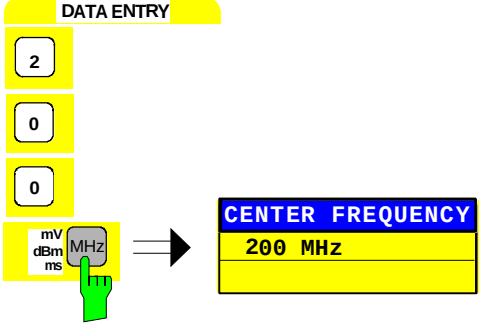
2. Connect the test signal to the RF INPUT located on the instrument front panel.



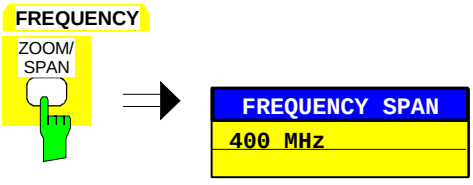
3. Set the center frequency to 200 MHz.

➢ Press the *CENTER* key in the *FREQUENCY* key field.

The input field for center frequency appears on the display screen.

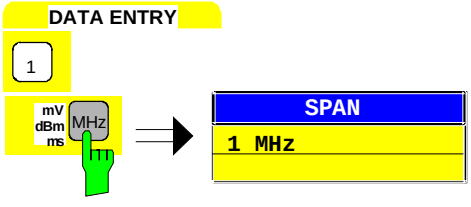


➢ Enter *200* via the numeric keypad and terminate with the *MHz* key.



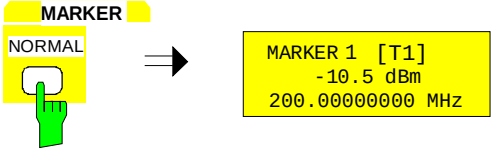
4. Reduce the measurement frequency range (SPAN) to 1 MHz.

➢ Press the *SPAN* key in the *FREQUENCY* key field.



➢ Enter *1* via the numeric keypad and terminate with the *MHz* key.

Note: *In conjunction with the change in measurement frequency range (SPAN), the resolution bandwidth (RES BW), video bandwidth (VIDEO BW) and sweep time (SWEEP TIME) are set to new values since they are defined as coupled functions in the standard PRESET settings.*



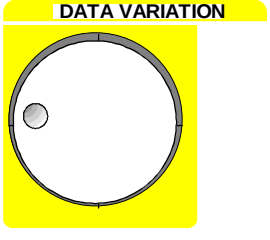
5. Measure level and frequency using the marker and read the resulting values on the display screen.

➢ Press the *NORMAL* key in the *MARKER* key field.

The marker jumps to the largest signal peak shown on the display screen.

Note: *When the marker is switched on for the first time, it automatically performs the PEAK SEARCH function as demonstrated in this example.*
If a marker was already active, the SEARCH key in the MARKER key field must be pressed in order to set the currently active marker to the displayed signal maximum.

The level and frequency measured by the marker can be read in the marker field at the upper edge of the display screen. (see Fig. 2-1).



➢ Using the roll-key, the marker can be moved along the measured curve.

The corresponding level and frequency values appear in the marker field.

Fig. 2-1 shows the measured curve on the display screen over a 1 MHz range as well as the marker level and frequency values.

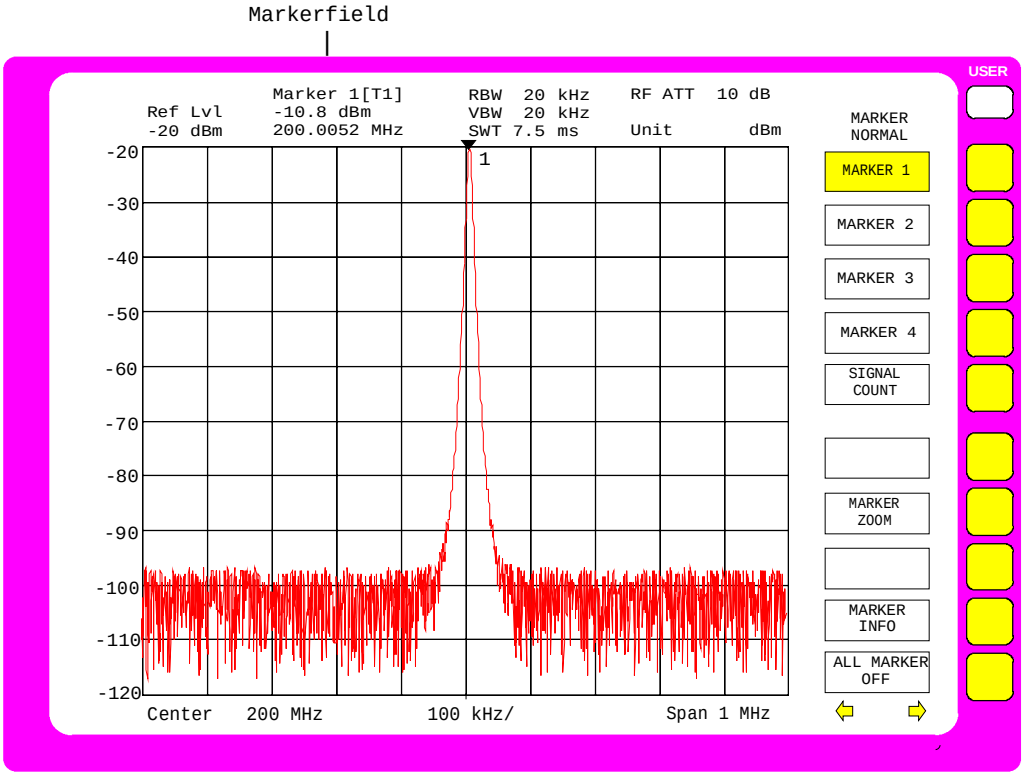
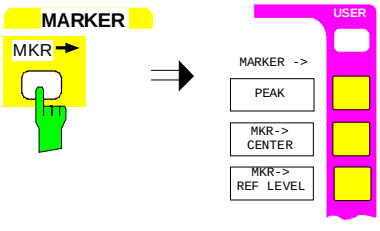


Fig. 2-1 200-MHz signal. The measured values are displayed in the marker field.

At low signal-to-noise ratios, the level measurement accuracy can be improved by an optimum selection of the FSET parameters. The accuracy of the frequency display can also be enhanced by applying the internal frequency counter.





6. Optimize the dynamic range and reduce the level measurement error.

➢ Press the *MKR→* key in the *MARKER* key field.

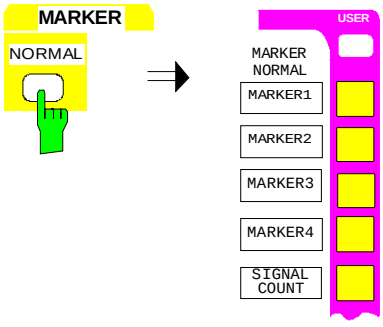
The *MARKER-MKR→* menu is opened.

➢ Press *MKR → REF LEVEL* softkey.

The reference level (REF LEVEL) is reduced to the signal level.

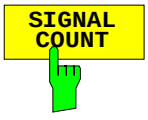
7: Determine the exact frequency with the internal frequency counter.

Note: *The frequency counter measures the frequency of the marked signal with the selected counter resolution and at the accuracy of the internal frequency reference. A frequency measurement made using the marker is, however, limited by the number of horizontal display points and the applicable resolution bandwidth.*



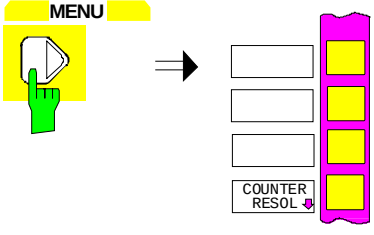
➢ Press the *NORMAL* key in the *MARKER* key field.

The *MARKER NORMAL* menu is opened.



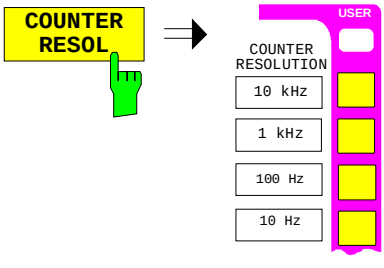
➢ Press the *SIGNAL COUNT* softkey.

The internal frequency counter is now active and measures the signal frequency with the PRESET resolution. The resolution is to be increased to 10 Hz.



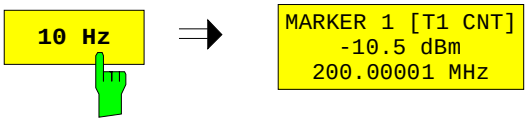
➢ Press the menu change key .

The supplementary menu is opened.



➢ Press the *COUNTER RESOL* softkey.

The *COUNTER RESOLUTION* sub-menu is opened.



➢ Press the *10 Hz* softkey.

The desired frequency resolution (10 Hz) is now selected.

In the marker field, the item [CNT] indicates that the counter is active (see Fig. 2-2).

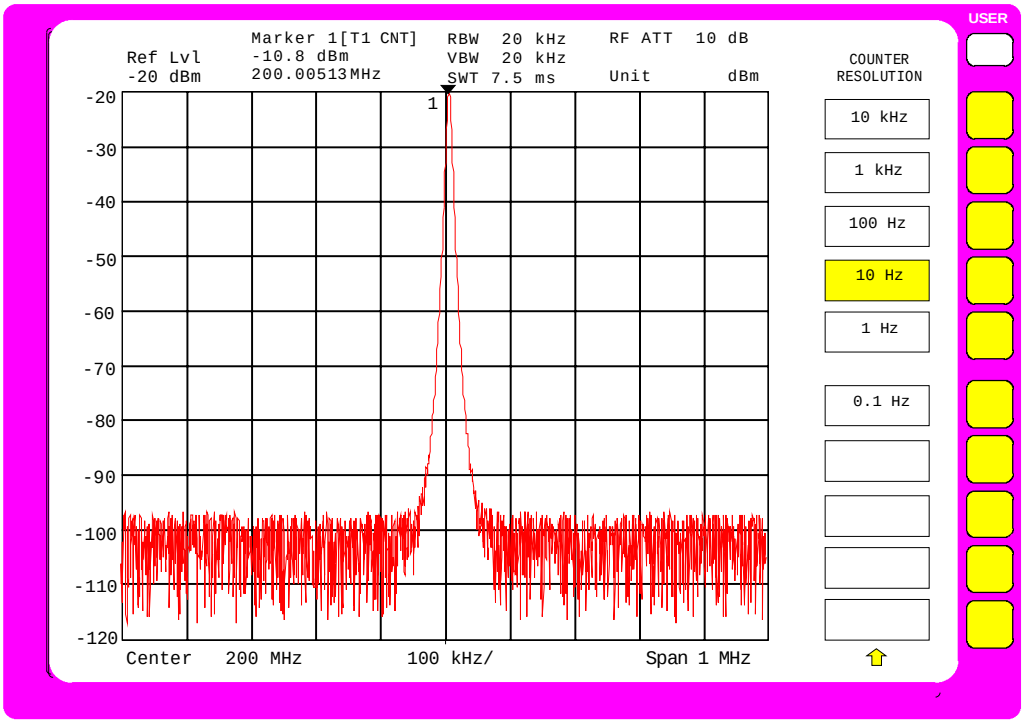


Fig. 2-2 Frequency measurement using the internal frequency counter.

Sweep, Level and Frequency Measurements – Example 2

The zoom function (*MARKER ZOOM*) operates much faster than the manual input of center frequency and measurement frequency range, and permits the measurement frequency range displayed on the screen to be as narrow as desired.

As in Example 1, a signal with a frequency of 200 MHz and a level of -10 dBm is applied to the analyzer RF INPUT.

The following setup steps are performed:

1. Reset the instrument.
2. Apply the signal.
3. Zoom in on the signal.
4. Measure the level and frequency with the marker.
5. Optimize the dynamic range and reduce the level measurement error.
6. Measure the frequency with the internal frequency counter.

Steps 1 to 2 and 4 to 6 correspond to steps 1 to 2 and 5 to 7, respectively, of Example 1. Step 3 replaces the manual input of center frequency and measurement frequency range. (steps 3 and 4).

See steps 1 and 2 of example 1

1. Reset the instrument to standard settings.

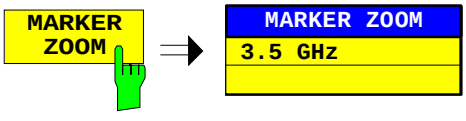
2. Connect the test signal to the analyzer RF INPUT.



3. Zoom in on the signal.

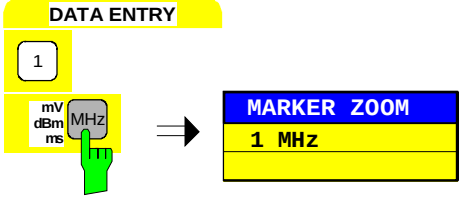
➢ Press the *NORMAL* key in the *MARKER key field* .

The marker moves to the largest signal displayed on the screen. In this example, it is the signal at 200 MHz. (PEAK SEARCH function, see step 5 in Example 1).



➢ Press the *MARKER ZOOM* softkey.

The input field for the measurement frequency range appears on the display screen.



➢ Enter 1 via the numeric keypad and terminate with the *MHz* key.

After entry of the measurement frequency range, the marked signal is counted and then used as the new center frequency. At the same time, the entered measurement frequency range is set.

Note: *In conjunction with the active measurement frequency range (SPAN) change, the resolution bandwidth (RES BW), video bandwidth (VIDEO BW) and sweep time (SWEEP TIME) are also set to new values since they are defined as coupled functions in the standard PRESET settings.*

See steps 5 to 7 of example 1:

4. Read the values for level and frequency as measured by the marker.

5. Optimize the dynamic range and reduce the level measurement error.

6. Determine the frequency with the internal frequency counter.

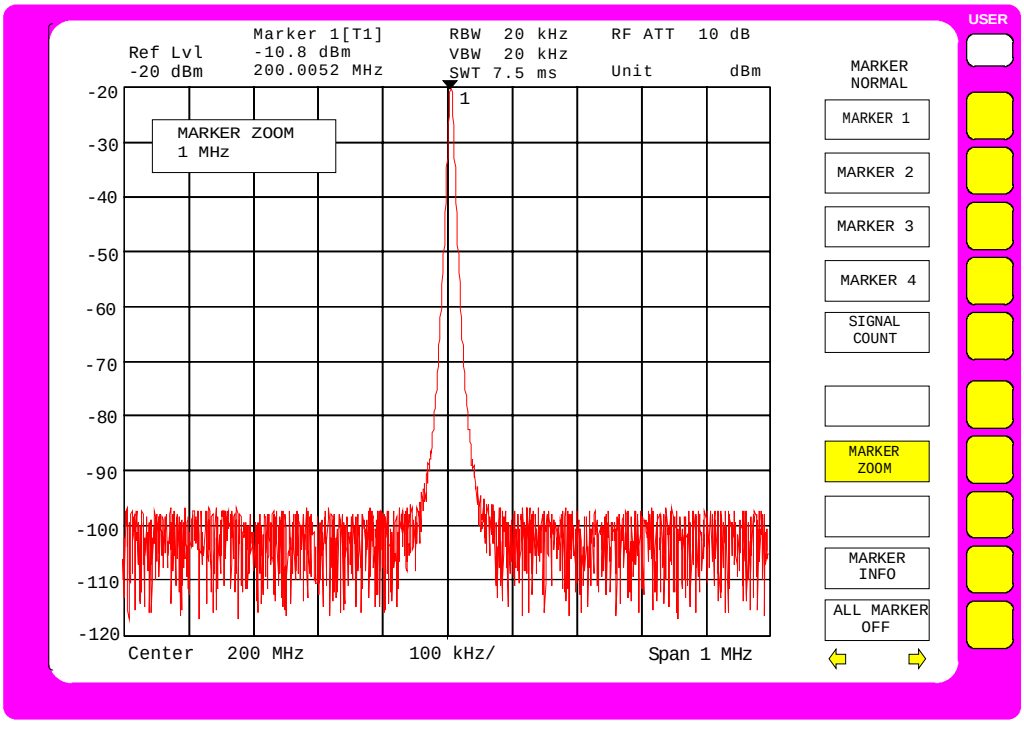


Fig. 2-3 The MARKER ZOOM function requires the entry of the measurement frequency range (span)

Level Measurement Accuracy

The level measurement accuracy of an analyzer is influenced by the following parameters:

- RF attenuator (*RF-ATT*)
- IF amplification
- Resolution bandwidth (*RES BW*)
- Display range (*LEVEL RANGE*)
- Display linearity (*SCALE FIDELITY*)

The error in a level measurement for the FSET is < 1 dB for frequencies up to 1 GHz and < 1.5 dB for frequencies from 1 GHz to 3.5 GHz. This specification includes all of the above mentioned influential factors. The frequency characteristics of the pertinent modules (RF divider, front end) are stored individually in memory on each module. The FSET initializing routines read out the corresponding values during execution immediately after the analyzer is turned on and corrects the frequency characteristics during the sweep. Any errors in the attenuation settings, the filter bandwidth or the video rectifier are corrected after calling the built-in calibration routines. For calibration purposes, the FSET has an internal 120 MHz calibration source which is switched internally to the RF INPUT.
The measurement accuracy is guaranteed only after running the calibration routines. It should be noted, however, that the individual parameters are so stable that a calibration need only be performed, after approximately 15 minutes warm-up time, for larger temperature variations. Normally, a weekly calibration is more than adequate.

Measurement of Harmonic Separation

Measurement Task

The measurement of signal harmonics is a frequently occurring task which can be optimally performed by a spectrum analyzer. In general, all signals will contain harmonics to some degree. Harmonics are especially critical in high-power transmitters, e.g., in radio transmitters, where a significant radiated harmonic component may interfere with the reception of other radio services. Generally, non-linear device characteristics create harmonics which are often selectively reduced through the use of low-pass filters. Since the spectrum analyzer also has non-linear characteristics, e.g., at the first mixer, it is necessary to exercise caution during a measurement to insure that the spurious harmonics generated by the analyzer do not influence the measurement results. If necessary, the fundamental frequency must be selectively attenuated with respect to the harmonics by insertion of an appropriate high-pass filter.

For harmonic-content measurements, the achievable measurement dynamic range is dependent upon the k2 intercept of the spectrum analyzer. The k2 intercept point is defined as the fictitious first-mixer input level where the levels of the first harmonic and of the fundamental frequency are equal. In practice, this level cannot be applied to the mixer since, to do so, would cause its destruction. However, using the k2 intercept point concept, the achievable measurement dynamic range for the harmonics of a Unit Under Test (UUT) can be calculated with relative simplicity.

As can be seen in Fig.2-4, the harmonic level is reduced by 20 dB when the level at the fundamental frequency is reduced by 10 dB.

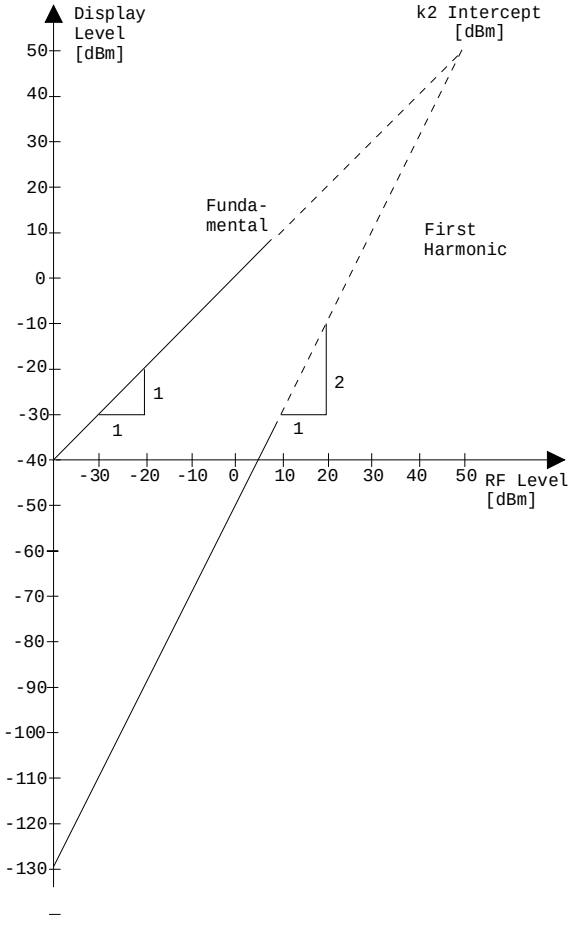


Fig.2-4 Theoretical display curve of fundamental and first harmonic with a k2 intercept of 50 dBm.

From the linear equations and the given intercept point, the following formula can be derived for the achievable harmonic separation a_{k2} in dB:

$$a_{k2} = IP2 - P_{e'} \qquad (1)$$

a_{k2} = harmonic separation
P_e = mixer level/dBm
IP2 = k2 intercept point

The formula for the internally produced level P_1 at the first harmonic in dBm is:

$$P_1 = 2 \bullet P_e - IP2 \qquad (2)$$

The lower harmonic measurement limit is dictated by the noise figure of the spectrum analyzer. Through adequate averaging with the video filter, the UUT harmonic level which is to be measured should be at least 4 dB over the noise figure so that the measurement error caused by the input noise is less than 1 dB.

From the above, the following rules for the measurement of large harmonic separations can be derived:

- Select an IF bandwidth as narrow as possible in order to reduce the noise figure.
- Select the RF attenuation as high as required so that the necessary harmonic separation can still be measured.

Note: *The mixer amplitude is the applied RF level reduced by the selected RF attenuation. The low distortion (LOW DISTORTION function) mode of the analyzer automatically sets the optimum RF attenuation for the best harmonic separation.*

The maximum harmonic separation is achieved when the harmonics level is equal to the inherent noise level of the receiver. The corresponding level at the mixer according to (2) is:

$$P_e[dBm] = \frac{P_{noise} / dBm + IP2}{2}$$

For a 30 Hz resolution bandwidth, (noise level < -140 dB, IP2 = 50 dBm), this level is -45 dBm. Therefore, according to (1) , the maximum measurable harmonic separation is 95 dB less 4 dB minimum signal-to-noise ratio.

Important Spectrum Analyzer Functions

In addition to frequency and level settings, the harmonic separation measurement requires, above all, the delta markers. Also, the MRK→ CF STEP SIZE function (marker frequency = center frequency step-width) is used in order to quickly measure the individual harmonics with the cursor keys.

There are several methods to measure harmonic content:

- The measurement of fundamental and harmonic signals in one measurement frequency range.
- The individual measurement of the harmonic separation in a narrow measurement frequency range. This method is preferred when high harmonic separation is to be measured (requires large dynamic range and, thus, narrow resolution bandwidth) or the frequency of the fundamental is very high, i.e., a very wide measurement frequency range is necessary.
- The measurement of fundamental and harmonics in two independent windows on the display screen (SPLIT SCREEN mode).

Example 1 describes the measurement of fundamental and harmonics in one measurement frequency range.

Example 2 describes the measurement of harmonic separation in separate measurement frequency ranges.

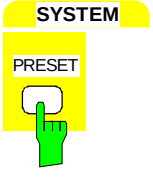
Example 3 shows the measurement of fundamental and harmonics in two independent windows on the display screen.

Measurement Procedure - Harmonic Separation – Example 1

The analyzer 10 MHz reference signal is used at the input signal. The connector EXT REF IN/OUT on the rear panel is connected to the analyzer front-panel RF INPUT. Since the output level is 7 dBm, the reference level must be set to 10 dBm.

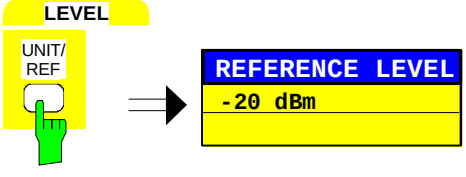
The following setup steps are performed:

1. Reset the instrument.
2. Set the reference level to 10 dBm.
3. Connect the rear-panel 10 MHz reference signal to the analyzer input RF INPUT.
4. Set the start frequency to 5 MHz.
5. Set the stop frequency to 55 MHz.
6. Smooth the displayed noise with the video bandwidth.
7. Measure the fundamental signal with the marker.
8. Measure the harmonic separation with the delta marker.
9. Measure the separation of remaining harmonics.



1. Reset the analyzer.

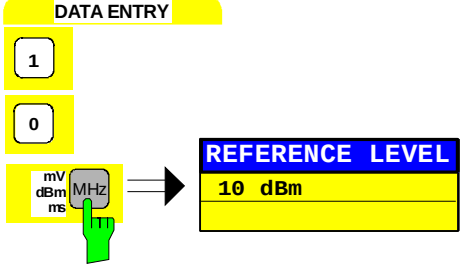
➢ Press the *PRESET key*.



2. Set the reference level to 10 dBm.

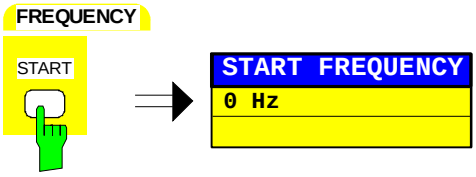
➢ Press *REF* key in the *LEVEL* key field.

The entry field for the reference level appears on the display screen.



➢ Enter 10 via the numeric keypad and terminate with the *dBm* key.

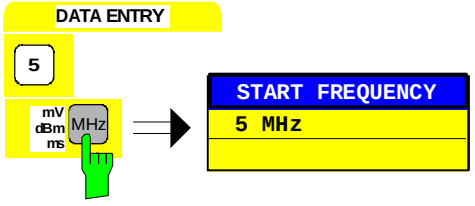
3. Connect the 10 MHz-reference signal (output EXT REF IN/OUT) to the analyzer RF INPUT.



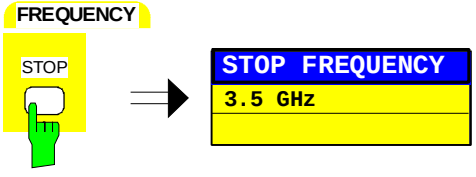
4. Set the start frequency to 5 MHz

➢ Press the *START* key in the *FREQUENCY* key field.

The entry window for the start frequency appears on the display screen.



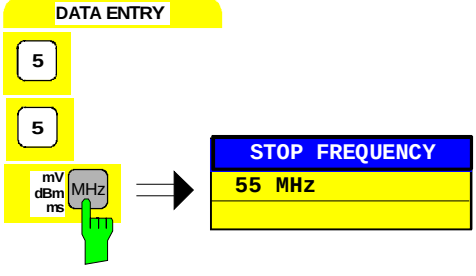
➢ Enter 5 via the numeric keypad and terminate with the *MHz* key.



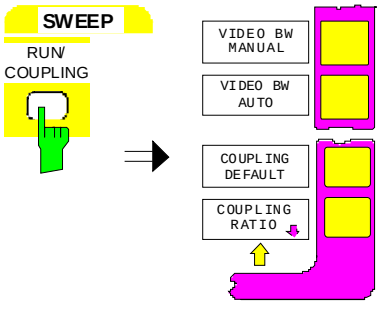
5. Set the stop frequency to 55 MHz

➢ Press the *STOP* key in the *FREQUENCY* key field.

The entry window for the stop frequency appears on the display screen.



➢ Enter 55 via the numeric keypad and terminate with the *MHz* key.

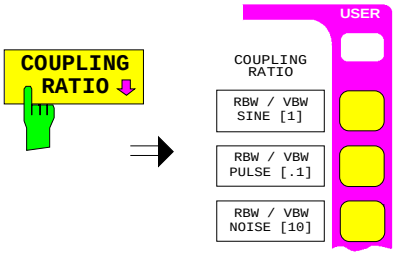


6. Smooth the displayed noise with the video bandwidth

➢ Press the *COUPLING* key in the *SWEEP* key field.

The *SWEEP-COUPLING* menu is opened.

The video bandwidth can now be either automatically coupled to the resolution bandwidth or manually entered.

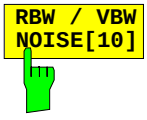


either:

Automatic coupling of the video bandwidth to the measurement frequency range

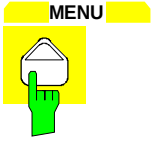
➢ Press the *COUPLING RATIO* softkey.

The sub-menu for setting the automatic coupling of bandwidths to the measurement frequency range is opened.



➢ Press the *RBW / VBW NOISE* softkey *[10]*.

The video bandwidth is set to a factor of 10 less than the resolution bandwidth. This smoothes the displayed noise.

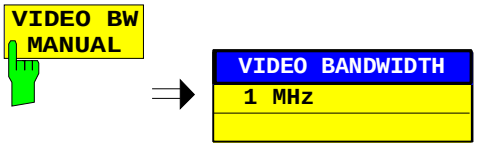


➢ Press the menu change key .

The *COUPLING RATIO* submenu is closed.

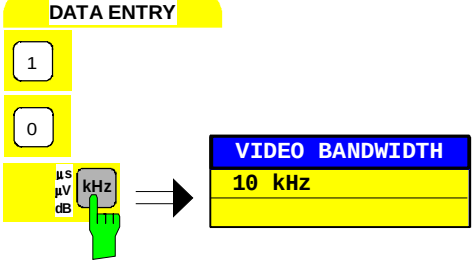
or:

Manual input of the video bandwidth



➢ Press the *VIDEO BW MANUAL softkey.*

The entry field for the video bandwidth appears on the display screen.



➢ Enter 10 via the numeric keypad and terminate with the *kHz* key.

The analyzer displays the fundamental as well as the first to third harmonics (see Fig.2-5).

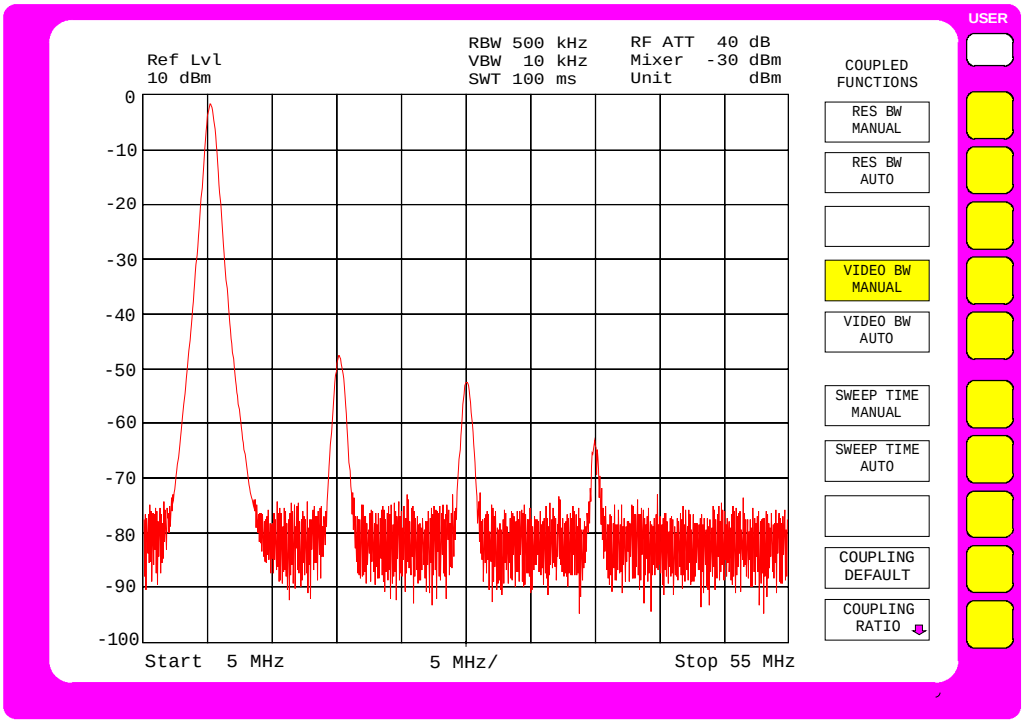


Fig.2-5 The fundamental and harmonics to 55 MHz



7. Measure the fundamental with the marker.

➢ Press the *NORMAL* key in *MARKER* key field.

The marker appears at the fundamental peak (see also level and frequency measurement step 5 of the PEAK SEARCH function).

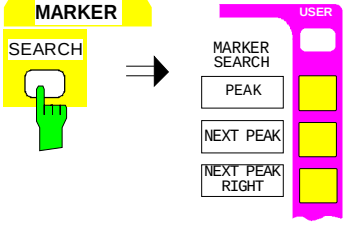
The measured values can be read at the upper left of the display screen.



8: Activate the delta marker and measure the harmonic separation

➢ Press the *DELTA* key in the *MARKER* key field

The delta marker is active and appears on the fundamental.



➢ Press the *SEARCH* key in the *MARKER* key group .

The *SEARCH-MARKER* menu is opened.



➢ Press the *NEXT PEAK RIGHT* softkey.

The delta marker jumps to the first harmonic and measures the difference between the harmonic and the fundamental. The measured values can be read at the upper left of the display screen. In this example, the harmonic separation is approx. 40 dB (see Fig.2-6).



9. Measure the separation of additional harmonics

➢ Press the *NEXT PEAK RIGHT* softkey.

The delta marker jumps to the next highest harmonic. The measured value can be read as before.

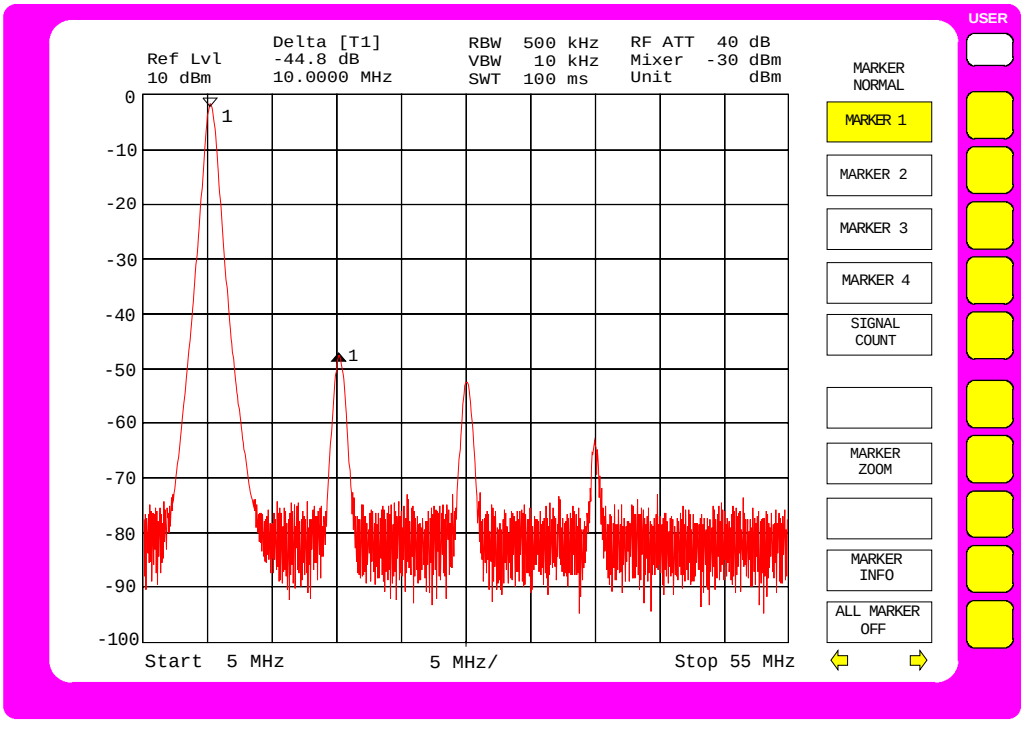


Fig.2-6 First harmonic separation: approx. 40 dB referred to the fundamental

Measurement Procedure - Harmonic Separation – Example 2

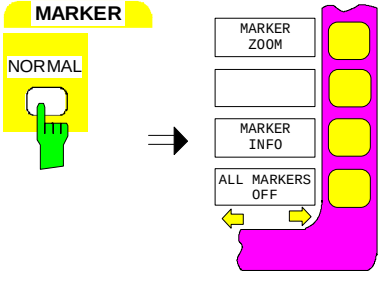
In example 2, the fundamental frequency of the test signal and the separation of the individual harmonics are measured. The reference to the fundamental is established with the REFERENCE FIXED marker, and the movement from harmonic to harmonic is performed with the MKR→ CF STEP SIZE and step keys. This method is recommended when the highest dynamic range is to be achieved.

The following measurement steps are carried out:

1. Reset the instrument.
2. Set the reference level to 10 dBm.
3. Connect the rear-panel 10 MHz reference signal (connector EXT REF IN/OUT) to the analyzer input RF INPUT.
4. Set the start frequency to 5 MHz.
5. Set the stop frequency to 55 MHz.
6. Smooth the displayed noise with the video bandwidth.
7. Measure the fundamental signal with the marker.
8. Reduce the measurement frequency range (ZOOM function):
9. Set the frequency step size to the fundamental frequency.
10. Save the reference value (REFERENCE FIXED)
11. Measure the separation to the first harmonic.
12. Measure the separations to the remaining harmonics.

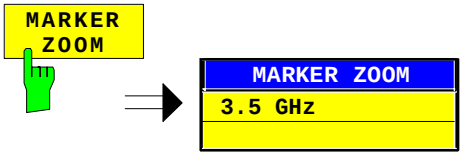
Set the analyzer according to Example 1 up to and including "Measure the fundamental with the marker" (steps 1 to 7).

8. Reduce the measurement frequency range.



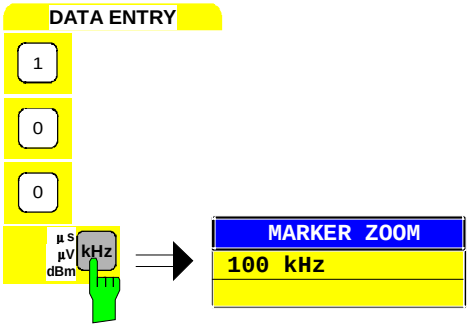
➢ Press the *NORMAL* key in the *MARKER key field* .

The *MARKER-NORMAL* menu is opened.



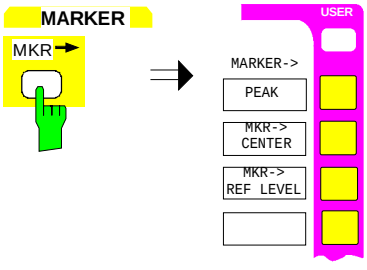
➢ Press the *MARKER ZOOM* softkey.

The entry field for the measurement frequency range appears on the display screen.



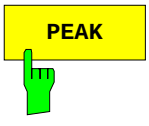
➢Enter 100 via the numeric keypad and terminate with the *kHz* key.

9. Set the frequency step size to the fundamental frequency



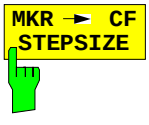
➢ Press the *MKR →* key in the *MARKER* key field

The *MARKER-MKR →* menu is opened.



➢ Press the *PEAK* softkey.

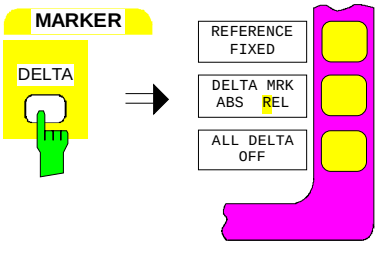
The marker appears at peak of the fundamental signal.



➢ Press the *MKR → CF STEP SIZE* softkey.

The step size used when setting the center frequency with the cursor keys is set equal to the marker frequency.

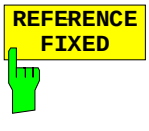
.



10. Fix reference value

➢ Press the *DELTA* key in the *MARKER* key field.

The *DELTA-MARKER* menu is opened.



➢ Press the *REFERENCE FIXED* softkey.

The position of the marker is now a curve-independent reference for the delta measurement, even when the actual reference point is not visible on the display screen.

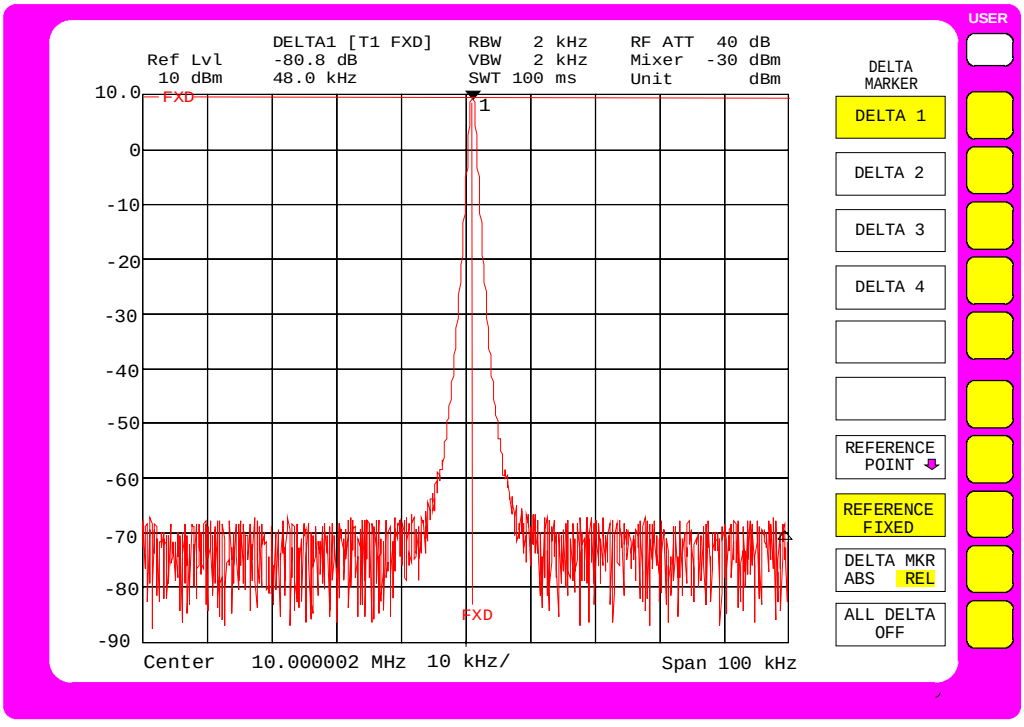
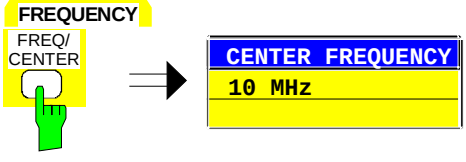


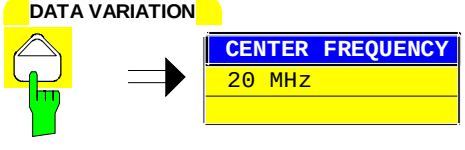
Fig. 2-7 Fundamental with REFERENCE FIXED marker



11. Measure the harmonic

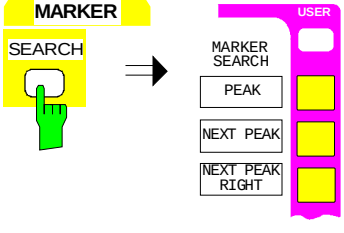
➢ Press the *CENTER* key in the *FREQUENCY* key field.

The entry field for the center frequency appears on the display screen.



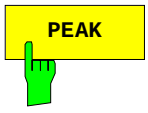
➢ Press the cursor key in the *DATA VARIATION* key field.

The center frequency is increased by one step (= fundamental frequency).



➢ Press the *SEARCH* key in the *MARKER* key field.

The *SEARCH-MARKER* menu is opened.



➢ Press the *PEAK* softkey.

The delta marker appears at the first harmonic and measures the separation from harmonic to fundamental. The measured value is displayed in the marker field at the upper left of the display screen (see Fig. 2-8).

12. Measure the separation of additional harmonics

➢ Repeat all of step 11.

The center frequency is once again increased by the frequency of the fundamental. The delta marker thus appears at the next harmonic.

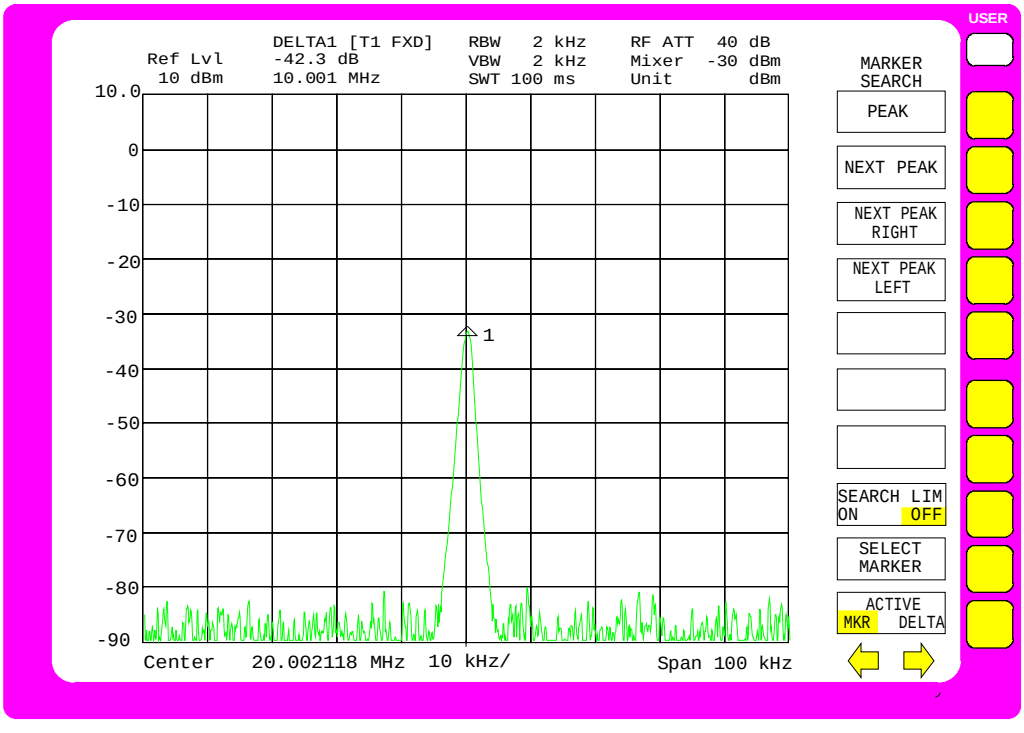


Fig. 2-8 Measurement of the first harmonic

Note: *The spurious harmonics generated internal to the analyzer can be easily recognised by switching in additional RF attenuation. When an additional 10 dB attenuation is inserted, the displayed level of harmonics generated by the analyzer will be reduced by 10 dB, however, harmonics from the UUT will remain unchanged. This assumes that the receiver noise is substantially below the displayed level.*

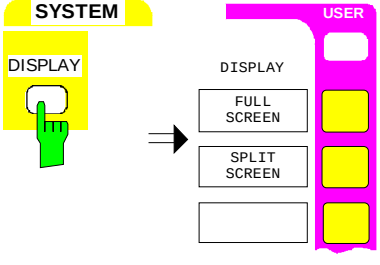
Measurement Procedure - Harmonic Separation – Example 3

The measurement of fundamental and harmonics can also be performed in two independent windows on the display screen (SPLIT-SCREEN mode). This mode permits the simultaneous presentation of the fundamental and harmonics with higher resolution and dynamic range.

The following measurement steps are carried out:

1. Reset the instrument.
2. Set the reference level to 10 dBm.
3. Connect the rear-panel 10 MHz reference signal (connector EXT REF IN/OUT) to the analyzer input RF INPUT.
4. Set the start frequency to 5 MHz.
5. Set the stop frequency to 55 MHz.
6. Smooth the displayed noise with the video bandwidth.
7. Measure the fundamental signal with the marker.
8. Reduce the measurement frequency range (ZOOM function):
9. Set the frequency step size to the fundamental frequency.
10. Set the display to two measurement windows.
11. Uncouple the window settings.
12. Measure the harmonic separation.

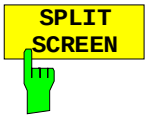
Set the analyzer according to Example 2 up to and including " Set the frequency step size to the fundamental frequency" (steps 1 to 9).



10. Set the display to two uncoupled measurement windows.

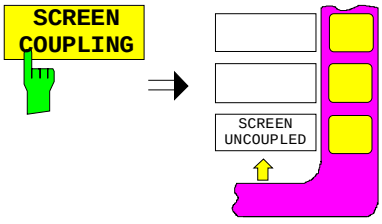
➢ Press the *DISPLAY* key in the *SYSTEM* key field.

The *SYSTEM DISPLAY* menu is opened.



➢ Press the *SPLIT SCREEN* softkey.

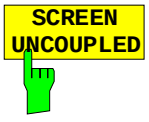
Two windows are displayed simultaneously on the display screen (see Fig.2-9). The upper measurement window is called Screen A and the lower is called Screen B. At the initial turn-on, both measurement windows are coupled, i.e., changes in settings such as frequency or levels take place in both windows.



11. Uncouple the window settings

➢ Press the *SCREEN COUPLING* softkey.

The *SCREEN COUPLING* sub-menu is opened.



➢ Press the *SCREEN UNCOUPLED* softkey .

The settings for each measurement window can now be selected independently. The entry is assigned to either *ACTIVE SCREEN A* or *ACTIVE SCREEN B* as selected by the softkey in the main menu window.

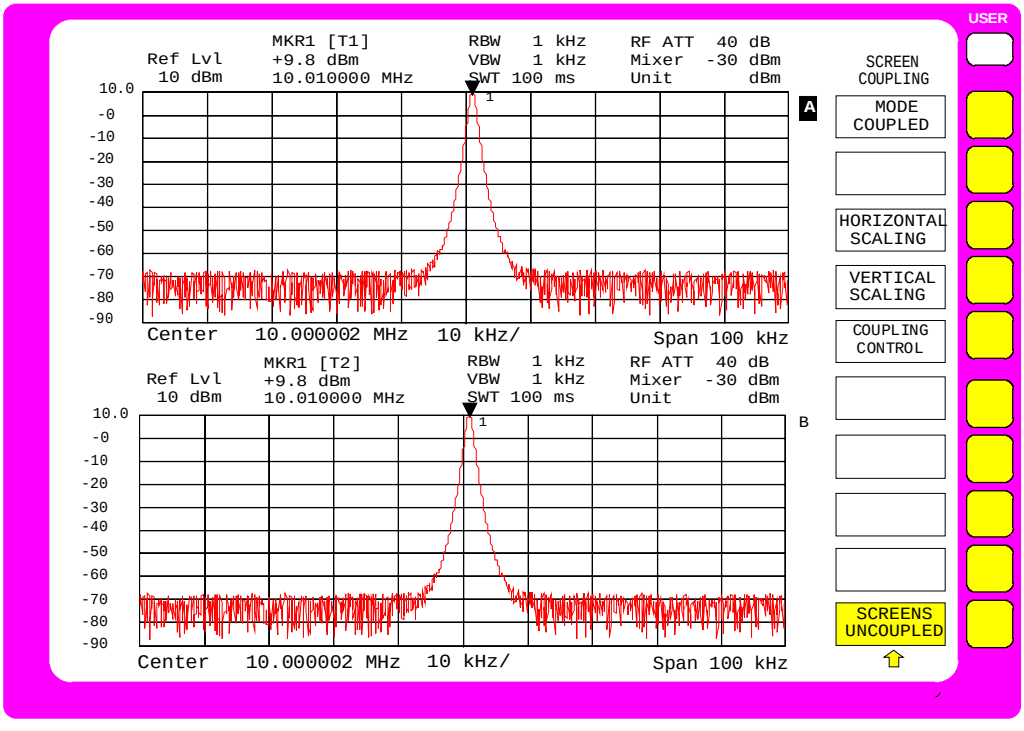
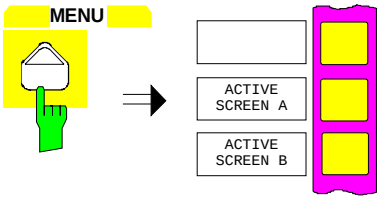


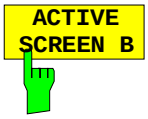
Fig.2-9 SPLIT-SCREEN Mode

12. Measure the harmonic in the lower measurement window SCREEN B.

➢ Press the menu change key .

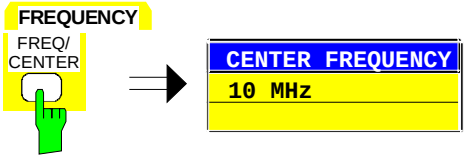
The main menu is opened.





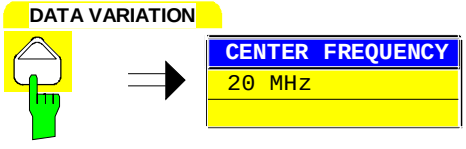
➢ Press the *ACTIVE SCREEN B* softkey.

The following entries are now valid for the lower window which is used to measure the harmonic separation.



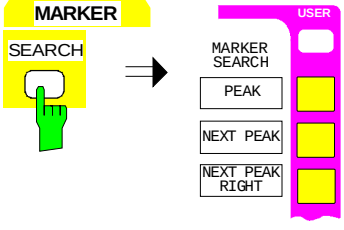
➢ Press the *CENTER* key in the *FREQUENCY* key field.

The entry field for the center frequency appears on the display screen.



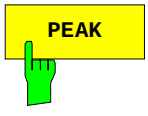
➢ Press the cursor key in the *DATA VARIATION* key field.

The center frequency is increased by one step. (= fundamental frequency).



➢ Press the *SEARCH* key in the *MARKER* key field.

The *SEARCH-MARKER* menu is opened.



➢ Press the *PEAK* softkey.

A marker appears at the first harmonic and measures the level of the harmonic. The measured value is displayed in the marker field at the upper left of the second measurement window (see Fig.2-10).

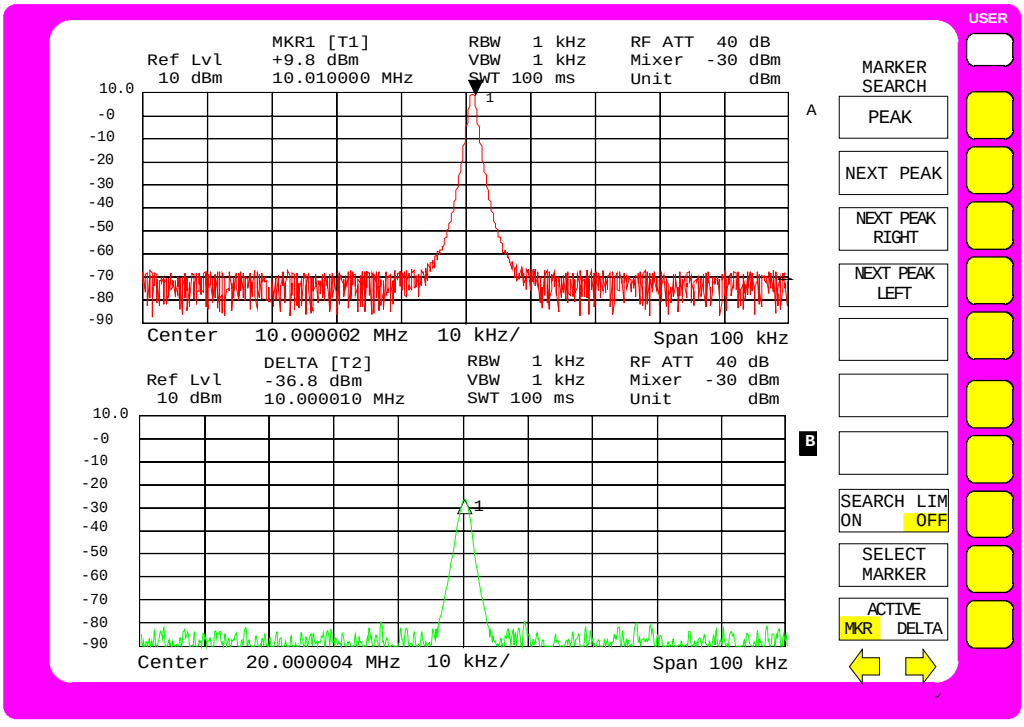


Fig.2-10 Alternate representation of fundamental and first harmonic

Measurement of Intermodulation Distortions

Measuring Task

If several signals are applied to a transmission quadripole with a non-linear characteristic, intermodulation products occur at its output due to addition and subtraction of the signals. The non-linear characteristic causes harmonics of the information signals to occur, which are mixed up at the characteristic. The low-order mixture products are particularly significant since they have the highest levels and are close to the information signals. The third-order intermodulation product causes the most significant distortions. In case of two-tone modulation it is the mixture product of the first information signal and the first harmonic of the second information signal.
The frequencies of the spurious signals occur with an offset of the information signals above and below the information signals. Fig. 2-11 shows the intermodulation products P_{S1} and P_{S2}, which are obtained from the two information signals P_{N1} and $P_{N2.}$

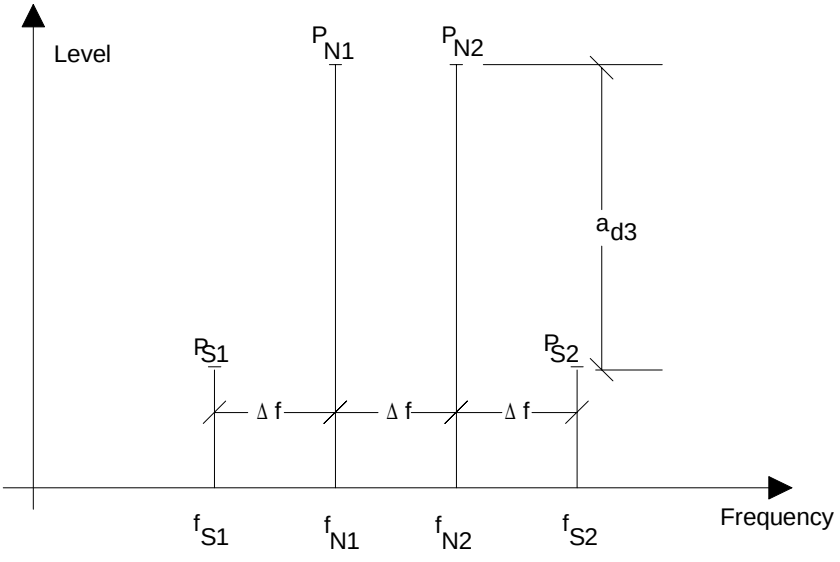


Fig. 2-11 Intermodulation products P_{S1} and P_{S2}

The intermodulation product at f_{S2} is obtained by mixture of the first harmonic of the information signal P_{N2} with the signal P_{N1}, the intermodulation product at f_{S1} by mixture of the first harmonic of the information signal P_{N1} with the signal P_{N2} .

$f_{s1} = 2 \times f_{n1} - f_{n2}$ (1)

$f_{s2} = 2 \times f_{n2} - f_{n1}$ (2)

The level of the spurious products depends on the level of the information signals. If both information signals are increased by 1 dB, the level of the spurious responses increases by 3 dB. I.e., the offset a_{d3} of the spurious responses decreases by 2 dB. This is illustrated by Fig.2-12.

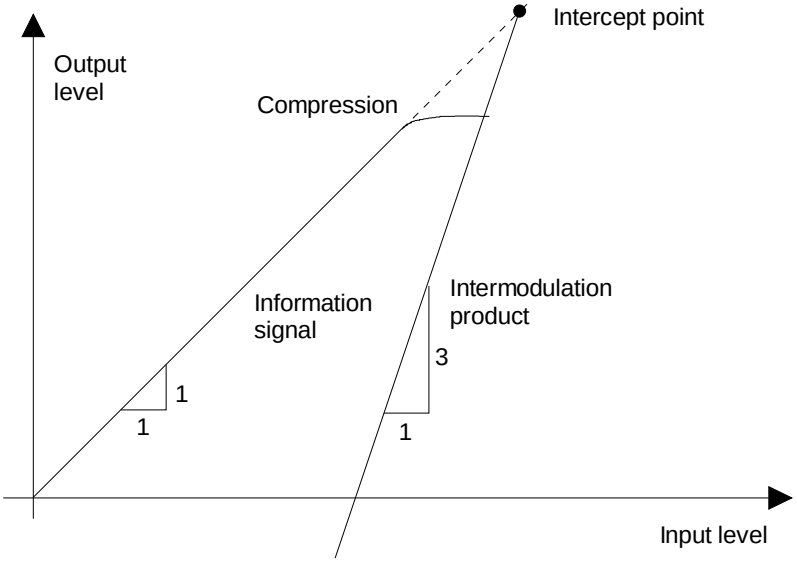


Fig.2-12 Dependance of the spurious product level from the level of the information signals

The information signals at the output of a four-terminal network increase as the input level increases as long as the input level is in the linear range. If the level changes by 1 dB at the input, it also changes by 1 dB at the output. At a specified input level the quadripole compresses and the output level does not increase any more. The third-order intermodulation products increase three times as fast as the information signals. The intercept point is the fictitious level where both lines intersect. It cannot be measured directly since the wanted level is limited by the maximum output power of the quadripole.
It can however be calculated from the known gradients of the lines and the measured intermodulation offset a_{D3} with a given level using the following formula:

$$IP3 = \frac{a_{D3}}{2} + P_N \qquad (3)$$

If, e.g., the intermodulation offset is 60 dB and the input level P_N is -20 dBm, the third-order intercept IP3 is calculated as follows:

$$IP3 = \frac{60}{2} + (-20dBm) = 10dBm. \qquad (4)$$

Important Spectrum-Analyzer Functions

Correct setting of the RF attenuation is particularly important for intermodulation measurements. In the **FSET**, the attenuation can be set automatically according to the reference level. There are three coupling methods:

– RF ATTEN AUTO

– ATTEN AUTO LOW DIST

– ATTEN AUTO LOW NOISE

The coupling mode ATTEN AUTO LOW DIST is recommended to be used for measurement of intermodulation distortions since the intrinsic spurious products are minimized.

Measurement

In the following, measurement of the third-order intercept of an amplifier is described, by way of example.

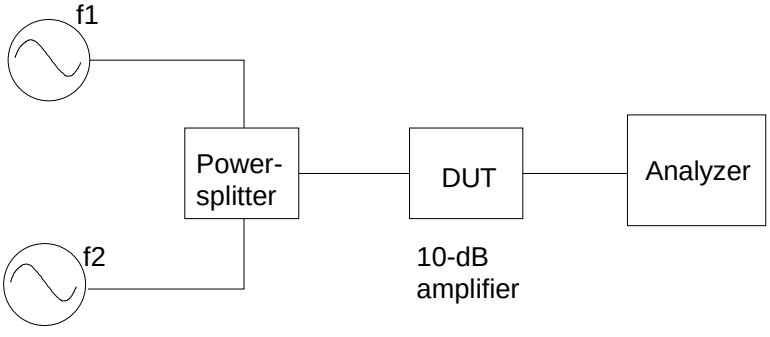
Two signal generators with the frequencies f_1 and f_2 supply signals to the amplifier via a power divider. The output of the device under test is connected to the RF input of the **FSET**. The level of the two signal generators is the same and is selected such that the DUT is not overloaded.

f_1 = 99.5 MHz

f_2 = 100.5 MHz

Level at amplifier input = -20 dBm with f_1 and $f_2$1

Test setup:



The following measurement steps are carried out:

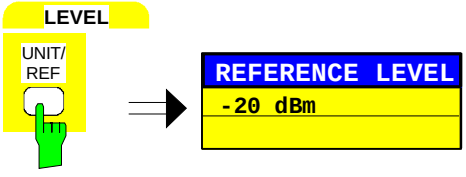
1. Reset the **FSET**.
2. Set the center frequency to 100 MHz.
3. Set the frequency-display range to 5 MHz (SPAN function).
4. Set the reference level to -10 dBm.
5. Set the resolution bandwidth to 10 kHz.
6. Set the RF attenuation for low-distortion mode.
7. Measure the intercept point using the markers.
8. Calculate IP3 from the measured offset and the signal level according to (4)

Cf. measurement example Level and Frequency Measurements (steps 1 to 3)

1. Reset the instrument.

2. Set the center frequency to 100 MHz.

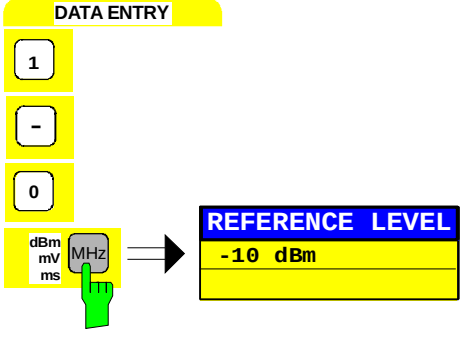
3. Set the frequency-display range to 5 MHz.



4. Set the reference level to -10 dBm

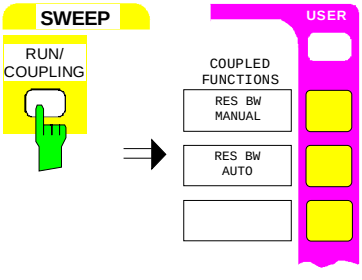
➢ Press the *REF* key in the *LEVEL* key field.

The entry window for the reference level is displayed.



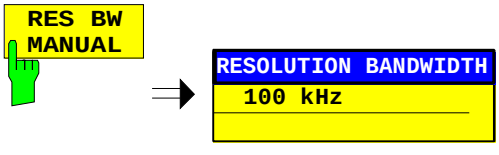
➢ Enter *-10* via the numeric keypad in the entry field and terminate the entry by pressing the *dBm* key.

5. Set the resolution bandwidth to 10 kHz



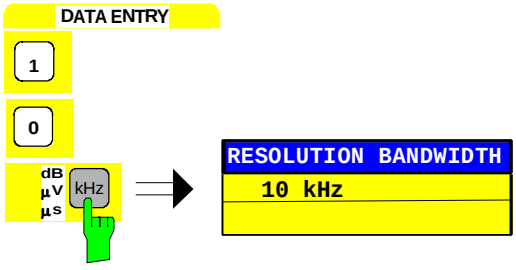
➢ Press the *COUPLING* key in the *SWEEP* key field.

The *SWEEP-COUPLING* menu is opened.

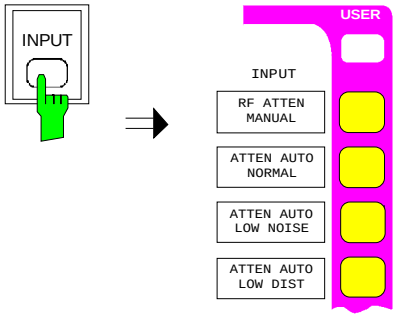


➢ Press the *RES BW MANUAL* softkey.

The entry field for the resolution bandwidth is displayed.



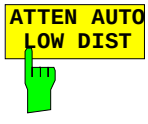
➢ Enter *10* in the entry field via the numeric keypad and terminate the entry by pressing the *kHz* key.



6. Set low-distortion mode

➢ Press the *INPUT* key

The *INPUT* menu is opened.

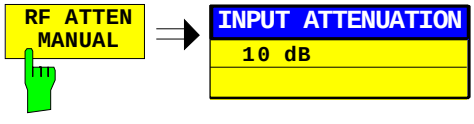


either

➢ Press the *ATTEN AUTO LOW DIST* softkey.

The low-distortion mode is selected. Thus, the combination of input attenuation and IF gain is selected such that the internal intermodulation products are the smallest possible and the intermodulation-free range is as large as possible.

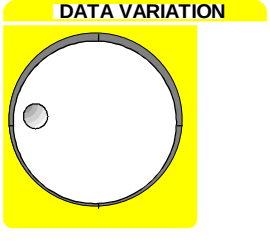
The FSET shows the measuring diagram in Fig.2-13



or

➢ Press the *RF ATTEN MANUAL softkey*.

The entry window for the RF attenuation is displayed.



➢ Vary the RF attenuation using the roll-key.

If the amplitude of the IM products doesn't change, the existing setting is sufficient
(see Fig.2-13)

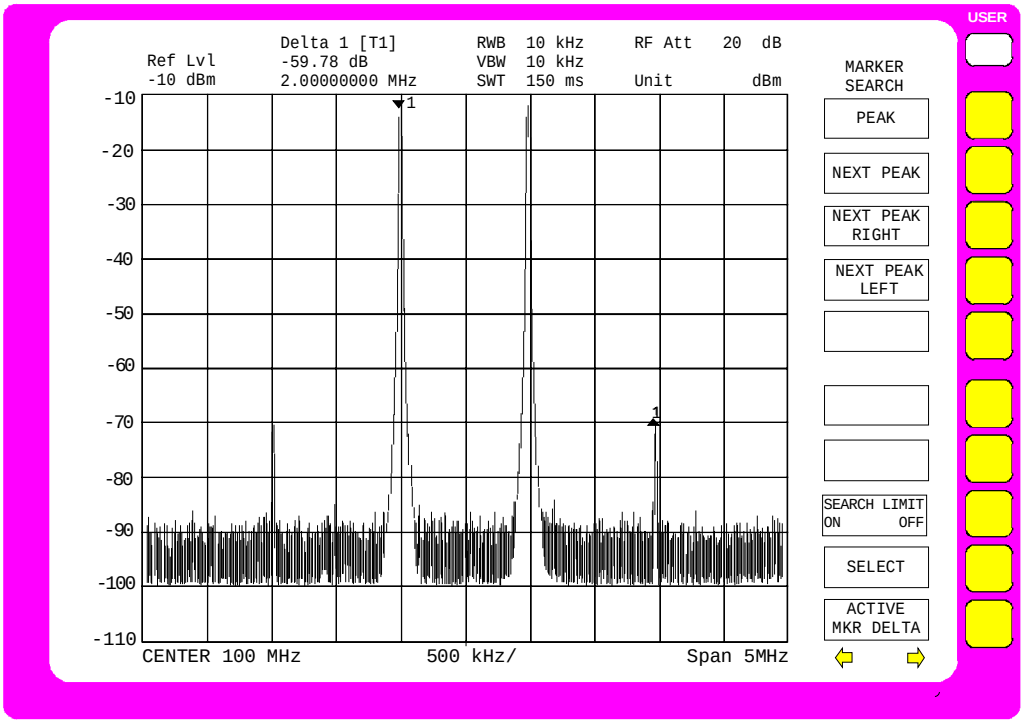


Fig.2-13 Measuring diagram in low distortion mode



7. Measure the intercept point using the markers

➢ Press the *NORMAL* key in the *MARKER* key field.

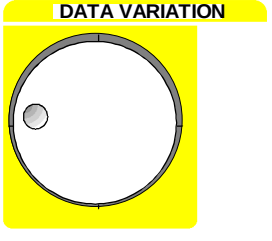
The marker appears on the fundamental (see also level and frequency measurement step 5, PEAK SEARCH function).

The measured values can be read off at the upper left of screen.



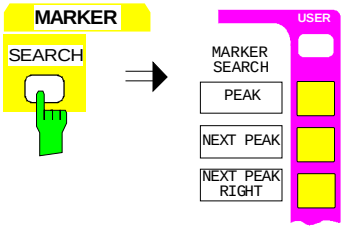
➢ Press the *DELTA* key in the *MARKER* key field.

The delta marker is active. It appears on the fundamental.



either

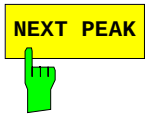
➢ Move the marker to an intermodulation product using the roll-key (see Fig.2-13).



or

➢ Press the *SEARCH* key of the *MARKER* keys.

The *SEARCH-MARKER* menu is opened.



➢ Press the *NEXT PEAK RIGHT* softkey until the delta marker appears on one of the IM products (see Fig.2-13).

8. Calculate IP3 from the measured offset and the signal level according to (4)

In the example, an intermodulation ratio of approx. 60 dB at a level of -10 dBm was measured. IP3 is thus:

$$IP3 = 60\ dB/2 + (-10dBm) = 20\ dBm$$

Time-domain Measurements with Pulsed Signals

Measuring Task

A lot of systems which handle pulsed signals do not only require measurement of the pulse width and the pulse repetition rate which can be derived from the spectrum but also assess the rise and fall time as well as the power ramping during the pulse. In particular, modern digital mobile radio systems which, like GSM e.g., employ the TDMA method, require the power to be measured versus time over a wide dynamic range.

Time-domain measurements are performed using the spectrum analyzer with ZERO SPAN selected. The analyzer operates as fix-tuned receiver on the set center frequency such that the signal power versus time is displayed.

Important Spectrum Analyzer Functions

Trigger functions such as video trigger and sweep settings such as blanking of the measured value (GAP SWEEP) are of particular importance for time-domain measurements. The pretrigger function of the GAP SWEEP just enables measurement of rise times since it allows for representation of measurements prior to the trigger point. The GAP function, which enables cutout of a part of the pulse allows for simultanous representation of both edges of a pulse signal on the screen at high time resolution. During the GAP time, the sweep and thus data acquisition at the time marked by the "GAP" line is interrupted and thus the pulse is not completely displayed (the part which is not important for this measurement is blanked) (see Fig. 2-14).

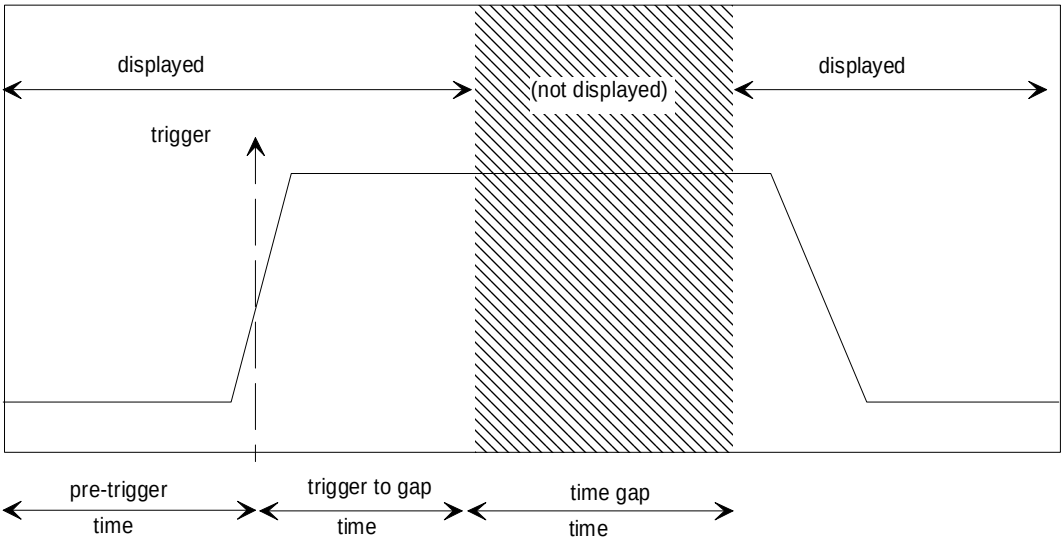


Fig. 2-14 Parameters of Gap Sweep

Note: *If the pretrigger time and the trg-to-gap time is 0 s, the gap time function has the same effect as a delayed trigger.*

Measurement

This example shows the measurement of the rise and fall times as well as the power ramping during the pulse.

The signal generator SME with built-in pulse modulation source SME-B4 is used as signal source. A signal generator providing for pulse modulation in conjunction with an external pulse generator may be used, instead.
Settings on the signal generator:

Frequency	900 MHz
Level	–5 dBm
Modulation	Pulse
Pulse width	ca. 600 µs
Pulse frequency	ca. 500 Hz

The following measuring steps are made:

1. Reset the instrument.
   The video bandwidth is thus set to 2 MHz.
2. Set the center frequency to 900 MHz.
3. Set the frequency display range to zero span.
4. Set the reference level to 0 dBm.
5. Set the resolution bandwidth to 2 MHz.
6. Set the sweep time to 1 ms.
7. Connect the RF output of the SME to the RF input of the **FSET**.
8. Set the video trigger.
9. Set the sweep time to 100 µs.
10. Set the trigger points.
11. Activate the gap sweep.

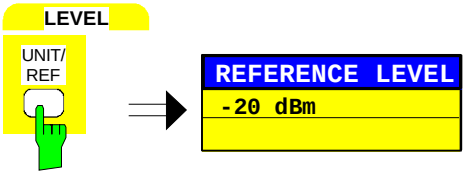
comp. measuring example - level and frequency measurement (steps 1 to 3)

1. Set the instrument to the default state. I.e., the video bandwidth is set to 2 MHz.

2. Set the center frequency to 900 MHz.

3. Set the frequency-display range to zero span.

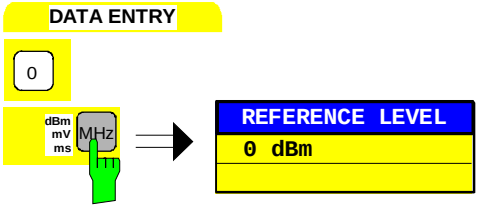
Note: *With first calling of the zero span following preset, a resolution bandwidth of 1 MHz is automatically set. Apart from that, switching on the zero span always causes that resolution bandwidth to be set that was last set in zero span.*



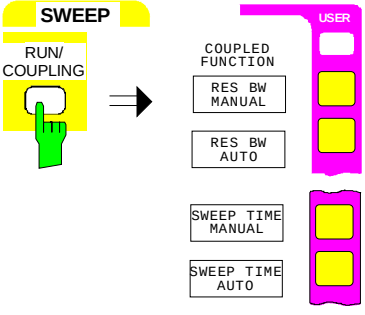
4. Set the reference level to 0 dBm.

➢ Press the *REF* key in the *LEVEL* key field.

The entry field for the reference level appears on the display screen.



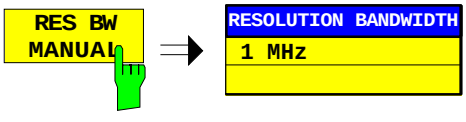
➢ Enter *0* in the entry field via the numeric keypad and terminate the entry by pressing the *MHz/ms* key.



5. Set the resolution bandwidth to 2 MHz

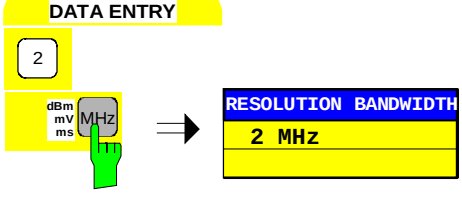
➢ Press the *COUPLING* key in the *SWEEP* key field.

The *SWEEP-COUPLING* menu is opened.

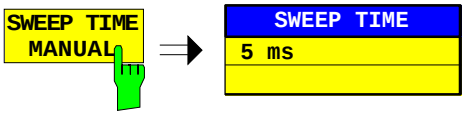


➢ Press the *RES BW MANUAL* softkey.

The entry field for the resolution bandwidth appears on the display screen.



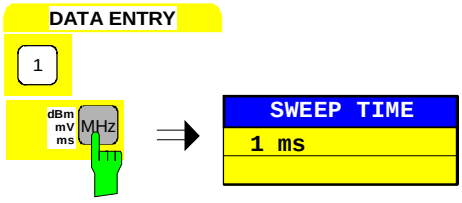
➢ Enter *2* via the numeric key pad and terminate the entry by pressing the *MHz* key.



6. Set the sweep time to 1 ms

➢ Press the *SWEEP TIME MANUAL* softkey.

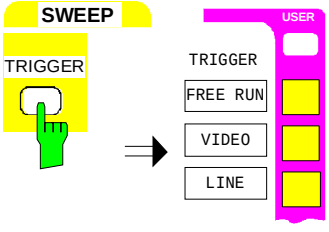
The entry field for the sweep time is opened.



➢ Enter *1* in the entry field via the numeric keypad and terminate the entry by pressing the *MHz* key.

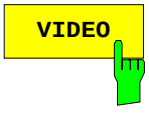
7. Connect the RF output of the SME to the RF input of the FSET.

8. Initiate triggering by means of the display voltage (video trigger)



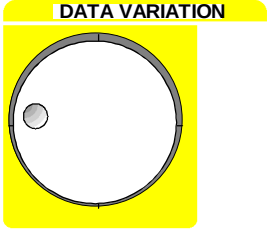
➢ Press the *TRIGGER* key in the *SWEEP* key field

The *TRIGGER* menu is opened.



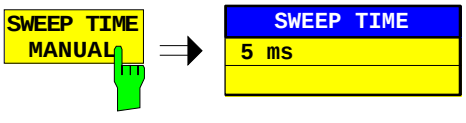
➢ Press the *VIDEO* softkey.

A dashed horizontal line is displayed which marks the trigger level.



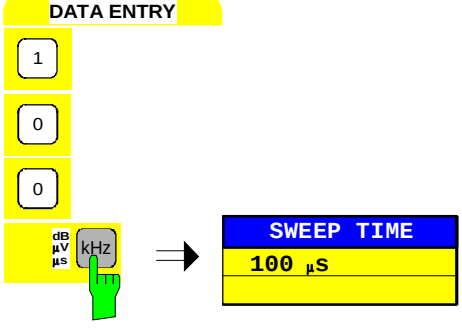
➢ Set the trigger level using the roll key such that a triggered display is obtained.
(see Fig. 2-15)

9. Set the sweep time to 100 µs



➢ Press the *SWEEP TIME MANUAL* softkey.

The window for entering the sweep time is opened.



➢ Enter *100* via the numeric keypad and terminate the entry by pressing the *kHz/µs* key.

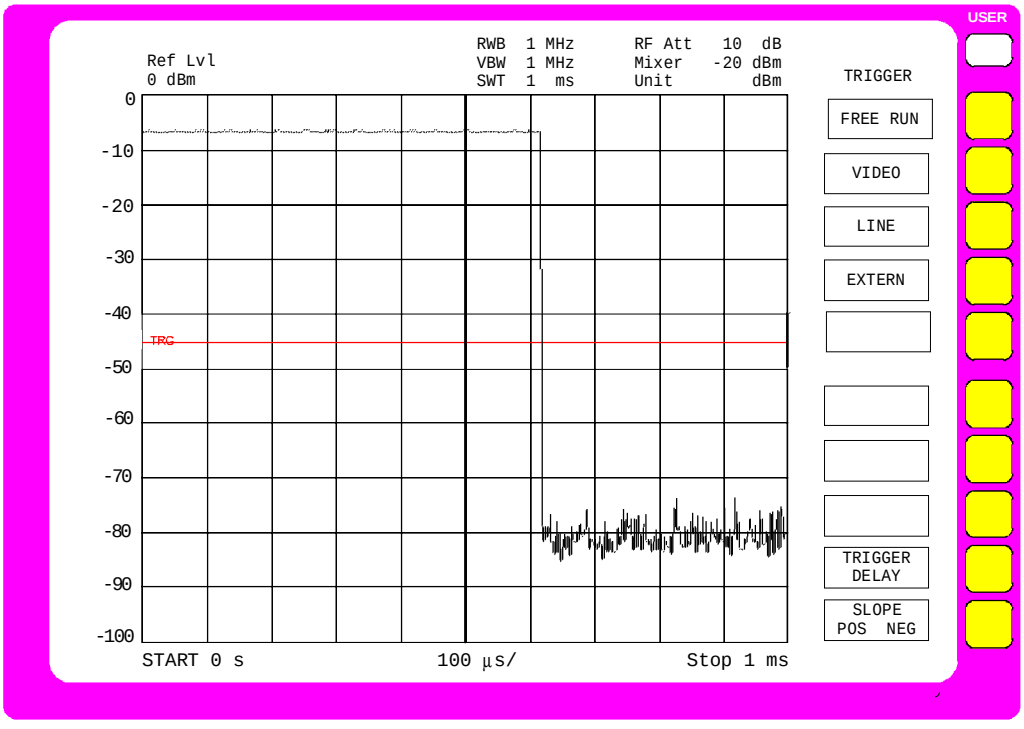
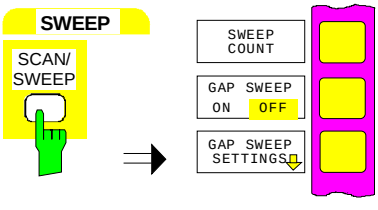


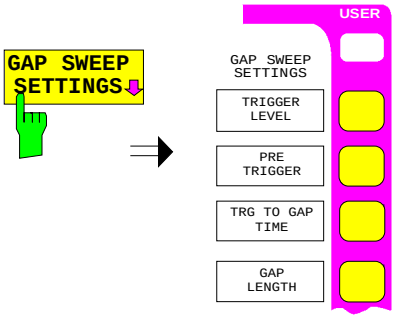
Fig. 2-15 Representation of pulse sequence with video trigger



10. Set the trigger points.

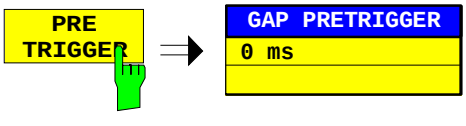
➢ Press the *SWEEP* key in the *SWEEP* keyfield.

The *SWEEP* menu is opened.



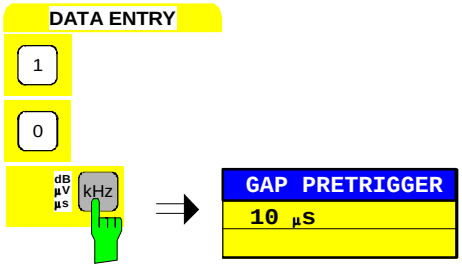
➢ Press the *GAP SWEEP SETTINGS* softkey.

The *GAP SWEEP SETTINGS* submenu for setting the trigger points is opened.

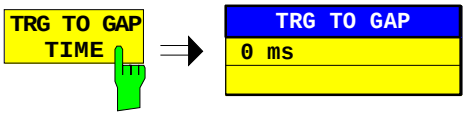


➢ Press the *PRE TRIGGER* softkey.

The entry field for the pretrigger is opened.

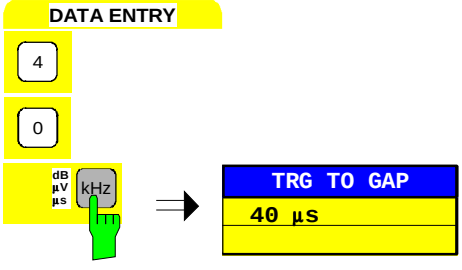


➢ Enter *10* via the numeric keypad in the entry field and terminate the entry by pressing the *kHz/µs* key.

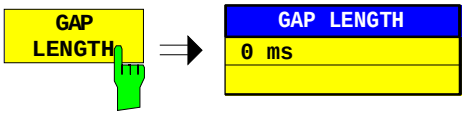


➢ Press the *TRG TO GAP* softkey.

The entry field for the trigger-to-gap-time is opened.

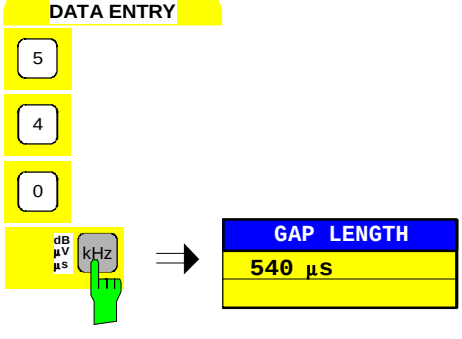


➢ Enter *40* via the numeric keypad in the entry field and terminate the entry by pressing the *kHz/µs* key.

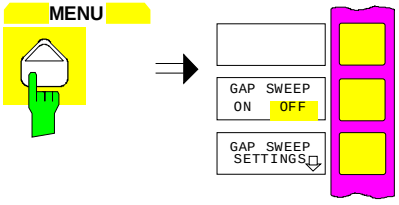


➢ Press the *GAP LENGTH* softkey.

The entry field for the length of the time gap is opened.



➢ Enter *540* in the entry field via the numeric keypad and terminate the entry by pressing the *kHz/µs* key.



11. Activate the measurement with mask-out of measured value

➢ Press the menu change key.

The right supplementary menu is opened.



➢ Press the *GAP SWEEP ON/OFF* key.

The measurement with blanking of measured value is activated. The measurement results are shown in Fig. 2-16

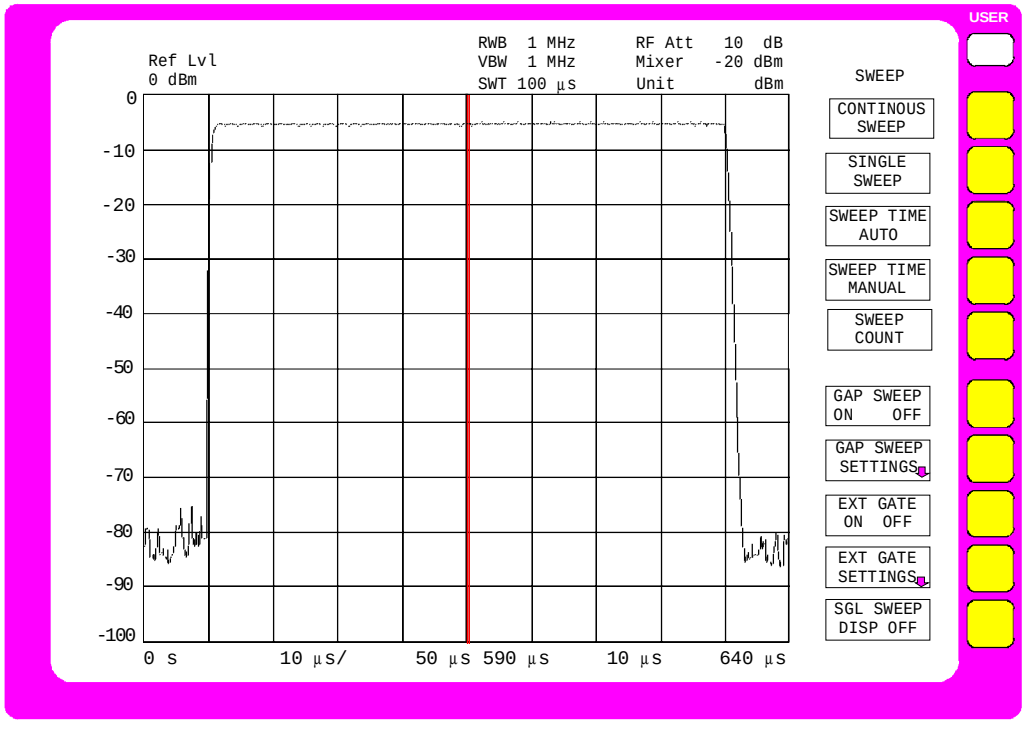


Fig. 2-16 Measured-value blanking for simultaneous display of rising and falling edge of a pulse signal. The position of the gap is indicated by the thick vertical line. The gap time is indicated via the double label 50 µs and 590 µs in the time axis.

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3 Manual Operation

Chapter 3 verviews manual operation of the FSET. This includes a description of the screen, menu operation and the setting of parameters. There is an overview of the menus at the end of this chapter.

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

The FSET is menu-controlled via keys and softkeys. Instrument parameters and test parameters can be set directly via softkeys or by entering values in entry fields and by making selections from tables. Softkey are used to select operating modes and the screen mode.
If required, data entry windows and tables also be displayed on the measurement screen.

After switching on the instrument a message about the BIOS version installed is displayed for a few seconds (e.g. "Analyzer BIOS Rev. 1.2").

The results of the self test is displayed next.

```
MAINPROCESSOR
SELFTEST STARTING ...
TESTING CMOS ...
DMA CHANNEL ...
INTERRUPTS ...
NMI ...
BASE MEMORY ...
EXTENDED MEMORY ...
HD CAPACITY ...
INIT FLOPPY DRIVE ...
INIT HD ...

SELFTEST DONE,
SYSTEM IS BOOTING ...
```

Subsequently, the Windows NT controller boots and the instrument then starts measuring. The type of measurement which was activated prior to last switch-off is performed, as long as no other instrument configuration was selected via *AUTO RECALL* in the *MEMORY RECALL* menu. While the measurement is being performed other menus and measuring modes can be entered simultaneously. The measurement results and the settings of the parameters are displayed on the screen.

The Screen

The screen informs continuously on the results and parameters for the selected measuring functions. The display mode for test results, the softkey labeling and the type of menu depend on the selected measuring function.

The screen is divided into two areas:

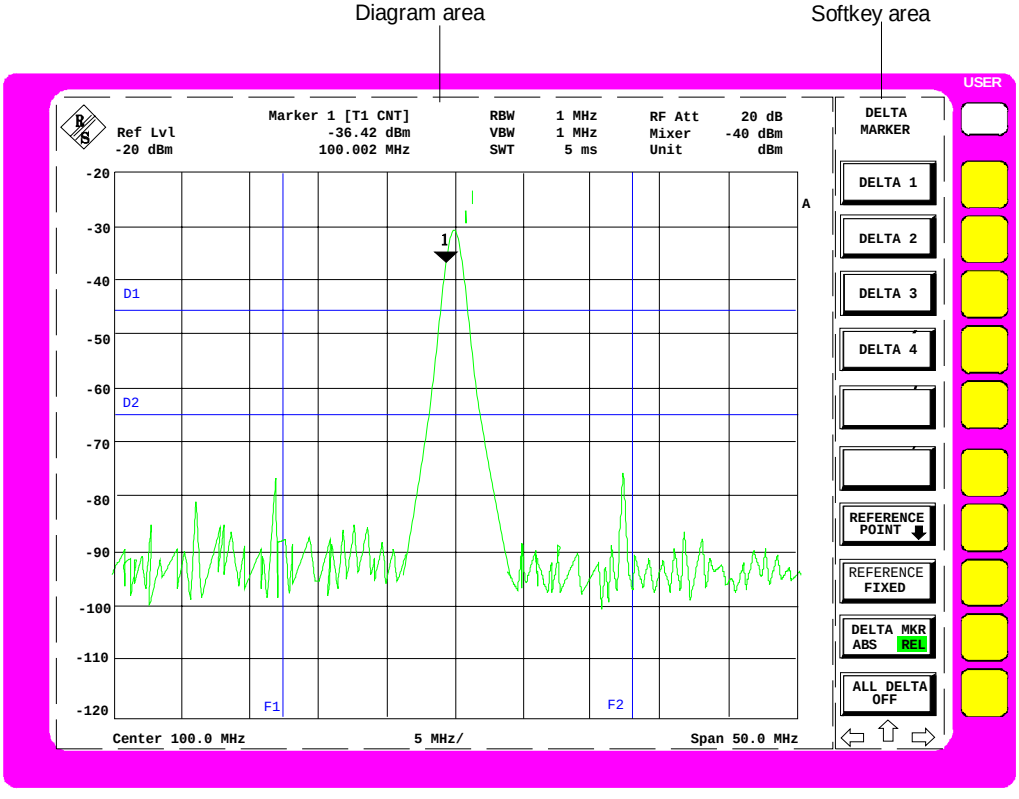


Fig. 3-1 Basic screen areas

Diagram area This area contains the measuring diagrams and other result displays as well as the parameters and status information which are important for analyzing the results.
Message fields, entry windows and tables may also be shown in this area.

Softkey area This area displays the instrument functions which can be selected via the softkeys. No other images are superimposed on the softkey area.

Diagram Area

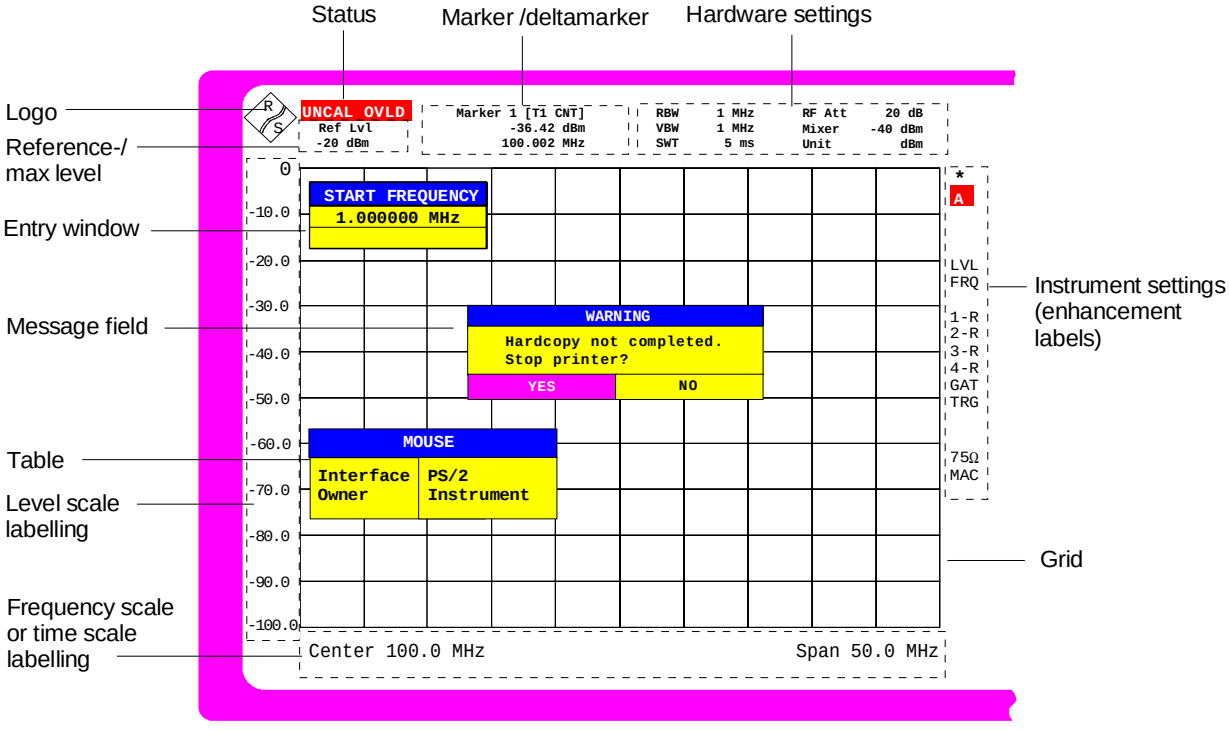


Fig. 3-2 Screen areas in analyzer mode

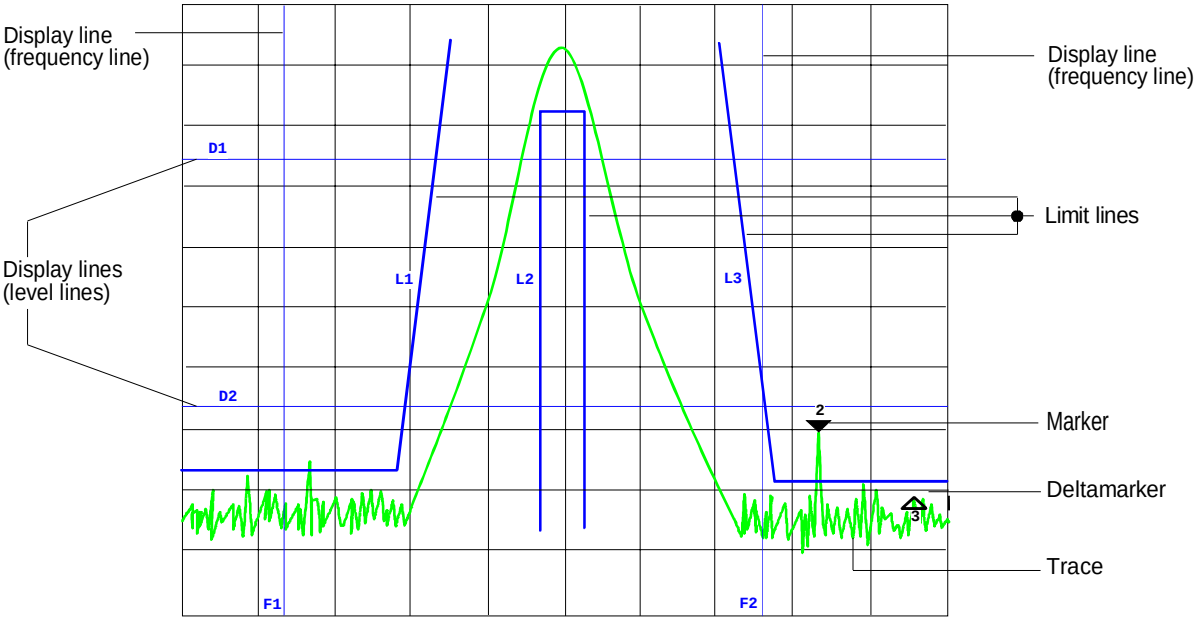


Fig. 3-3 Measuring diagram

Displays in the Diagram Area

The following graphic elements are displayed in the diagram area:

Status information A status information indicates that a problem has occurred.

In addition the status display displays MAX / REF LVL, if the maximum level and the reference level have different values .

UNCAL "UNCAL" is displayed under the following circumstances:

- no valid correction data (Status CALIBRATION FAILED in table CAL RESULTS), may occur after a cold start following a firmware update
  ⇒ record correction data (CAL TOTAL)
- correction data are switched off (menu CAL, CAL CORR OFF).
  ⇒ switch on CAL CORR ON or PRESET
- Sweep time too short for current instrument settings (span, resolution bandwidth, video band width).
  ⇒ increase sweep time
- resolution bandwidth too small for set symbol rate (Vector Anaylsis: digital demodulation) .
  ⇒ increase resolution bandwidth

OVLD „Overload“ is displayed when the input mixer is overloaded
⇒ Increase input attenuation

IFOVLD „IF Overload“ is displayed when an overload occurs after the input mixer.
⇒ Increase reference level

DIFOVL „Digital IF Overload“ is displayed when the digital resolution filter is overloaded.
⇒ Increase reference level

ExtRef „External Reference“ is displayed when the instrument is set to *REFERENCE EXT* (menu *SETUP*), but the reference signal is missing at the rear panel connector.
⇒ Ceck input signal of external reference

LO unl „LO unlock“ is indicated when the 1st LO is unlocked (module error).

LO Lvl „LO Level“ is displayed when the output level of the 1st LO is too small (module error).

LO LvD „LO Level Digital IF“ is displayed when the output level of the oscillator of module Digital IF is too small (module error).

OCXO 'OCXO cold' is indicated when the crystal oscillator has not yet reached ist operating temperature. This indication vanishes after a few minutes after switch on.

UNLD 'Underload' is displayed when the analyzer is not in its optimal dynamic range. In this case the measuring accuracy is not optimal. This indication is only output in vector analyzer operating mode.
⇒ Decrease reference level

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. As additional information, 2 fields in square brackets are provided which 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:

CNT frequency counter active

TRK signal track active

NOI noise measurement active

The marker text has the same color as the trace which the marker is assigned to. If, for example, the active marker is assigned to trace 1, and trace 1 is yellow, the marker text will be yellow, too.

Hardware settings

Receiver mode

RBW Indication of the set resolutíon bandwidth

Det Indication of the set detectors

Meas T Indication of the set measurement time

Trd Indication of the active transducer factors or sets

Unit Indication of unit of measurement results

Analyzer mode

RBW Display of the set resolution bandwidth.

VBW Display of the set video bandwidth.

SWT Display of the set sweep time.

RF Att Display of the set RF attenuation.

Mixer Display of the user set level at the input mixer (only when level differs from standard settings) .

Unit Display of the level unit of the measuring results and the associated setting and test parameters in full length. This label is particularly important for selection of units with more than 4 digits, since they can only be indicated as dB* in the other labels (except for marker).

Vector Analyzer mode

CF Display of the set center frequency

SR Display of the symbol rate

Demod Display of the switched on demodulator.

Standard Display of the set standard (e.g. GSM)

Grid

X-axis: frequency or time,
Y-axis: level

Instrument settings
(Enhancement Labels)

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

***** The current instrument setting is not the same as the setting selected when one of the traces was stored. This occurs under the following circumstances:

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

The display will not change until the cause is eliminated by the user. I.e., either a new sweep is started (SINGLE SWEEP mode), or the trace in question is switched to BLANK (all cases).

A Identification for screen A. Screen A is activated for the entry of test parameters.

B Identification for screen B. Screen B is activated for the entry of test parameters.

C If, in the Vector Analyzer mode, the inphase and quadrature signal is displayed in the measurement window A, the window is subdivided into two diagrams. The upper diagram is marked with an A and the bottom one with C.

D If, in the Vector Analyzer mode, the inphase and quadrature signal is displayed in the measurement window B, the window is subdivided into two diagrams. The upper diagram is marked with an B and the bottom one with D.

LN The automatic setting of the input attenuation is set to ATTEN LOW NOISE .

LD The automatic setting of the input attenuation is set to ATTEN LOW DISTORTION.

P0 RF preselection and 0 dB preamplification are switched on.

P10 RF preselection and 10 dB preamplification are switched on.

P20 RF preselection and 20 dB preamplification are switched on.

P30 RF preselection and 30 dB preamplification is switched on.

10 10 dB preamplification is switched on.

20 20 dB preamplification is switched on.

30 30 dB preamplification is switched on.

DIR Preselector FSET-Z.. is set to direct mode.

BAL Preselector FSET-Z.. is set to balanced input.

DC DC coupling is switched on at the RF entry of Preselector FSET-Z...

AC AC coupling is switched on at the RF entry of Preselector FSET-Z...

TDF An antenna correction factor (*TRANSDUCER FACTOR*) is switched on.

TDS A set of antenna correction factors (*TRANSDUCER SETS*) is switched on.

LVL A level offset ≠ 0 dB has been set. A level offset of the installed tracking generator (option) leads to the same display.

FRQ A frequency offset ≠ 0 Hz has been set.

SGL The scan/sweep is set to SINGLE SCAN or SINGLE SWEEP.

PLS The pulse stretcher is switched on.

1-<n> Subtraction Trace 1 - Trace <n> active (<n>: numeric value) or subtraction Trace 1 - Reference Line active (<n>: R)

2-<n> Subtraction Trace 2 - Trace <n> active (<n>: numeric value) or subtraction Trace 1 - Reference Line active (<n>: R)

3-<n> Subtraction Trace 3 - Trace <n> active (<n>: numeric value) or subtraction Trace 1 - Reference Line active (<n>: R)

4-<n> Subtraction Trace 4 - Trace <n> active (<n>: numeric value) or subtraction Trace 1 - Reference Line active (<n>: R)

<n>AP For trace <n> (n = 1 to 4) the detector is set to AUTOPEAK.

<n>MA For trace <n> (n = 1 to 4) the detector is set to MAX PEAK.

<n>MI For trace <n> (n = 1 to 4) the detector is set to MIN PEAK.

<n>SA For trace <n> (n = 1 to 4) the detector is set to SAMPLE.

<n>AV For trace <n> (n = 1 to 4) the detector is set to AVERAGE.

<n>RM For trace <n> (n = 1 to 4) the detector is set to RMS.

GAT The frequency sweep is controlled via the *EXT TRIG/GATE* connector.

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

EXT The unit is configured for operation with external reference

EVD FSET is configured for operation with an external video filter.

NFI The video notch filter for the suppression of AC hum is switched on

MAC Macro recording active.

PRN A printout is taking place. PRN overwrites the enhancement label MAC.

<n>VIEW Trace <n> (n = 1 to 4) is set to VIEW

<n>AVG Trace <n> (n = 1 to 4) is set AVERAGE

<n>CAPT For trace <n> (n = 1 to 4) CAPTURE MEMORY is switched on.

Frequency axis labeling Display of the x-scaling.

123.4 ms/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 CENTER/SPAN or 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 CENTER/SPAN or START/STOP were last pressed.
If span = 0 Hz, the trigger moment (*PRETRIGGER*) is displayed.

Optional labeling Optional indication of date, time and comment.

14.Jun 97 12:13

Level axis labeling Display of the y-scaling.

Entry window The data entry window is superimposed in the diagram area, if required.

Reference level/ Max. level Display of the set reference level or combined display of maximum level and reference level in analyzer mode.

Limit lines Limit lines are are the upper and/or lower limits for level curves or spectral distributions.

Traces 1 to 4 Up to 4 traces can be displayed simultaneously.

Display lines Utilities for trace analysis.

The FSET provides two display modes:

- Full Screen: 1 window, all traces are displayed in one screen.
- Split Screen: 2 windows, traces, grid and labels are distributed on the two screens.

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.
The *DISPLAY* key is used to switch between the windows. The current measurement is terminated when its window goes blank.
Switching from split-screen to full-screen mode is performed in menu *SYSTEM DISPLAY*.

Split Screen

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

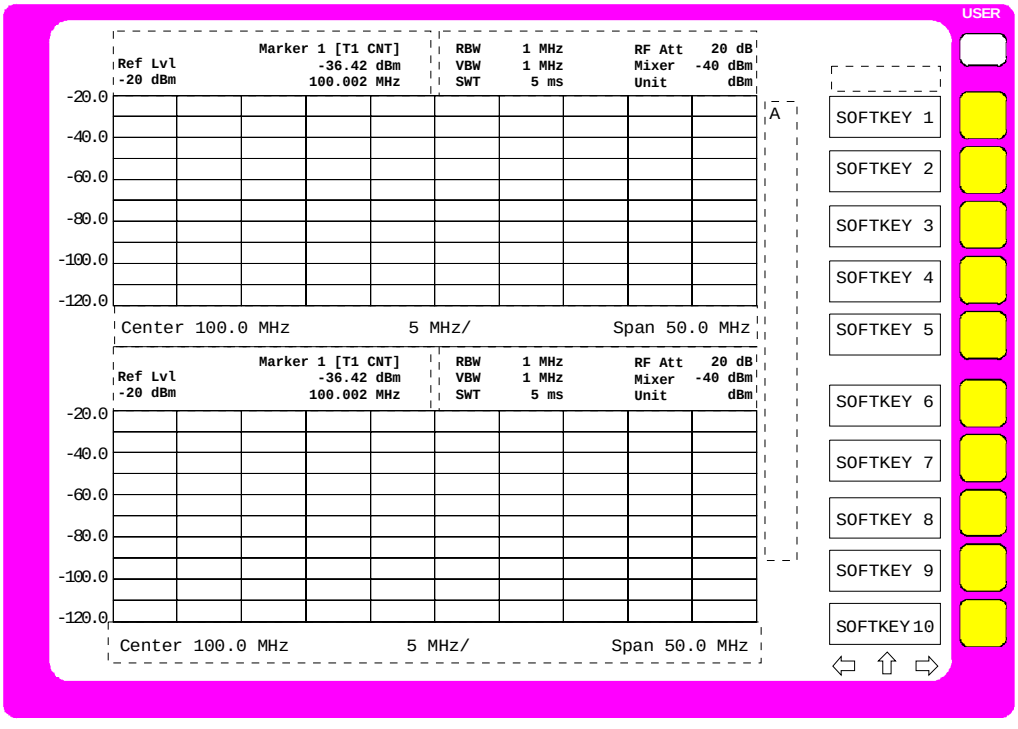


Fig. 3-4 Split Screen mode

In the default receiver mode, the screen is divided up according to fixed configurations.

Table 3-1 Default assignment of traces to windows with split screen in the receiver mode

upper (screen A)	Indication of level and frequency	Zoomed scan
lower (screen B)	Scan spectrum	Scan spectrum

However, a selection can be made in the upper half of the screen (SCREEN A) between bargraph display of the receiver mode and the spectrum analyzer mode.
With spectrum analyzer selected, the scan display in the lower half of the screen remains unchanged and the spectrum analyzer with all its measurement functions is available in the upper screen half (see Chapter 4, Section 'Display Configuration').

In analyzer mode, the upper half is always assigned to Screen A, the lower to Screen B. The measurement settings 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 window for entry of the measuring parameters or the marker operation is selected using the *DISPLAY* key.
The indications which apply only to one window appear in the margin of the associated diagram. Indications which apply to the two windows are displayed between the diagrams.
The assignment of traces to the windows is fixed and cannot be modified.

Table 3-2 Assignment of traces to windows with split screen in the signal or vector analyzer mode

Trace 1:	upper (screen A)	Trace 3:	upper (screen A)
Trace 2:	lower (screen B)	Trace 4:	lower (screen B)

The two windows can be subdivided into two measurement diagrams. This applies to separate display of measurement values, eg to the display of the inphase and quadrature signal in vector analysis. Screen A is divided into diagrams A and C, screen B is divided in diagrams B and D.

Softkey Area

The layout of the softkey area is independent of the operating mode. It consists of the following graphic elements:

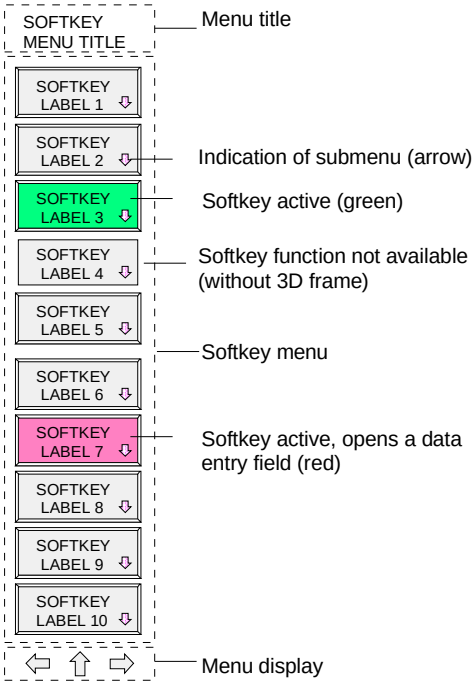


Fig. 3-5 Layout of the softkey area

The softkeys have different functions depending on the instrument state. Therefore, their labeling changes. The current state of the softkeys is indicated by color coding. The color code is factory-set as follows:

Table 3-3 Factory-set color code for softkeys

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

These colors can be changed by the user as desired in the *SYSTEM DISPLAY-CONFIG DISPLAY* menu.
A softkey is switched on or off by pressing it. If a mouse is connected to the instrument, the softkey label on the display can be clicked.

Softkey labels are not displayed if the function they represent is not available. There are two cases:

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

Changing the Menu

With manual control, the FSET can be operated via the front-panel keys, the external keyboard or with a mouse.

Operation is menu-controlled. Various **softkey menus** are displayed depending on the instrument status. The menus are organized using a tree structure. The start menu (the root of the menu tree) is always called by pressing a hardkey. The softkeys are then used to branch into further menus (submenus).

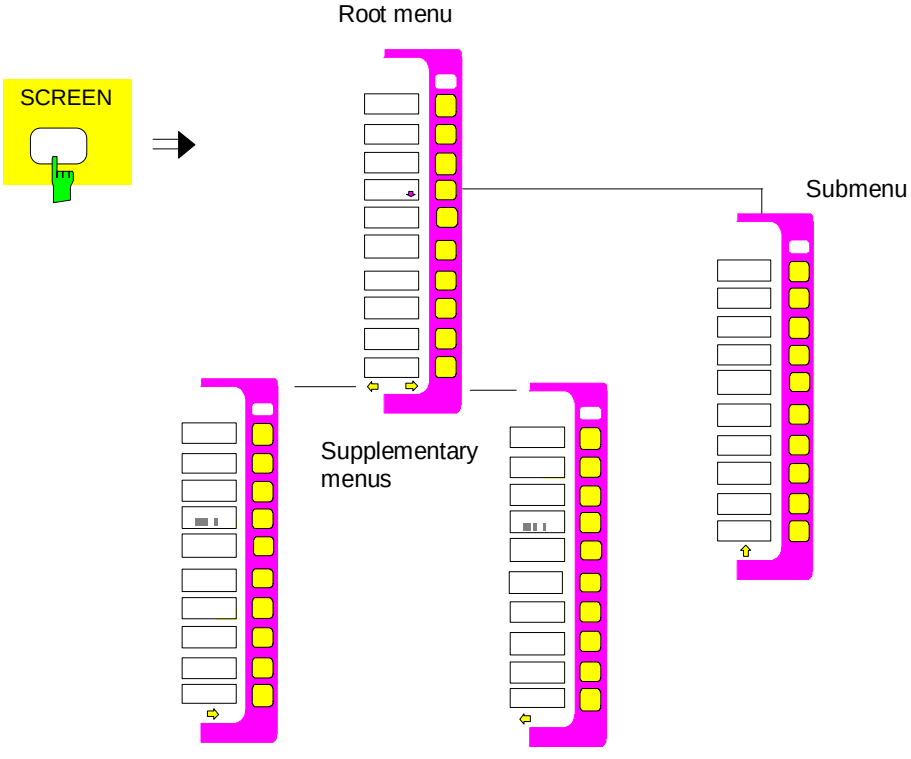


Fig. 3-6 Theory of menu selection

Each softkey menu consists of max. 30 softkeys, 10 softkeys being arranged in a main menu, 10 in a left-hand supplementary menu and 10 in a right-hand supplementary menu. In contrast to empty main menus, empty supplementary menus are not displayed. Arrows at the lower edge of the softkey area indicate whether a supplementary menu exists or not.

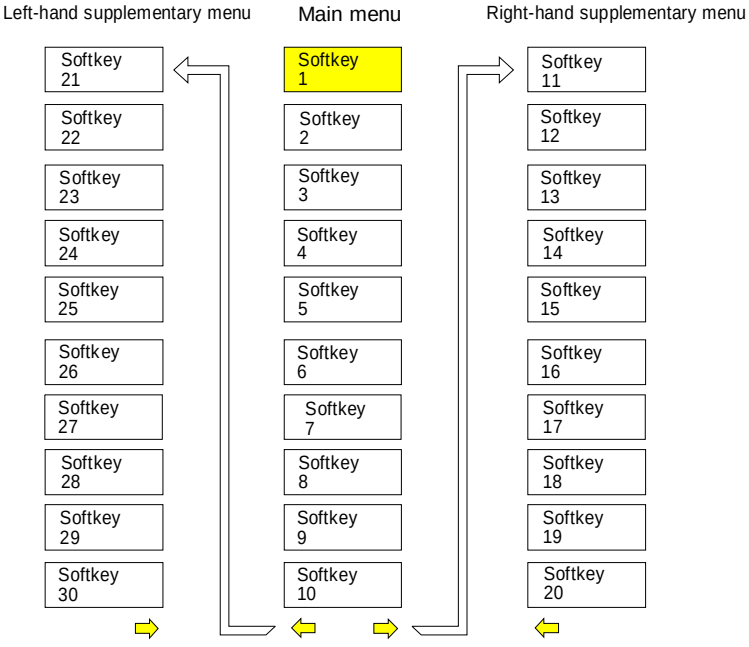
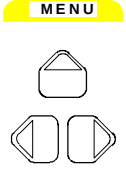


Fig. 3-7 Switching between main menu and supplementary menu

The menu arrows help to orient inside the menu tree.

Examples: ⇦ ⇨ This menu has a right-hand and a lefthand supplementary menu. It is the root menu since there is no ⇧ arrow.

⇧ ⇨ Only a right-hand supplementary menu or the upper menu can be accessed from this menu.



The MENU keys allow for selecting the main menu and the supplementary menus. If a mouse is connected to the instrument, the menu arrows can be selected to enter the respective menus. The MENU keys have the following functions:



When this key is pressed, the FSET enters the left-hand supplementary menu.

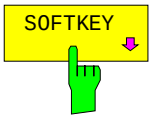


This key is pressed to call the upper menu which is located in the next higher hierarchical level in the menu tree. Several menus provide for automatic change, i.e., return to the next higher menu is caused automatically after pressing a softkey.



The right-hand supplementary menu is selected by pressing this key.
A supplementary menu cannot be selected from another supplementary menu but only via the main menu.

Submenu are always selected with a softkey.



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

The softkeys are masked out in remote mode and during macro processing.

Setting the Parameters

Data Entry

Instrument parameters can be entered in an entry window or in a table via the numeric keypad on the front panel (*DATA ENTRY*), an external keyboard and the roll-key.
The numeric keypad *DATA ENTRY* is provided for entry of numeric parameters (e.g., the start frequency). The roll-key is used for fast incrementing or decrementing of numeric parameters with a defined step size.

It is advisable to use the external keyboard for definition of alphanumeric parameters (e.g., file names) since the front panel does not allow for entry of letters.

Numeric Keypad on the Front Panel

The keys are assigned the following functions:



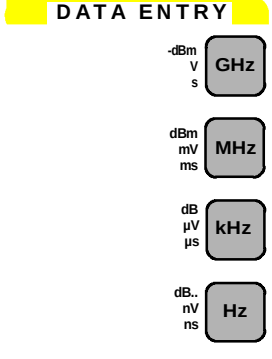
Number keys



Changes the sign of a numeric parameter. A "-" is inserted at the cursor position in the case of an alphanumeric parameter.



Inserts a decimal point "." at the cursor position in the numeric string.



Append the selected unit to the numeric value that has been entered

The unit keys are all assigned the value "1" if quantities are indicated without dimensions in order to prevent faulty operations The unit keys, therefore, also adopt the function of an ENTER key. The same applies to alphanumeric entries.



Adds an exponent (E-xx) to the end of the numeric string.

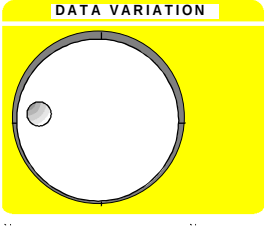


Deletes the character to the left of the cursor with numeric entry.
Toggles between the current parameter and the previous value - but not when an entry is being made (UNDO function).



Closes the entry field when entry has been made.
Aborts the entry before it has been confirmed.
Closes the system message windows.

Roll-key and Cursor Keys



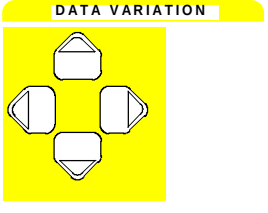
The roll-key has several functions.

- With numeric entry, the instrument parameter is incremented (turning clockwise) or decremented (turning counterclockwise) at a defined step size.

  The step size may be equal to or smaller (e.g., 1/10) than the step size being defined for the cursor keys (see description of the *STEP* key).
- 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 changed with 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.

As the roll-key is turned faster, the step size increases so speeding up the setting procedure.

Cursor keys:



With numeric entry, the keys ⌃ or ⌄ are used to increase or decrease the instrument parameter by the selected step size. The keys are disabled With alphanumeric entry, the keys are used to toggle between the editing line and the help line editor.

The keys ⟨ and ⟩ are used to shift the cursor to the required position within the (alpha)numeric editing line..

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

Entry Windows

Setting Up the Entry Window

The instrument parameters are not entered at the location where the parameter is displayed but in an individual entry window.

The entry window is called by a softkey or a hardkey and is used for definition of numeric or alphanumeric instrument parameters (START FREQUENCY by way of example):

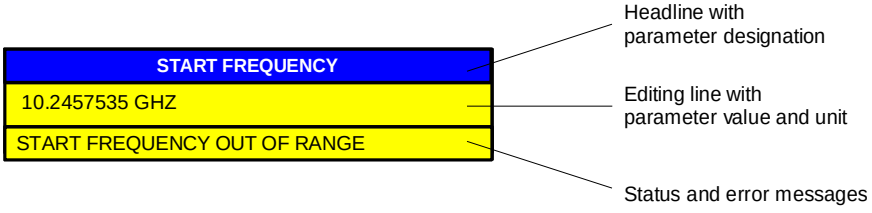


Fig. 3-8 Setup of an entry window

Subsequent to calling the entry window the current parameter value including the unit is displayed in the editing line. Status and error messges which refer to the current entry are displayed in the third and (optionally) fourth line.

The entry window is displayed in the left upper edge of the active measuring window with the default setting. When a mouse is connected to the instrument, open entry windows can be shifted to any position on the screen provided that they do not cover the softkey line. The new position is valid until measuring window is selected. The data entry window is represented transparent or non-transparent, as required.

Alphanumeric parameters are displayed as a simple character string in the editing line. Numeric parameters which consist of mantissa, exponent and unit are set up as follows:

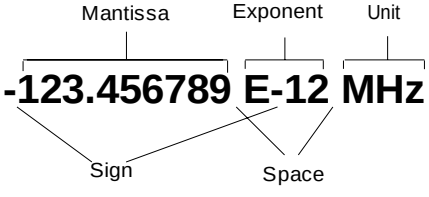


Fig. 3-9 Setup of numeric parameters

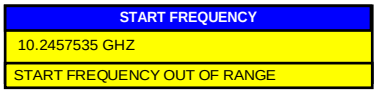
Mantissa: The first character is the sign of the mantissa, the positive sign is not displayed. The actual numeric value follows. The number of digits depends on the instrument parameter. The cursor may be shifted to the first digit of the mantissa at maximum, however, it may not precede the sign. The decimal point can be set as required.

Exponent: The exponent is separated from mantissa by a space character. The sign field of the exponent follows the "E", the positive sign "+" being not displayed similar to the representation of the mantissa. The cursor skips the "E" and the sign field. Two characters are fixed for the exponent value.

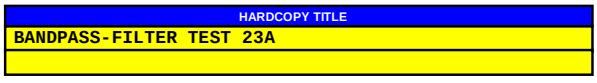
Unit: The unit (not represented in editing mode) is separated from the exponent by a space character.

The number of digits which can be entered for each instrument parameter is limited by the width of the input field only, but not by the amount which is physically enabled. (Example: Levels should be indicated with two decimals. The user may, however, enter as many decimals as desired - the entered value is rounded accordingly).

There are two types of entry windows:



The editing line of the entry window for numeric parameters allows for display of up to 24 characters. Horizontal scrolling is not possible in the editing line.



The editing line of the entry window for alphanumeric parameters allows for display of up to 60 characters (cf. display section). Maximum 256 characters may be entered. Horizontal scrolling is possible.

Editing of Numeric Parameters

Calling the entry window:

- Subsequent to calling the entry window, the current value of the numeric parameter including the unit is displayed in inverted color. The cursor is not displayed in this state. The transparent data entry window has no background color.
- The entry window is closed upon pressing the key CLR.

Editing mode:

- Pressing a number, sign or decimal point key causes the value and unit to be deleted. The new value is output left-justified. The individual characters are entered in insert mode. If the maximum amount of characters for the mantissa or the exponent has been entered, no further entry is possible (no horizontal scrolling). If characters are positioned to the right of the cursor, they are shifted right when reaching the maximum length and get lost.
- Pressing the keys DATA VARIATION or causes normal representation of the current value. The unit is no longer displayed and the cursor precedes the first digit of the mantissa ( ) or follows the last digit entered ( ). The DATA VARIATION keys and change the numeric value of the cursor.
- Pressing the DATA VARIATION keys or or the roll-key causes the original parameter value to be restored and modified according to the defined step size for this parameter.
- The data management of the instrument stores the previous value of a parameter in addition to the current value. The BACK key allows for toggling between these two values.

Termination and abortion of entry:

- The editing mode is terminated by pressing a unit key. The validity of the new parameter value is checked and accepted for the instrument setting. If an error occurs, a corresponding error message is displayed in the status line of the editing field, e.g., *"Out of range"*, *"Value adjusted"*, etc.
- Editing of a parameter can be aborted by pressing the key CLR. The original parameter is then displayed again. The entry window is closed by pressing the CLR key again.
- Pressing a key or softkey subsequent to starting the entry causes the entry to be aborted and the entry window to be closed. If the same softkey which has opened the entry window is activated during entry, the original value is restored and displayed.

Editing of Alphanumeric Parameters

Generally, the regulations for numeric parameters analogously apply for alphanumeric parameters. Note the exceptions given below:

- Alphanumeric parameters are not displayed with a unit.
- The four unit keys adopt the function of the ENTER key.
- Horizontal scrolling is possible in the editing line.
- Incrementing or decrementing cannot be effected via the keys , or the roll-key.
- Pressing the sign key causes a "-" character to be inserted at the cursor position, the decimal point key causes insertion of a point ".".
- The exponent key has no function.

Help Line Editor

The help line editor allows for labelling or text entries to be made without an external keyboard being required. In this case, a field containing letters and special characters is added to the standard entry window. The help line editor is displayed automatically if no external keyboard is provided and an entry window for alphanumeric entry is opened.

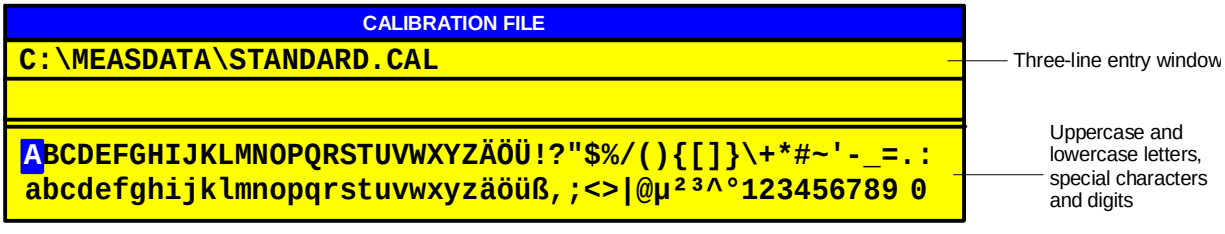


Fig. 3-10 Help line editor

- The keys and are used to toggle between the editing line and the help line editor.
- The cursor can be positioned to the required character in the help line editor using the cursor keys and the roll-key.
- A character is entered in the editing line by pressing any of the unit keys.
- If the cursor is already located in the editing line, pressing a unit key terminates data entry.

Table Entry

The FSET uses numerous tables for indication and configuration of instrument parameters. The tables differ very much in the number of lines, columns and inscriptions and have a different functionality.

Tables are represented in a non-transparent form. The size is predefined and cannot be modified. If a mouse is connected, the tables may be shifted on the display without covering the softkeys. Tables can be superimposed by entry windows or suchlike.

Tables are mostly coupled to a softkey menu which provides further functions for editing table entries, e.g., deletion of tables, copying lines or columns, marking of table elements, restoring of default states etc. Another kind of tables is exclusively used for indication of instrument parameters and cannot be edited.

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

The basic concept of operation is, however, the same for all tables. A differentiation is made between shifting mode and editing mode.

Shifting Mode

This mode is active subsequent to opening a table. The **cursor** is shifted between the table elements by means of the cursor keys. The table element which is below the cursor is represented in inverted color.

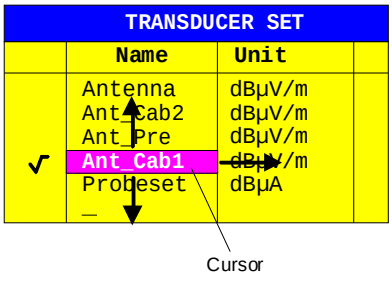


Fig. 3-11 Shifting mode

Editing Mode

A table element which is marked by a cursor can be editied as follows:

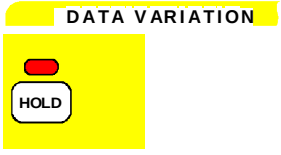
- by pressing one of the unit keys on the front panel or the *ENTER* key on the external keyboard.
- by a double-click of the mouse on the table element. If the clicked element is not yet marked by the cursor, the letter is positioned on the element, additionally.
- For numeric or alphanumeric instrument parameters, the editing operation may be started by entry of any number or letter on the front panel or on the external keyboard.

The data entry window, the selection list or the toggle editor are provided for this purpose.

After the editing operation has been terminated, the table enters the shifting mode again. The cursor is positioned automatically on the next table element.

Disabling the Control Elements - HOLD Key

The individual softkeys have the following functions:

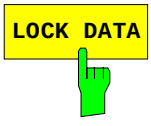


The functions of the *HOLD* menu allow for disabling individual control elements or the complete instrument control. The LED above the *HOLD* key indicates that either the function *LOCK DATA* or *LOCK ALL* has been activated. The control can be enabled again by successively pressing the two *UNLOCK* softkeys in any order.

Switching off the instrument resets control such that the instrument can be normally operated again after subsequent switch-on.



After selecting the two UNLOCK softkeys, the instrument keyboard is enabled again. The LED above the HOLD key goes out.



Selection of softkey *LOCK DATA* causes the roll-key to be disabled in order to prevent a parameter from being varied by mistake.

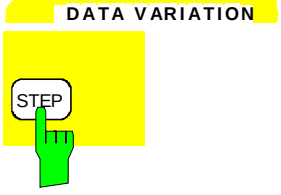


Selection of *LOCK ALL* softkey disables the complete front panel (including the *PRESET* key and roll-key, not including the *UNLOCK* softkeys*)*, the mouse and all keys of the external keyboard. Exit from the *HOLD* menu is no longer possible. Control is enabled again by actuating the two *UNLOCK* softkeys.

Setting the Stepsize - STEP Key

A number of numeric instrument parameters allow for step-by-step incrementing or decrementing the value in the editing line of the entry window using the keys ⌃ or ⌄ or the roll-key. The stepsize used with the cursor keys can be specified for the selected parameters in the *STEP* menu.

Notes: – *It is not possible to set the stepsize by all of the numeric parameters.*
– *An extended STEP menu is available by some parameters. The extra functions are described by the respective parameter.*
– *Setting the step size has no effect on the roll-key (the resolution of the roll-key is higher than that of the step size functuion)*



The *STEP* key opens the *STEP* menu for entry of the stepsize.

The stepsize of an instrument parameter can only be varied when this parameter is edited in an entry window.
The softkeys in the *STEP* menu are disabled if no instrumentnparameter is being varied or if the parameter being edited does not support stepsize variation (as is the case by all of the alphanumeric parameters.

The key ⌃ leads to exit from the *STEP* menu and automatic return to the previously active menu.

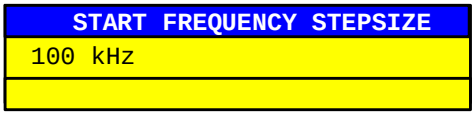


The softkey *STEPSIZE AUTO* causes the stepsize for the corresponding instrument parameter to be set automatically and be continuously varied with varying instrument settings (in accordance with other parameters).

Example:
The stepsize of the *CENTER* frequency depends on the selected span.



The softkey *STEPSIZE NORMAL* calls an entry window for definition of a stepsize by the user. The parameter whose stepsize is varied, is displayed in the headline of the entry window:



The stepsize remains constant until a new value is entered or until the STEPSIZE AUTO softkey is activated. It is no longer coupled to other instrument parameters.

Mouse and External Keyboard Control

External Keyboard Control

The connection of an external keyboard provides additional characters for the entry (letters and special characters). It is permitted to use both, front panel keys and the external keyboard, for control. The number, cursor and sign keys have the same effect as the corresponding front panel keys. A few keys of the external keyboard provide an extended functionality with entries or tables which is described in the following table. The table shows the external keyboard key combinations through which the functions of the front panel keys can be emulated.

Note: *The key combination <ALT> <SYSREQ> switches between the instrument display screen and the controller display screen*

Table 3-3 Front Panel Keyboard Emulation

FSET front panel keys		Key assignments for the external keyboard
Soft keys:	SK1 SK2 SK3 SK4 SK5 SK6 SK7 SK8 SK9 SK10	F1 F2 F3 F4 F5 F6 F7 F8 F9 F10
Menu select:	Menu left Menu right Menu up	CTRL ← CTRL → CTRL ↑
Cursor control:	Cursor left Cursor right Cursor up Cursor down	← → ↑ ↓
Roll-key:	Turn left Turn right	SHIFT ↑ SHIFT ↓
Numeric keys:	0 to 9	0 to 9
Units keys:	GHz... MHz... kHz... Hz...	ALT-G ALT-M ALT-K <ENTER>
Edit keys:	Clear Backspace	<ESC> BACK
Misc. data entry keys:		
	Exponent "Exp" Sign "+/-" Decimal point"."	ALT-E - .
Hold key:	Hold	SHIFT-F1
User menu:	User	SHIFT-F2
System keys:	Preset Cal Display Info	SHIFT-F4 ALT-F12 ALT-F10 SHIFT-F5
Configuration key group:	Mode Setup	ALT-F2 SHIFT-F8

FSET front panel keys		Key assignments for the external keyboard
Hardcopy key group:	Start Settings	SHIFT-F6 SHIFT-F9
Status key group :	Local	SHIFT-F3
Frequency key group:	Start Stop CenterFreq/Center Zoom/Span	CTRL-F7 CTRL-F8 CTRL-F9 CTRL-F10
Level key group:	Unit/Ref Range Input Cal	CTRL-F11 CTRL-F12 ALT-F11 ALT-F12
Marker key group :	Normal Search Delta → Mkr	CTRL-F1 CTRL-F2 CTRL-F3 CTRL-F4
Lines key group :	Display Limit	CTRL-F5 CTRL-F6
Traces key group :	1 2 3 4	ALT-1 ALT-2 ALT-3 ALT-4
Sweep key group :	-- -- -- Run/Coupl. Scan/Sweep Trigger	ALT-F3 ALT-F4 ALT-F5 ALT-F6 ALT-F7 ALT-F8
Memory key group:	Config Save Recall	SHIFT-F10 SHIFT-F11 SHIFT-F12
Data entry key group :	Step	SHIFT-F7
Letters and special characters		A to Z (ext.) a to z (ext.) Special characters (ext.)
Edit key		Delete
Cursor control		Home End Page up Page down

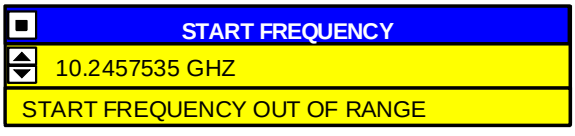
Data Entry Windows with Mouse Control

With a mouse being connected, additional functions are provided in the entry windows. Therefore, buttons are displayed in the entry window.

Essentially, the definitions which have been made for all types of entry window also apply for mouse control. However, note the following deviations:

- The so-called close-button is displayed on the left margin of the headline. Selecting this button via the mouse aborts the entry and closes the entry window. This corresponds to the function of the CLR key with manual control.
- In the numeric entry window, two buttons (⇕) are displayed on the left margin of the editing line. Simply clicking the buttons causes the parameter in the editing line to be incremented or decremented (similar to the keys ▲ / ▼ or the roll-key with manual control).
- The cursor can be positioned in the entry line by clicking a character using the mouse.
- A character in the letter window of the help line editor can be selected by a single click. A double click copies the character from the letter window into the editing line.
- Open entry windows can be shifted across the complete screen using the mouse; they must not, however, be superimposed on the softkey line. Shifting is performed by clicking the headline and pushing the mouse while he mouse-key is being pressed.

Example: Numeric entry window with mouse control



Mouse Control of Further Display Elements

All display and control elements (enhancement labels, soft keys, function fields, display and limit lines) which can be displayed on the display screen can also be controlled by the mouse. Each soft key or key is assigned to a display element.

Double-klicking an display or control element opens the corresponding softkey menu. The assignment of softkeys/keys to display elements is shown in the following table.

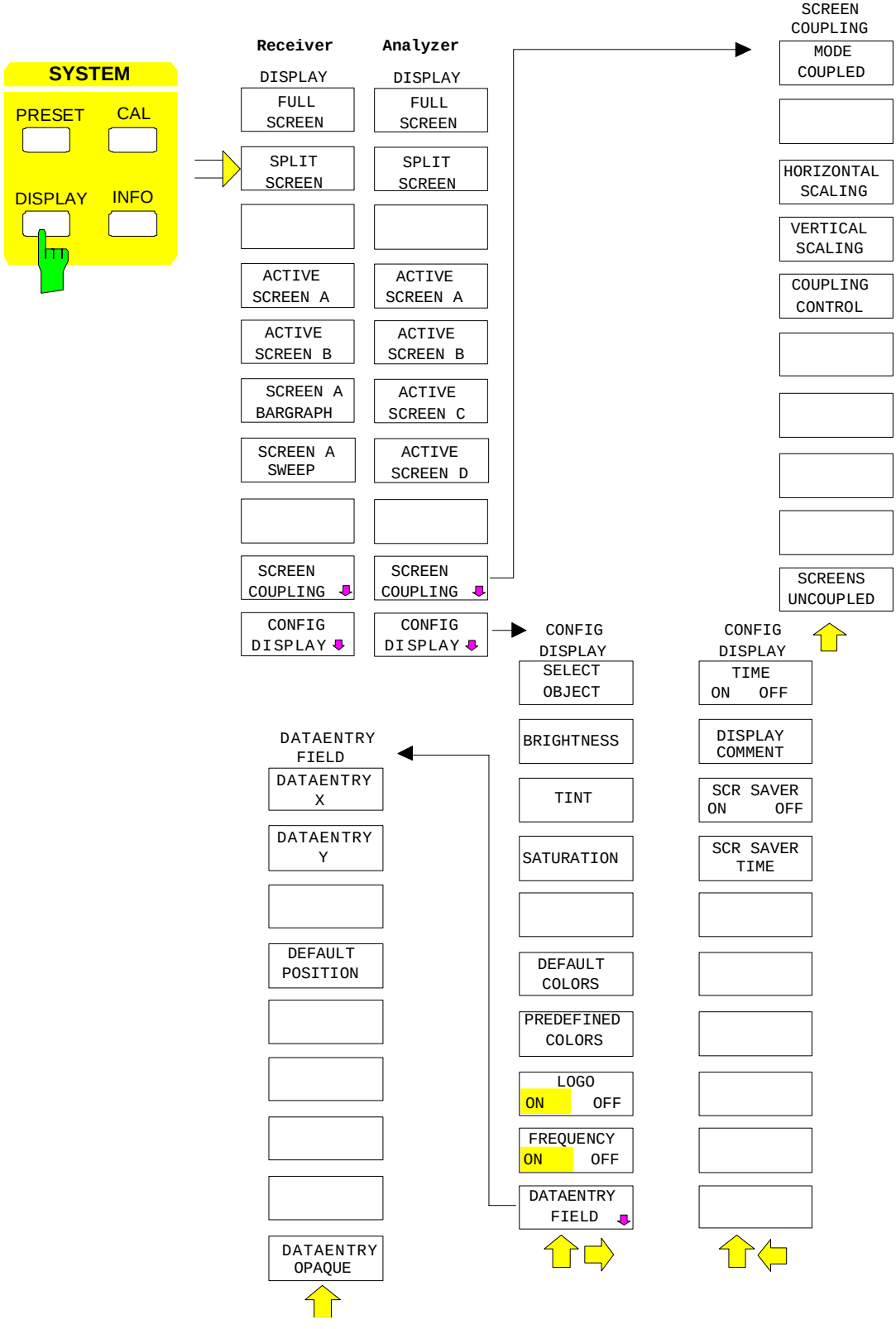
Klicking the right mouse key call all softkey menus one after the other.

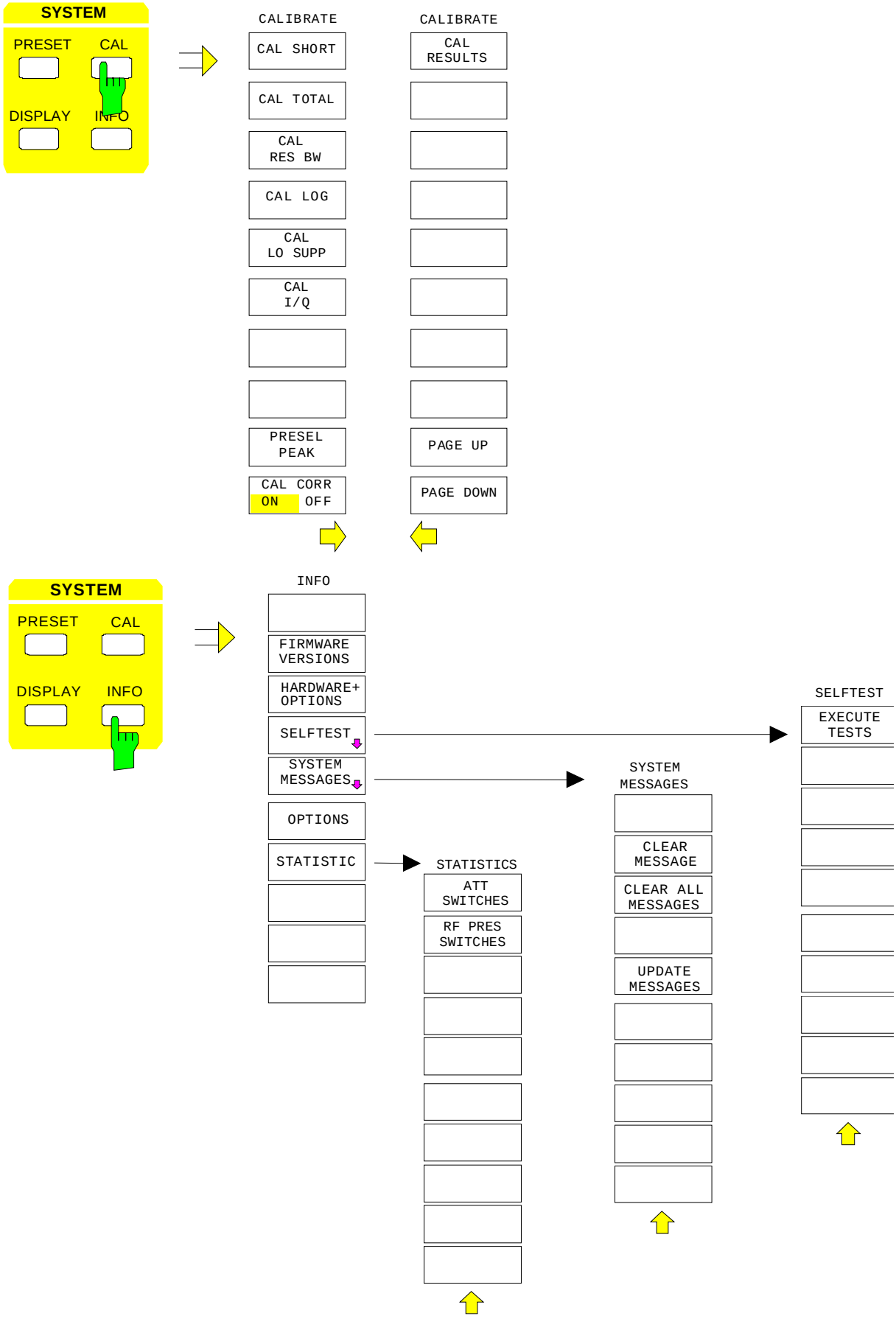
Table 3-4 Mouse Control of Display Elements

Display element for mouse control.		**Assigned soft key or key**
Display field for Soft Key 1 to Soft Key 10		Soft Key 1 to Soft Key 10
Display field for menu arrow: right/center/left		Key right/center/left supplementary menu
Enhancement labels	*	--
	PA	SETUP key
	PS	SETUP key
	UNS	RUN/COUPLING key
	LVL	UNIT/REF key
	FRQ	FREQ/CENTER key
	1-x	TRACE 1 key
	2-x	TRACE 2 key
	3-x	TRACE 3 key
	4-x	TRACE 4 key
	TRG	TRIGGER key
	DC	INPUT key
	75Ω	INPUT key
	MAC	USER key
Status display	UNCAL	CAL key
	OVLD	UNIT/REF key
	ERR	INFO key
Display fields above the diagram		
	Ref. Level / Max	UNIT/REF key
	Level	NORMAL key
	Marker	RUN/COUPLING key
	RBW	RUN/COUPLING key
	VBW	RUN/COUPLING key
	SWT	INPUT key
	RF Att	INPUT key
	Mixer	UNIT/REF key
	Unit	
Display fields below the diagram		
	Start	START key
	Stop	STOP key
	Center	FREQ/CENTER key
	Span	ZOOM/SPAN key
	Trigger	TRIGGER key
	/Div	--

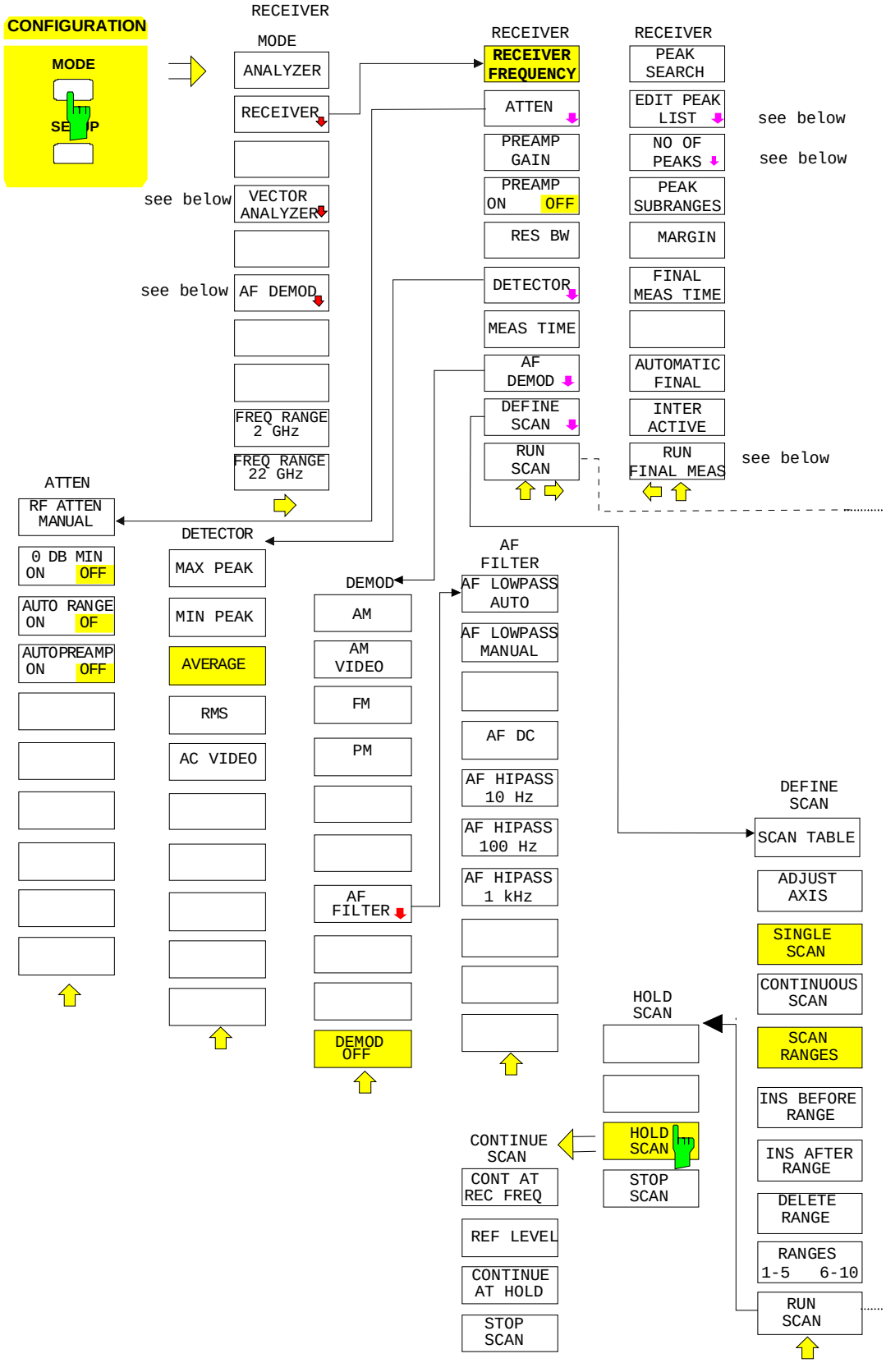
Menu Overview

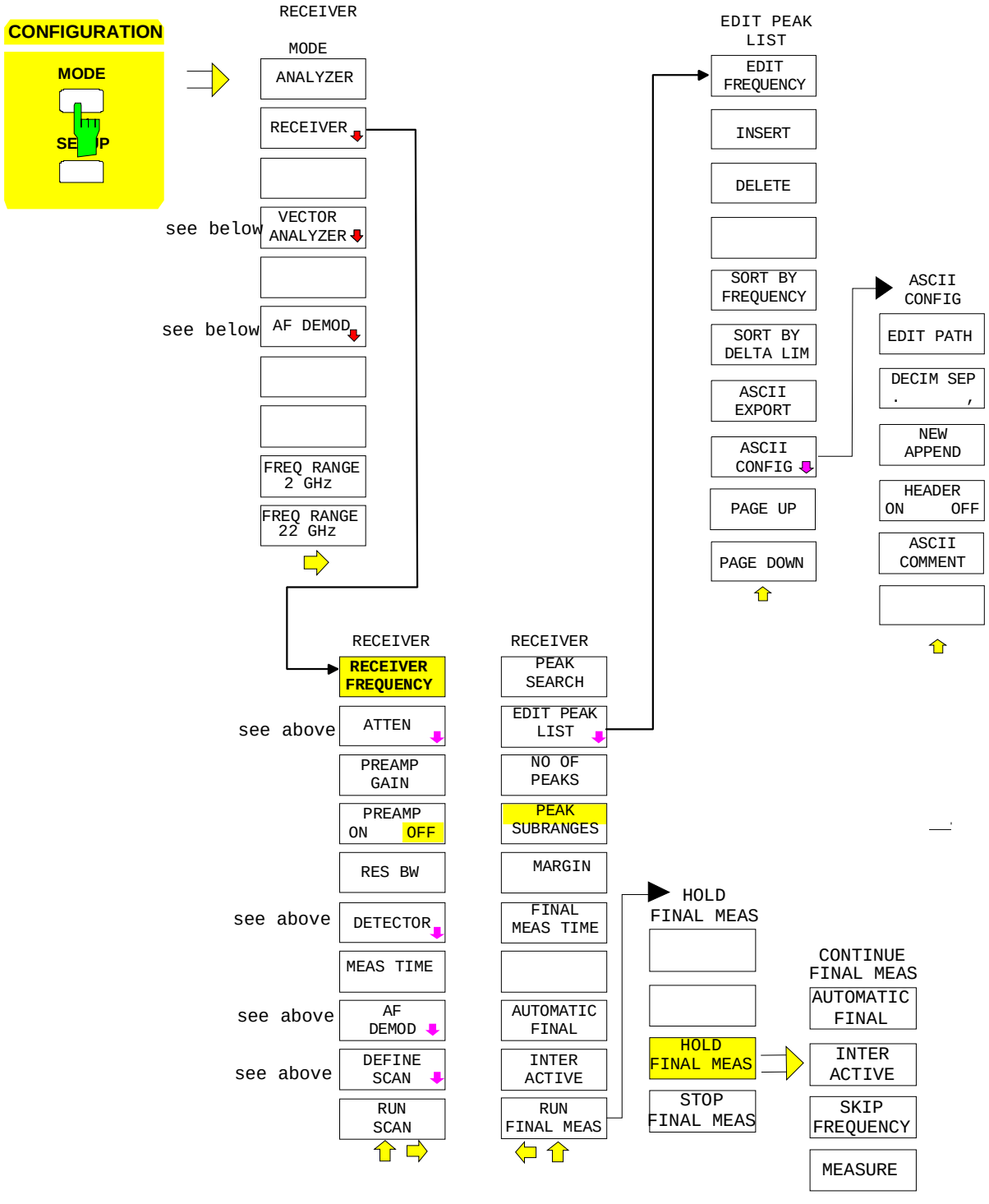
System Key Group

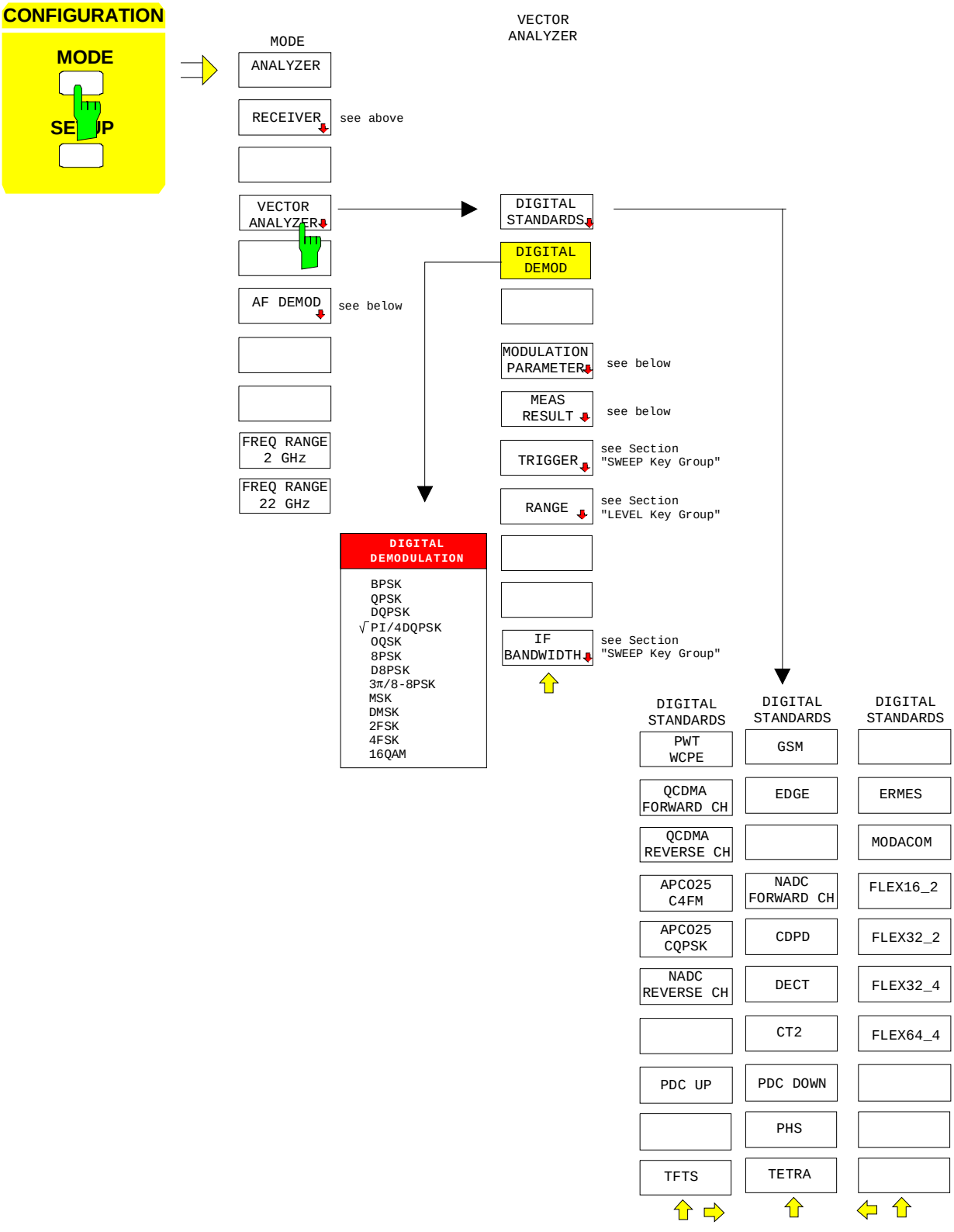


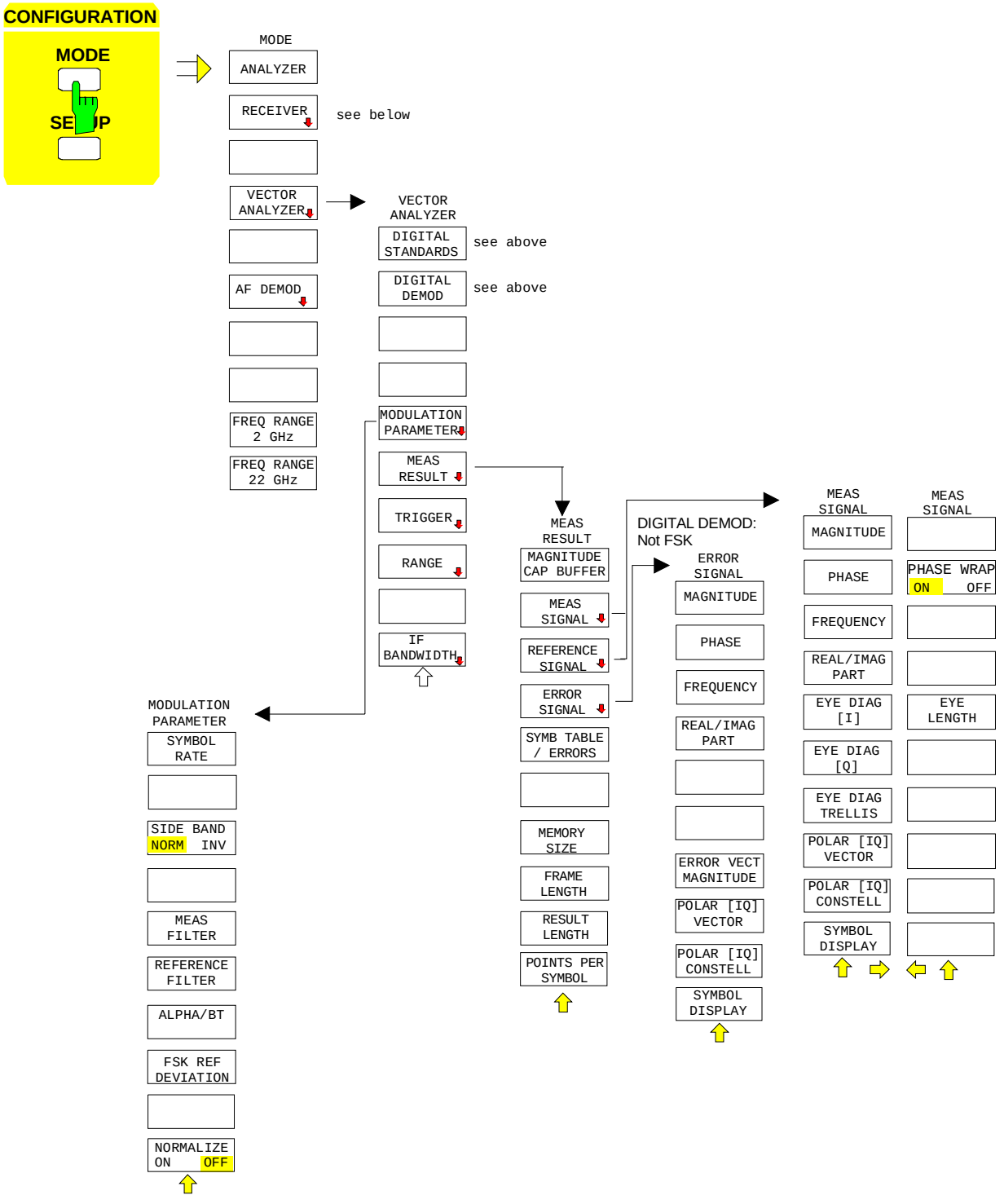

SYSTEM
PRESET
CAL
DISPLAY
INFO
CALIBRATE
CAL SHORT
CAL TOTAL
CAL RES BW
CAL LOG
CAL LO SUPP
CAL I/Q
PRESEL PEAK
CAL CORR ON OFF
CALIBRATE
CAL RESULTS
PAGE UP
PAGE DOWN
SYSTEM
PRESET
CAL
DISPLAY
INFO
INFO
FIRMWARE VERSIONS
HARDWARE+ OPTIONS
SELFTEST
SYSTEM MESSAGES
OPTIONS
STATISTIC
STATISTICS
ATT SWITCHES
RF PRES SWITCHES
SYSTEM MESSAGES
CLEAR MESSAGE
CLEAR ALL MESSAGES
UPDATE MESSAGES
SELFTEST
EXECUTE TESTS

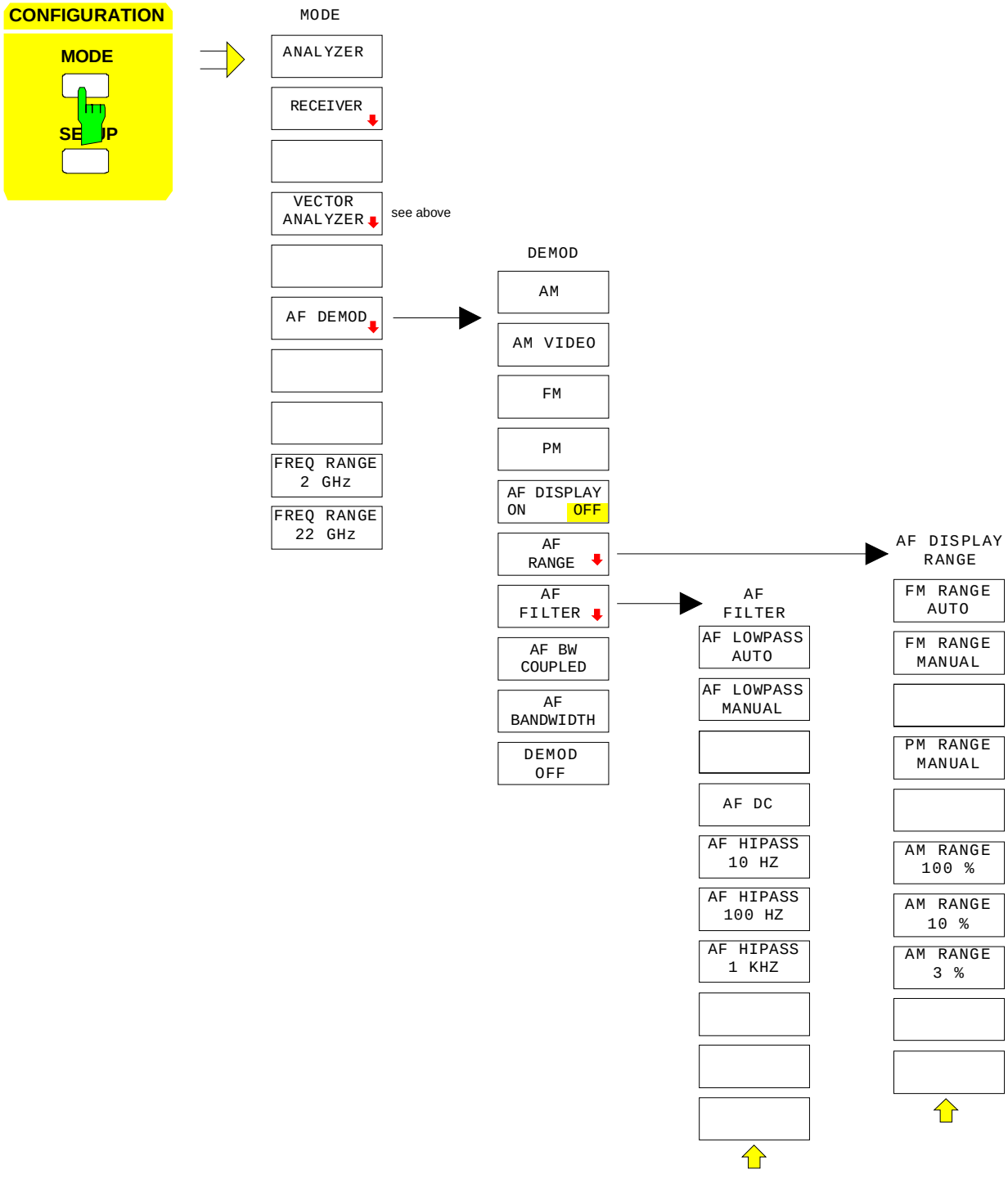
Configuration Key Group

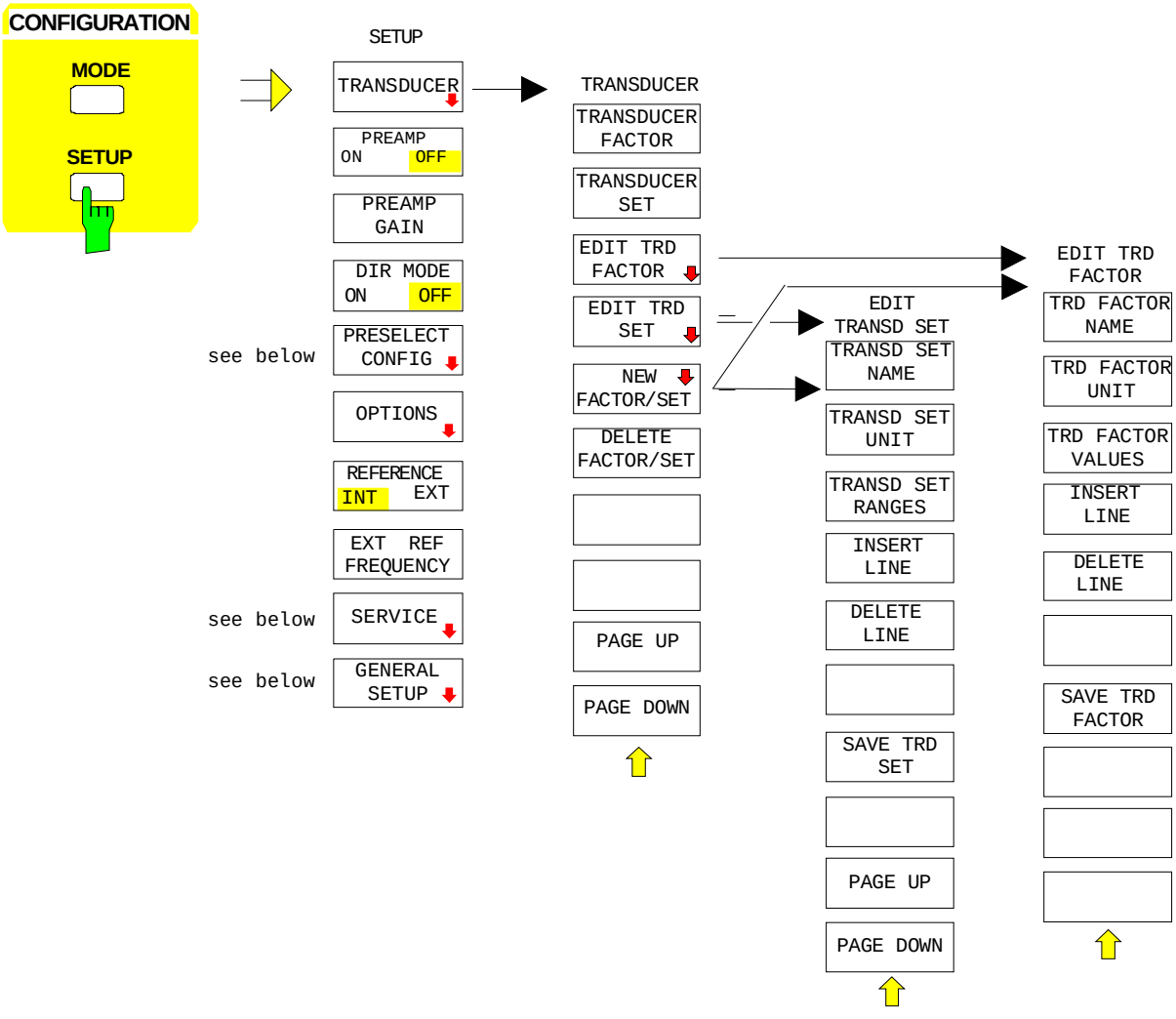


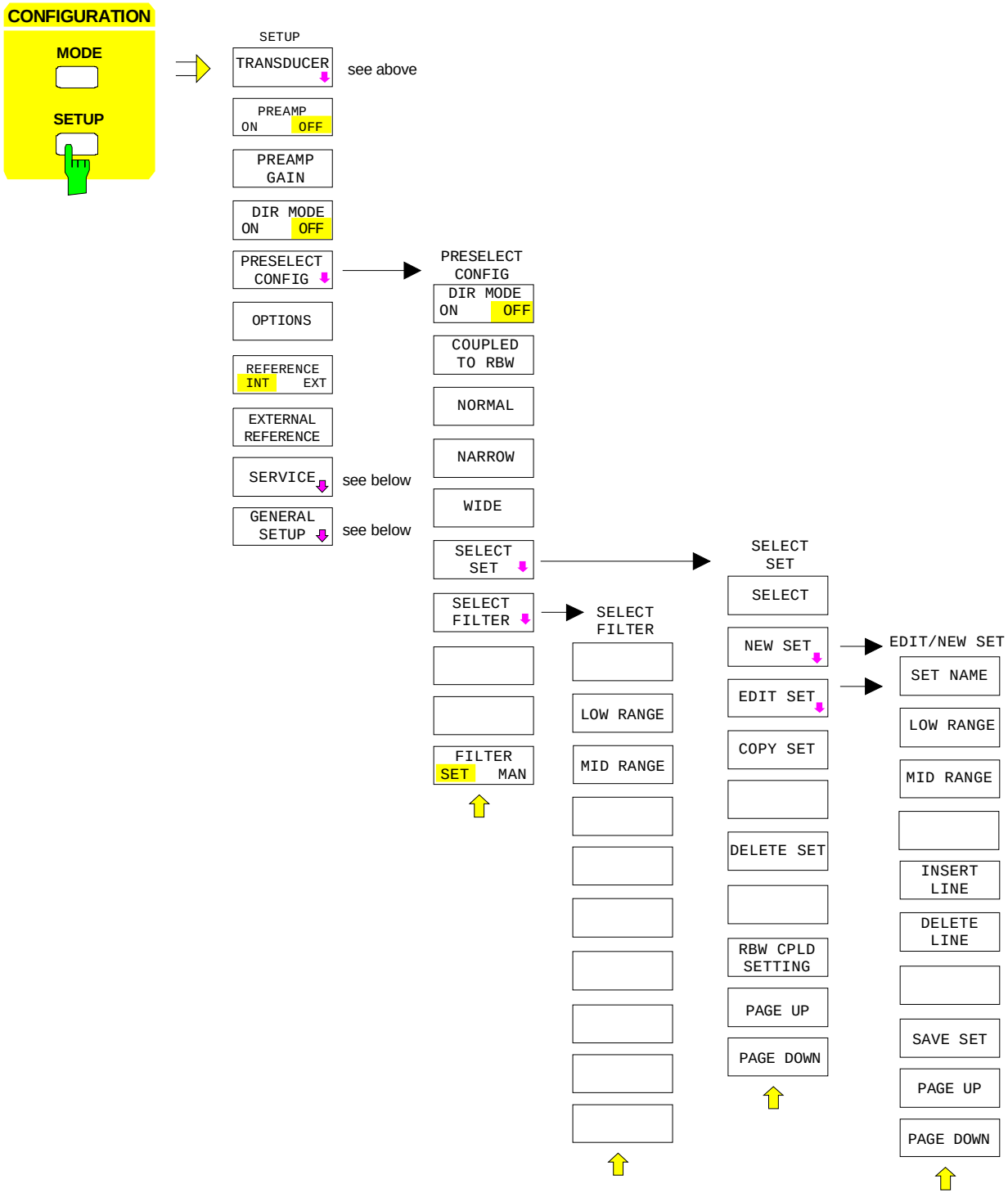

CONFIGURATION
MODE
SETUP
RECEIVER
MODE
ANALYZER
RECEIVER
see below
VECTOR ANALYZER
see below
AF DEMOD
FREQ RANGE 2 GHz
FREQ RANGE 22 GHz
RECEIVER
RECEIVER FREQUENCY
see above
ATTEN
PREAMP GAIN
PREAMP ON OFF
RES BW
see above
DETECTOR
MEAS TIME
see above
AF DEMOD
see above
DEFINE SCAN
RUN SCAN
RECEIVER
PEAK SEARCH
EDIT PEAK LIST
NO OF PEAKS
PEAK SUBRANGES
MARGIN
FINAL MEAS TIME
AUTOMATIC FINAL
INTER ACTIVE
RUN FINAL MEAS
EDIT PEAK LIST
EDIT FREQUENCY
INSERT
DELETE
SORT BY FREQUENCY
SORT BY DELTA LIM
ASCII EXPORT
ASCII CONFIG
PAGE UP
PAGE DOWN
ASCII CONFIG
EDIT PATH
DECIM SEP . ,
NEW APPEND
HEADER ON OFF
ASCII COMMENT
HOLD FINAL MEAS
HOLD FINAL MEAS
STOP FINAL MEAS
CONTINUE FINAL MEAS
AUTOMATIC FINAL
INTER ACTIVE
SKIP FREQUENCY
MEASURE

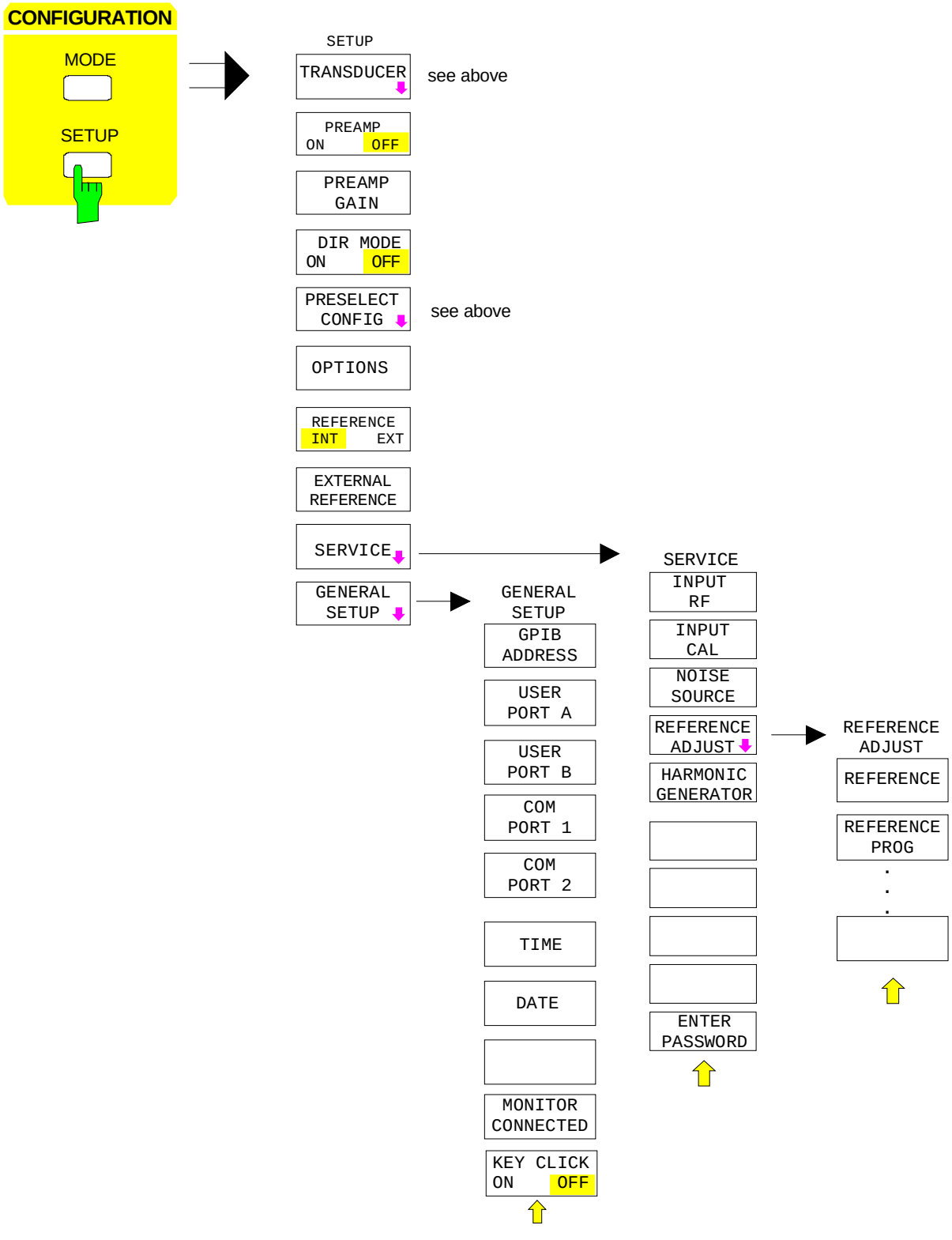

CONFIGURATION
MODE
SETUP
MODE
ANALYZER
RECEIVER
see above
VECTOR ANALYZER
AF DEMOD
see below
FREQ RANGE 2 GHz
FREQ RANGE 22 GHz
VECTOR ANALYZER
DIGITAL STANDARDS
DIGITAL DEMOD
MODULATION PARAMETER
see below
MEAS RESULT
see below
TRIGGER
see Section "SWEEP Key Group"
RANGE
see Section "LEVEL Key Group"
IF BANDWIDTH
see Section "SWEEP Key Group"
DIGITAL DEMODULATION
BPSK
QPSK
DQPSK
√PI/4DQPSK
OQSK
8PSK
D8PSK
3π/8-8PSK
MSK
DMSK
2FSK
4FSK
16QAM
DIGITAL STANDARDS
PWT WCPE
QCDMA FORWARD CH
QCDMA REVERSE CH
APCO25 C4FM
APCO25 CQPSK
NADC REVERSE CH
PDC UP
TFTS
DIGITAL STANDARDS
GSM
EDGE
NADC FORWARD CH
CDPD
DECT
CT2
PDC DOWN
PHS
TETRA
DIGITAL STANDARDS
ERMES
MODACOM
FLEX16_2
FLEX32_2
FLEX32_4
FLEX64_4


CONFIGURATION
MODE
SETUP
MODE
ANALYZER
RECEIVER
see below
VECTOR ANALYZER
AF DEMOD
FREQ RANGE 2 GHz
FREQ RANGE 22 GHz
VECTOR ANALYZER
DIGITAL STANDARDS
see above
DIGITAL DEMOD
see above
MODULATION PARAMETER
MEAS RESULT
TRIGGER
RANGE
IF BANDWIDTH
MODULATION PARAMETER
SYMBOL RATE
SIDE BAND NORM INV
MEAS FILTER
REFERENCE FILTER
ALPHA/BT
FSK REF DEVIATION
NORMALIZE ON OFF
MEAS RESULT
MAGNITUDE CAP BUFFER
MEAS SIGNAL
REFERENCE SIGNAL
ERROR SIGNAL
SYMB TABLE / ERRORS
MEMORY SIZE
FRAME LENGTH
RESULT LENGTH
POINTS PER SYMBOL
DIGITAL DEMOD: Not FSK
ERROR SIGNAL
MAGNITUDE
PHASE
FREQUENCY
REAL/IMAG PART
ERROR VECT MAGNITUDE
POLAR [IQ] VECTOR
POLAR [IQ] CONSTELL
SYMBOL DISPLAY
MEAS SIGNAL
MAGNITUDE
PHASE
FREQUENCY
REAL/IMAG PART
EYE DIAG [I]
EYE DIAG [Q]
EYE DIAG TRELLIS
POLAR [IQ] VECTOR
POLAR [IQ] CONSTELL
SYMBOL DISPLAY
MEAS SIGNAL
PHASE WRAP ON OFF
EYE LENGTH

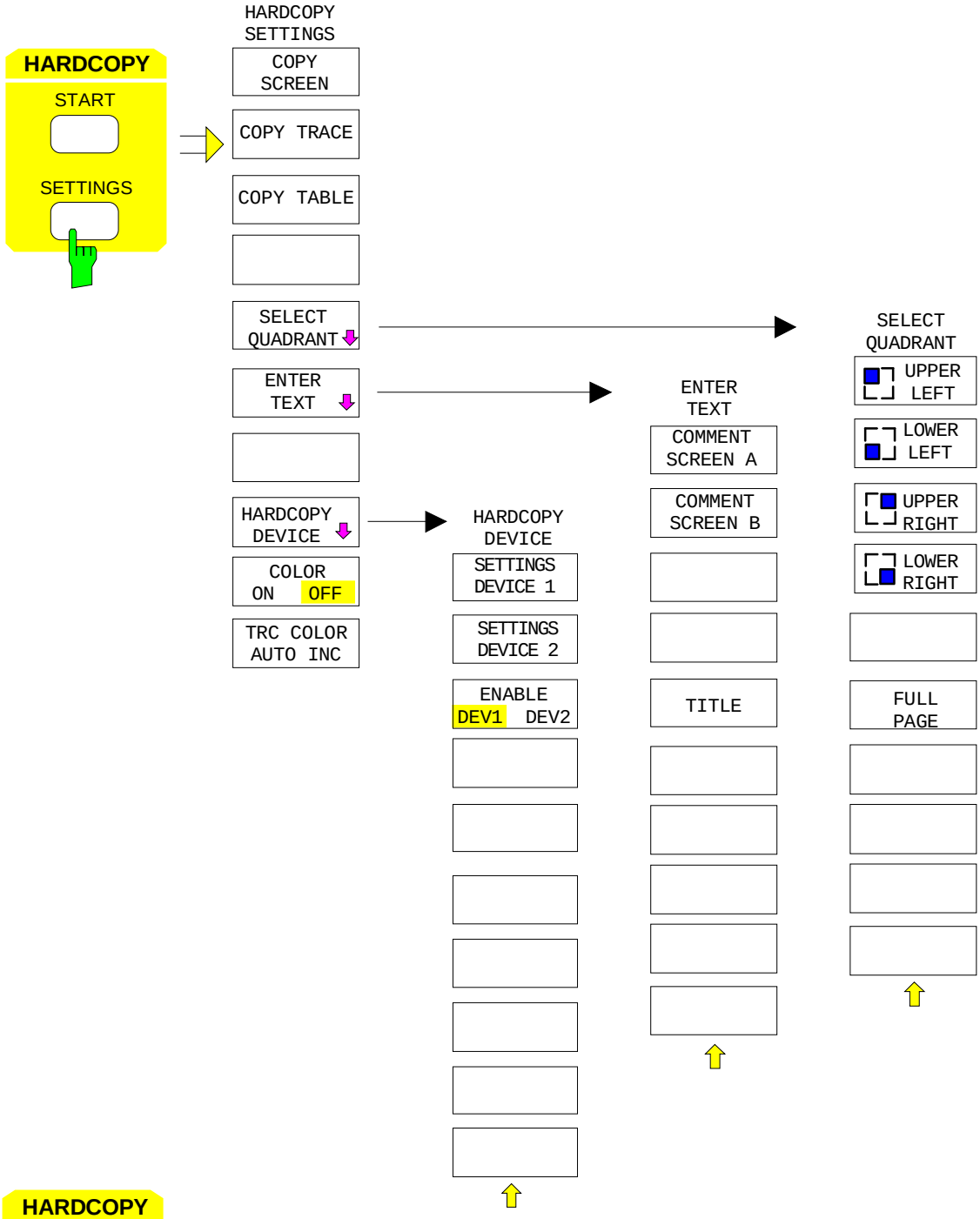

CONFIGURATION
MODE
SETUP
MODE
ANALYZER
RECEIVER
VECTOR ANALYZER
see above
AF DEMOD
FREQ RANGE 2 GHz
FREQ RANGE 22 GHz
DEMOD
AM
AM VIDEO
FM
PM
AF DISPLAY ON OFF
AF RANGE
AF FILTER
AF BW COUPLED
AF BANDWIDTH
DEMOD OFF
AF DISPLAY RANGE
FM RANGE AUTO
FM RANGE MANUAL
PM RANGE MANUAL
AM RANGE 100 %
AM RANGE 10 %
AM RANGE 3 %
AF FILTER
AF LOWPASS AUTO
AF LOWPASS MANUAL
AF DC
AF HIPASS 10 HZ
AF HIPASS 100 HZ
AF HIPASS 1 KHZ


CONFIGURATION
MODE
SETUP
SETUP
TRANSDUCER
PREAMP
ON OFF
PREAMP GAIN
DIR MODE
ON OFF
see below
PRESELECT CONFIG
OPTIONS
REFERENCE
INT EXT
EXT REF FREQUENCY
see below
SERVICE
see below
GENERAL SETUP
TRANSDUCER
TRANSDUCER FACTOR
TRANSDUCER SET
EDIT TRD FACTOR
EDIT TRD SET
NEW FACTOR/SET
DELETE FACTOR/SET
PAGE UP
PAGE DOWN
EDIT TRANSD SET
TRANSD SET NAME
TRANSD SET UNIT
TRANSD SET RANGES
INSERT LINE
DELETE LINE
SAVE TRD SET
PAGE UP
PAGE DOWN
EDIT TRD FACTOR
TRD FACTOR NAME
TRD FACTOR UNIT
TRD FACTOR VALUES
INSERT LINE
DELETE LINE
SAVE TRD FACTOR


CONFIGURATION
MODE
SETUP
SETUP
TRANSDUCER
see above
PREAMP
ON OFF
PREAMP
GAIN
DIR MODE
ON OFF
PRESELECT
CONFIG
OPTIONS
REFERENCE
INT EXT
EXTERNAL
REFERENCE
SERVICE
see below
GENERAL
SETUP
see below
PRESELECT
CONFIG
DIR MODE
ON OFF
COUPLED
TO RBW
NORMAL
NARROW
WIDE
SELECT
SET
SELECT
FILTER
FILTER
SET MAN
SELECT
FILTER
LOW RANGE
MID RANGE
SELECT
SET
SELECT
NEW SET
EDIT SET
COPY SET
DELETE SET
RBW CPLD
SETTING
PAGE UP
PAGE DOWN
EDIT/NEW SET
SET NAME
LOW RANGE
MID RANGE
INSERT
LINE
DELETE
LINE
SAVE SET
PAGE UP
PAGE DOWN

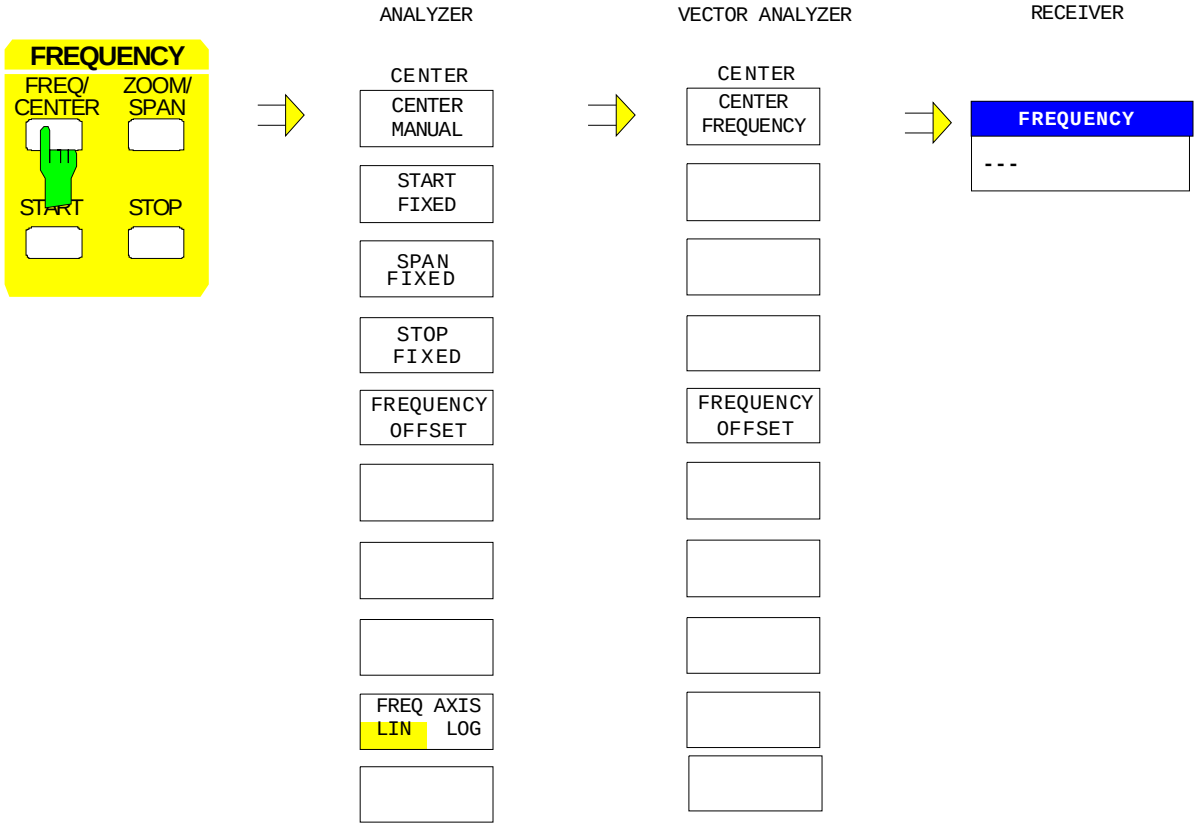

CONFIGURATION
MODE
SETUP
SETUP
TRANSDUCER
see above
PREAMP
ON OFF
PREAMP
GAIN
DIR MODE
ON OFF
PRESELECT
CONFIG
see above
OPTIONS
REFERENCE
INT EXT
EXTERNAL
REFERENCE
SERVICE
GENERAL
SETUP
GENERAL
SETUP
GPIB
ADDRESS
USER
PORT A
USER
PORT B
COM
PORT 1
COM
PORT 2
TIME
DATE
MONITOR
CONNECTED
KEY CLICK
ON OFF
SERVICE
INPUT
RF
INPUT
CAL
NOISE
SOURCE
REFERENCE
ADJUST
HARMONIC
GENERATOR
ENTER
PASSWORD
REFERENCE
ADJUST
REFERENCE
REFERENCE
PROG

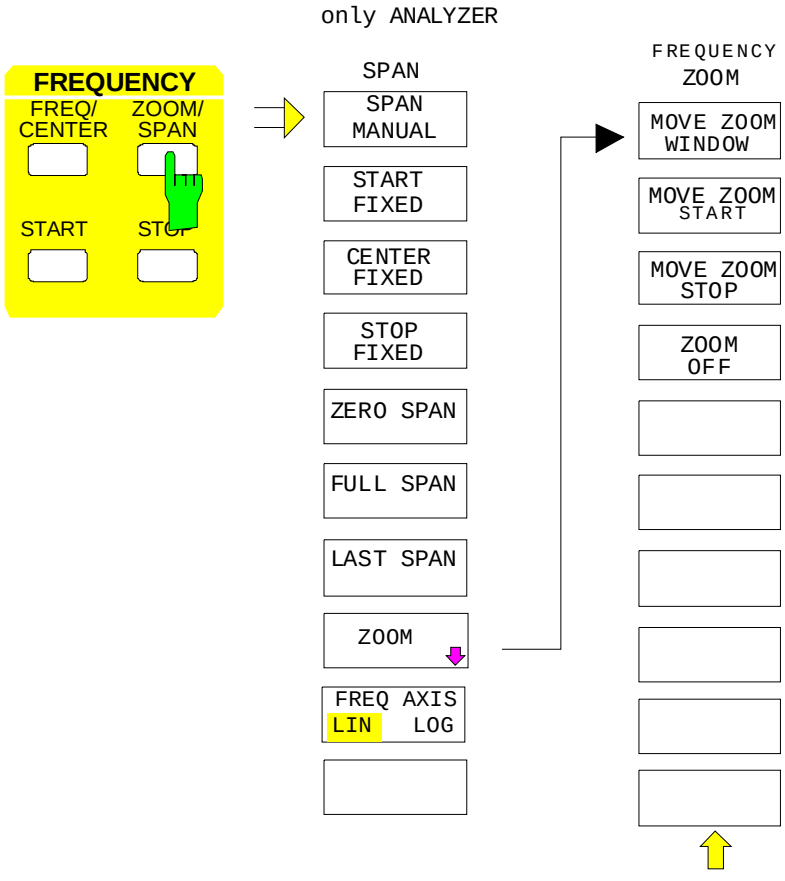
Hardcopy Key Group

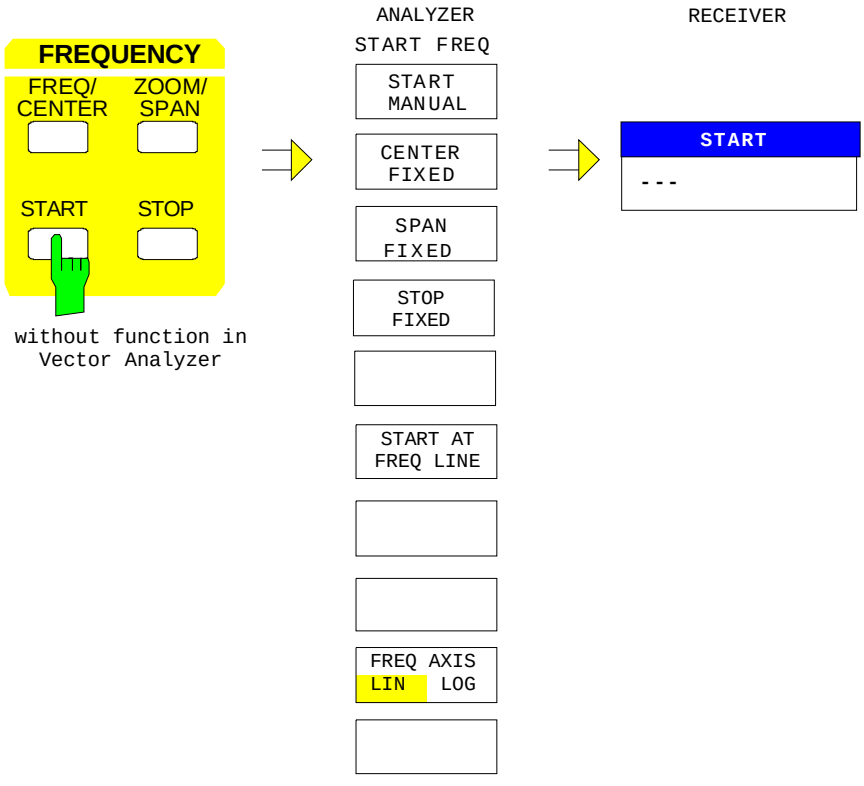


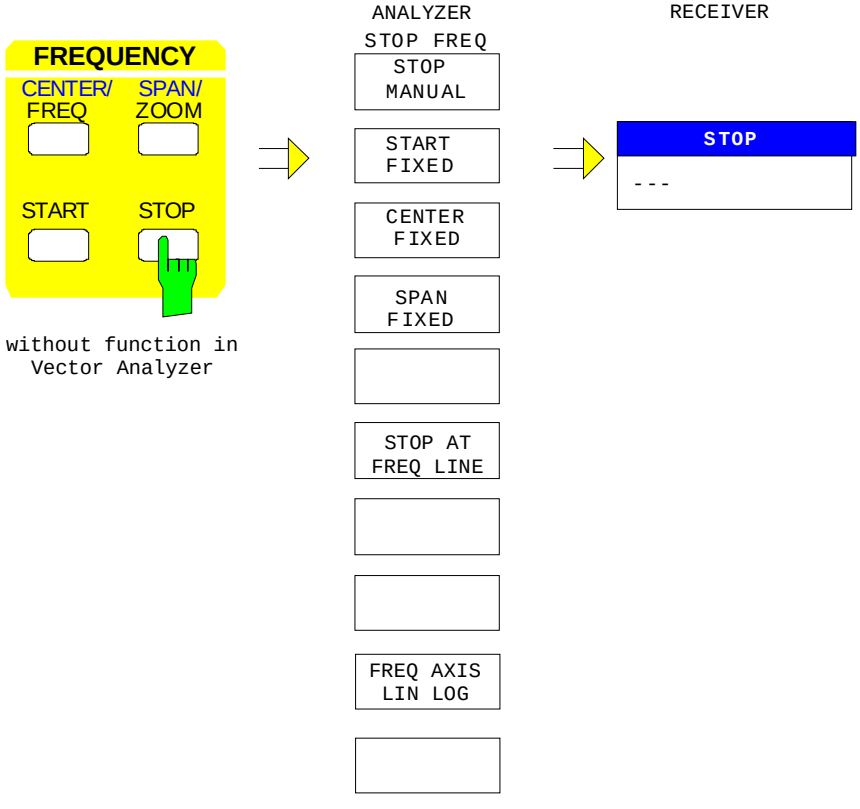
no softkey menu

Frequency Key Group

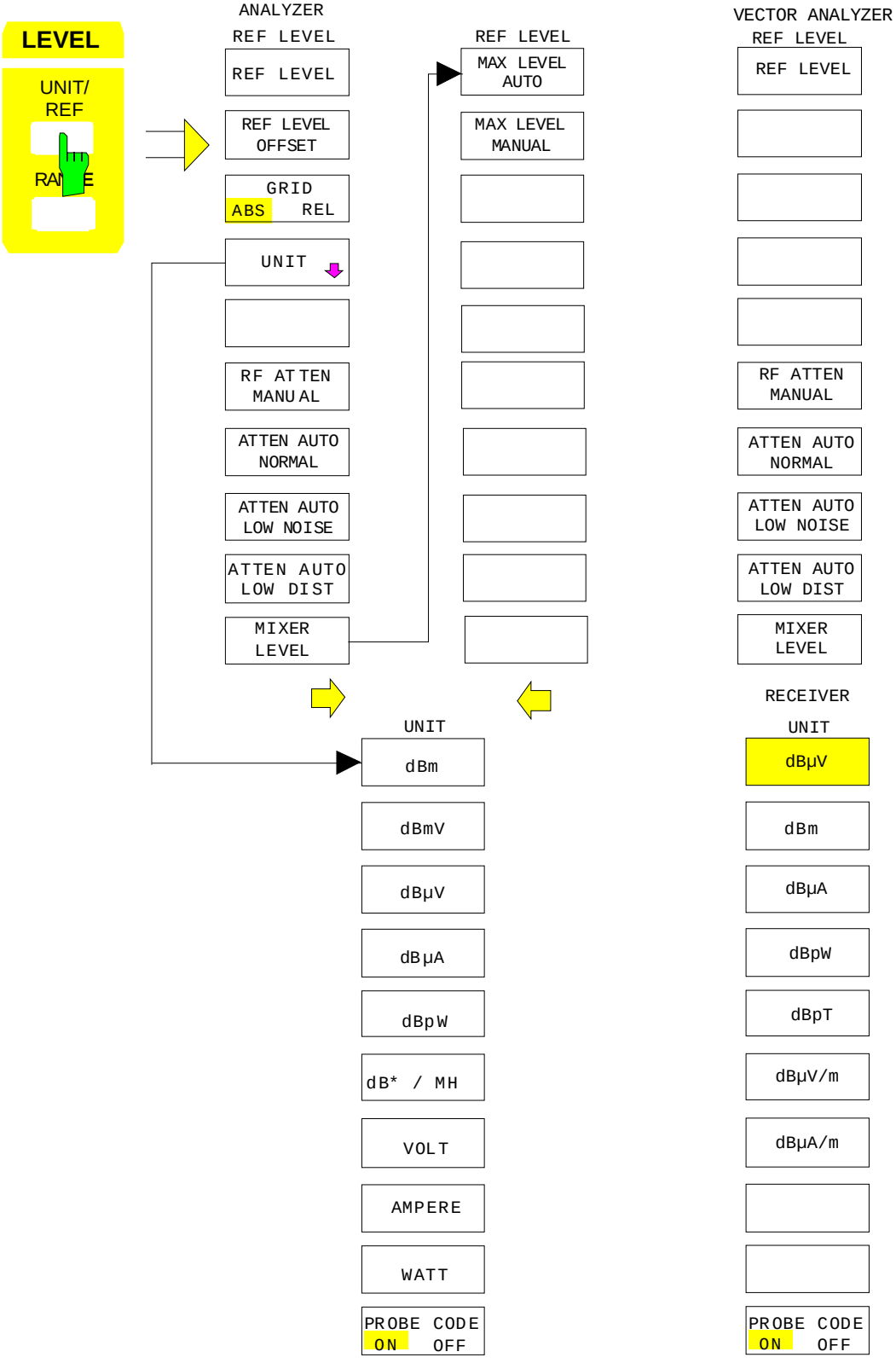


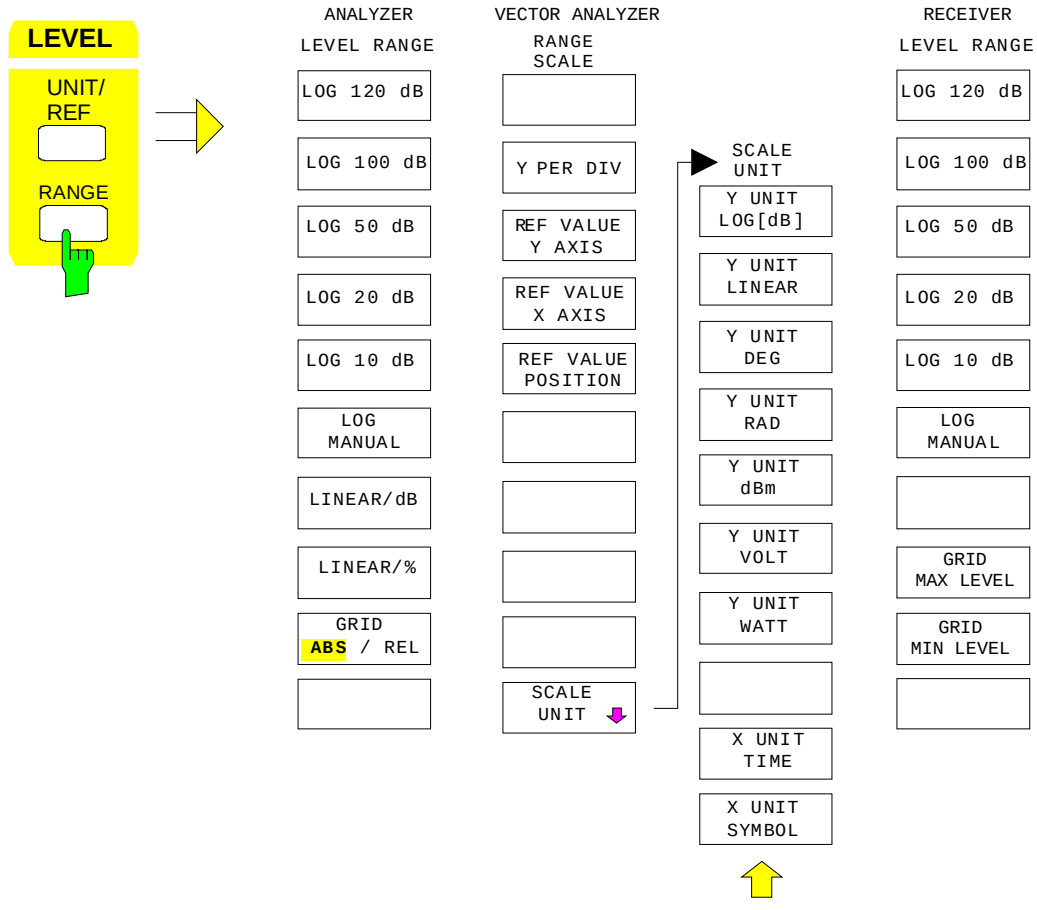

only ANALYZER
FREQUENCY
FREQ/ CENTER
ZOOM/ SPAN
START
STOP
SPAN
SPAN MANUAL
START FIXED
CENTER FIXED
STOP FIXED
ZERO SPAN
FULL SPAN
LAST SPAN
ZOOM
FREQ AXIS
LIN LOG
FREQUENCY
ZOOM
MOVE ZOOM WINDOW
MOVE ZOOM START
MOVE ZOOM STOP
ZOOM OFF

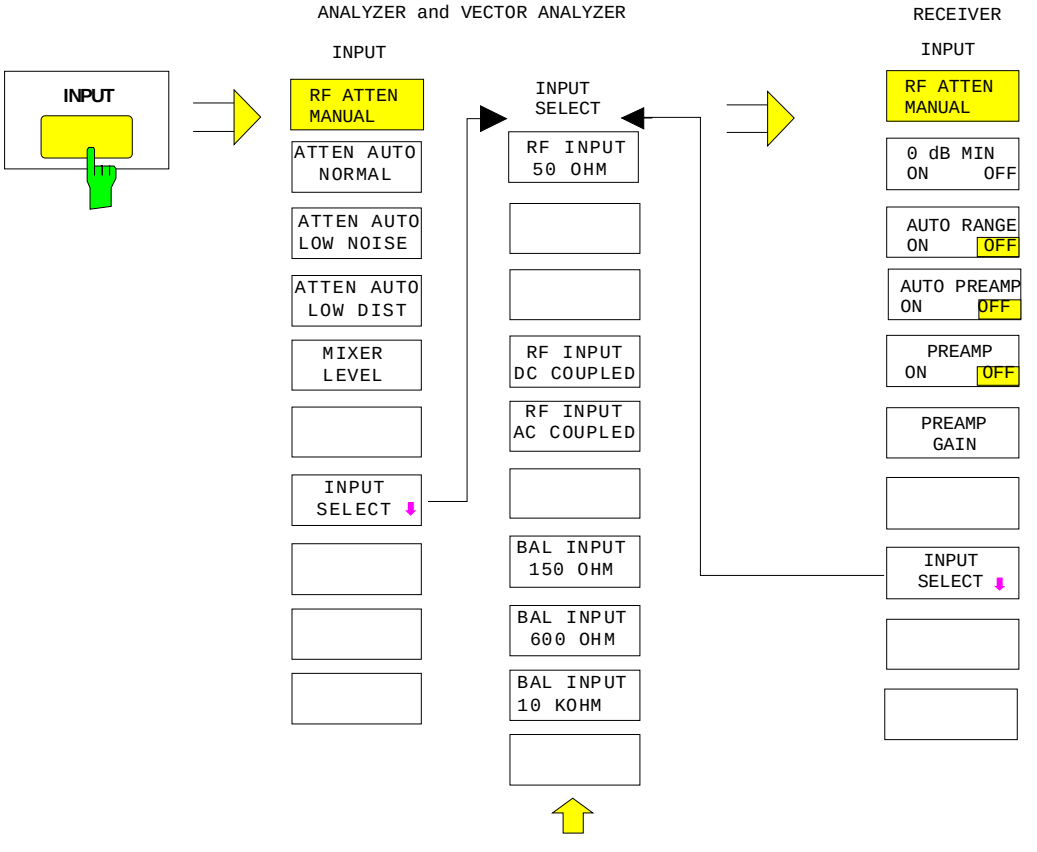

FREQUENCY
FREQ/ CENTER
ZOOM/ SPAN
START
STOP
without function in Vector Analyzer
ANALYZER
START FREQ
START MANUAL
CENTER FIXED
SPAN FIXED
STOP FIXED
START AT FREQ LINE
FREQ AXIS
LIN LOG
RECEIVER
START


FREQUENCY
CENTER/ FREQ
SPAN/ ZOOM
START
STOP
without function in Vector Analyzer
ANALYZER
STOP FREQ
STOP MANUAL
START FIXED
CENTER FIXED
SPAN FIXED
STOP AT FREQ LINE
FREQ AXIS
LIN LOG
RECEIVER
STOP

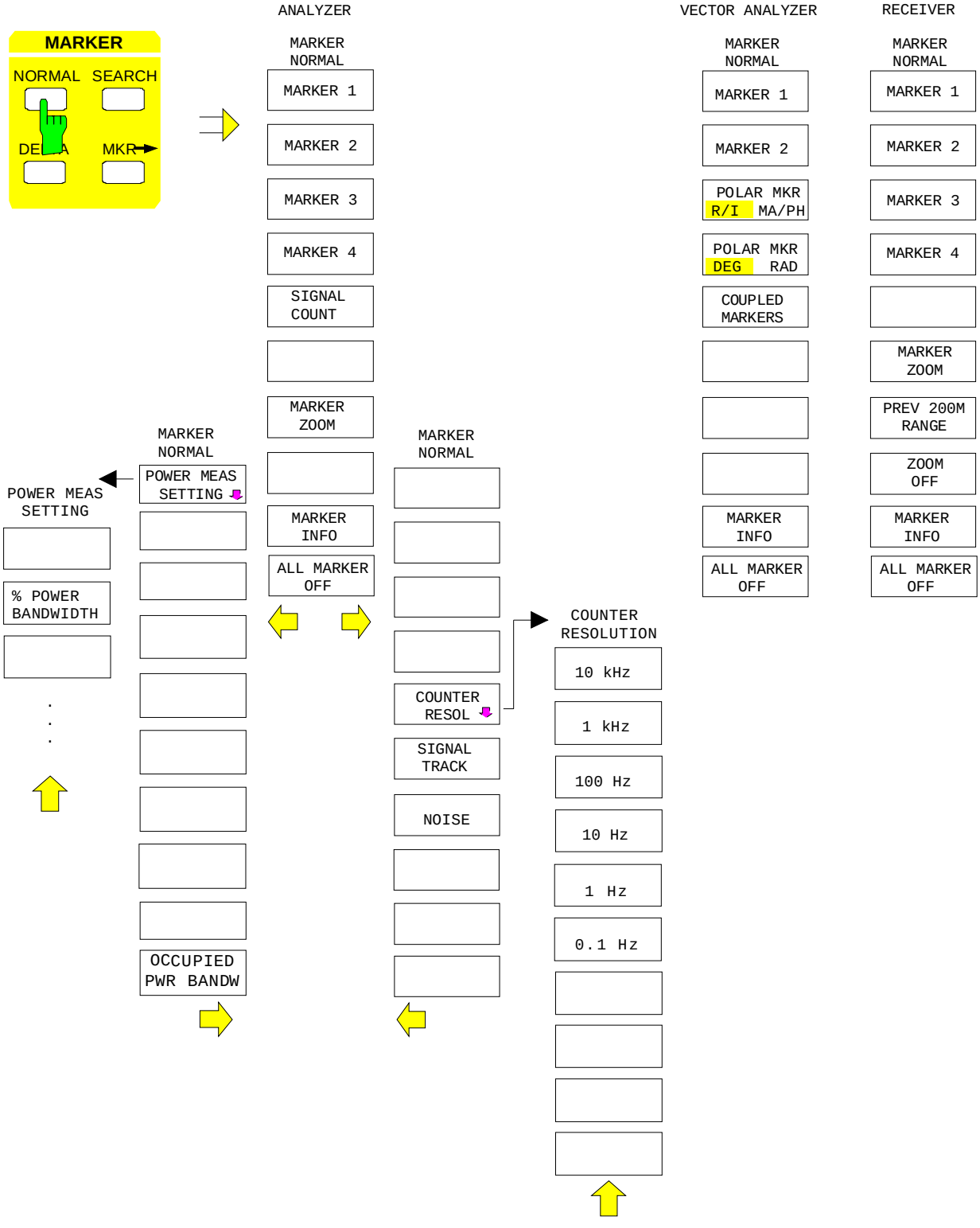
Level Key Group, Input Key

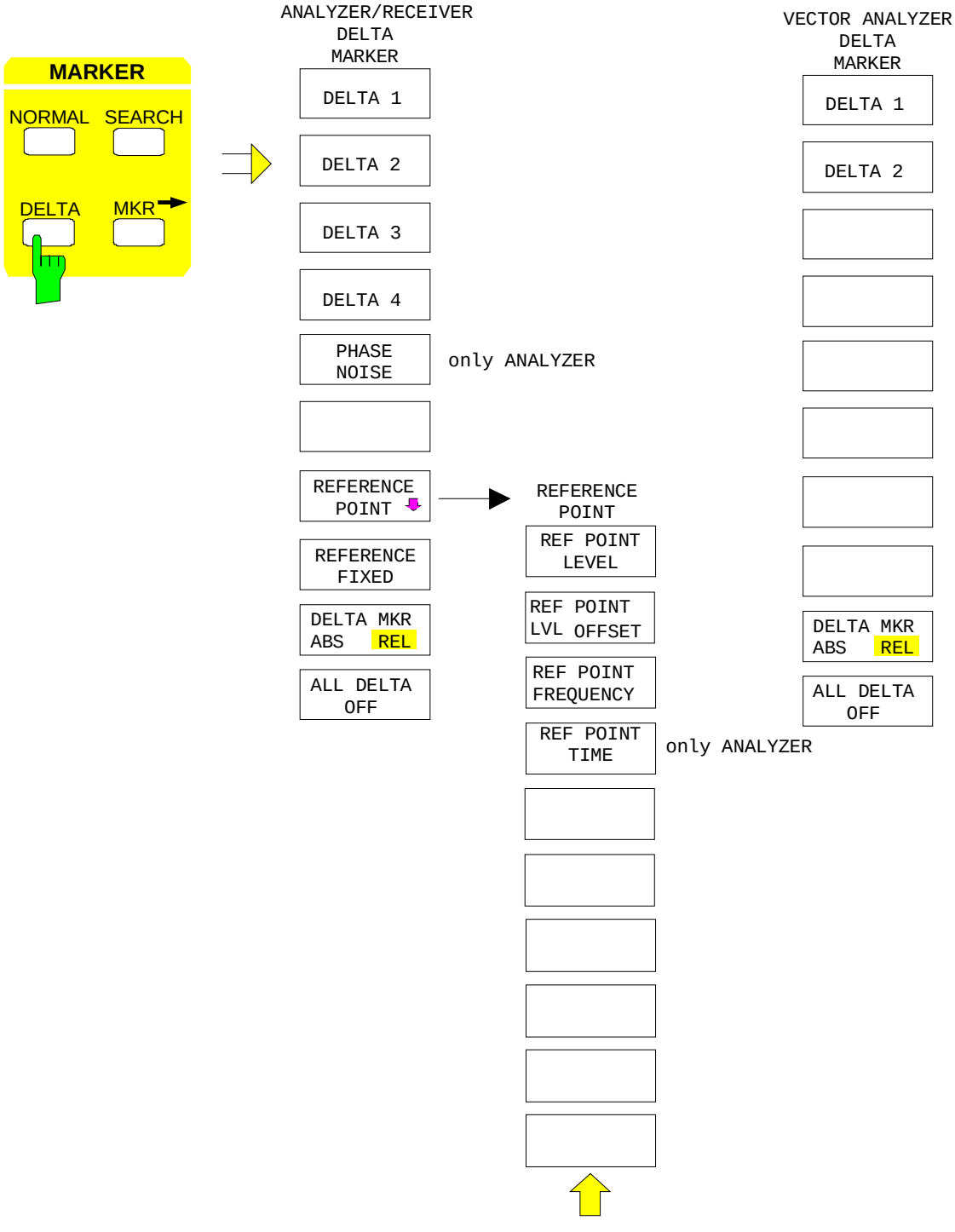


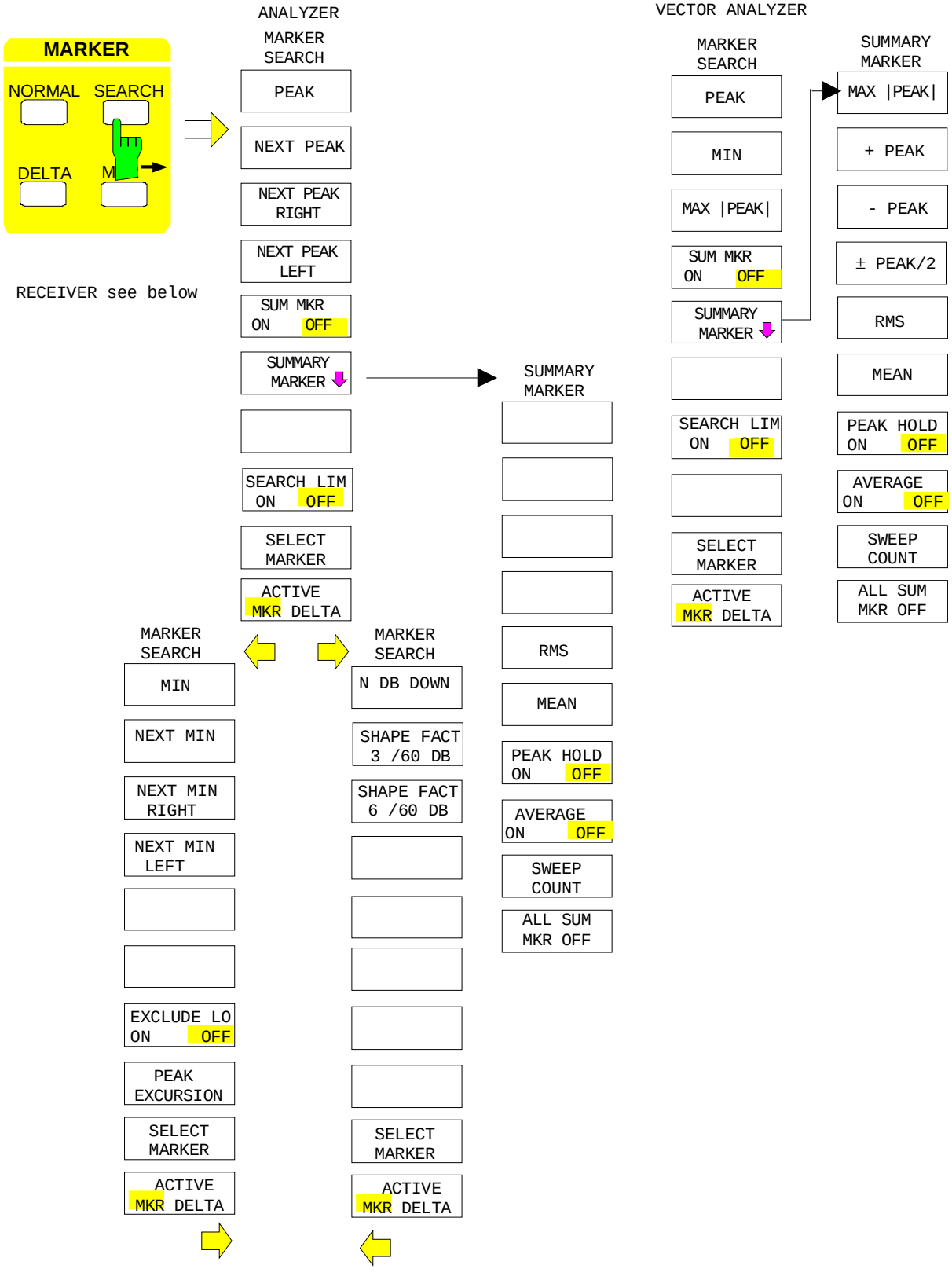

LEVEL
UNIT/
REF
RANGE
ANALYZER
LEVEL RANGE
LOG 120 dB
LOG 100 dB
LOG 50 dB
LOG 20 dB
LOG 10 dB
LOG
MANUAL
LINEAR/dB
LINEAR/%
GRID
ABS / REL
VECTOR ANALYZER
RANGE
SCALE
Y PER DIV
REF VALUE
Y AXIS
REF VALUE
X AXIS
REF VALUE
POSITION
SCALE
UNIT
SCALE
UNIT
Y UNIT
LOG[dB]
Y UNIT
LINEAR
Y UNIT
DEG
Y UNIT
RAD
Y UNIT
dBm
Y UNIT
VOLT
Y UNIT
WATT
X UNIT
TIME
X UNIT
SYMBOL
RECEIVER
LEVEL RANGE
LOG 120 dB
LOG 100 dB
LOG 50 dB
LOG 20 dB
LOG 10 dB
LOG
MANUAL
GRID
MAX LEVEL
GRID
MIN LEVEL

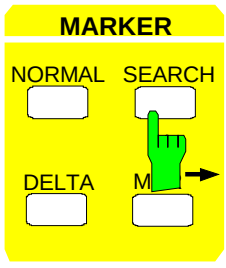

INPUT
ANALYZER and VECTOR ANALYZER
INPUT
RF ATTEN
MANUAL
ATTEN AUTO
NORMAL
ATTEN AUTO
LOW NOISE
ATTEN AUTO
LOW DIST
MIXER
LEVEL
INPUT
SELECT
INPUT
SELECT
RF INPUT
50 OHM
RF INPUT
DC COUPLED
RF INPUT
AC COUPLED
BAL INPUT
150 OHM
BAL INPUT
600 OHM
BAL INPUT
10 KOHM
RECEIVER
INPUT
RF ATTEN
MANUAL
0 dB MIN
ON OFF
AUTO RANGE
ON OFF
AUTO PREAMP
ON OFF
PREAMP
ON OFF
PREAMP
GAIN
INPUT
SELECT

Marker Key Group



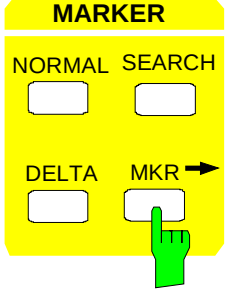

MARKER
NORMAL
SEARCH
DELTA
MKR
ANALYZER/RECEIVER
DELTA
MARKER
DELTA 1
DELTA 2
DELTA 3
DELTA 4
PHASE NOISE
only ANALYZER
REFERENCE POINT
REFERENCE FIXED
DELTA MKR ABS REL
ALL DELTA OFF
REFERENCE POINT
REF POINT LEVEL
REF POINT LVL OFFSET
REF POINT FREQUENCY
REF POINT TIME
only ANALYZER
VECTOR ANALYZER
DELTA
MARKER
DELTA 1
DELTA 2
DELTA MKR ABS REL
ALL DELTA OFF


MARKER
NORMAL
SEARCH
DELTA
M
RECEIVER see below
ANALYZER
MARKER SEARCH
PEAK
NEXT PEAK
NEXT PEAK RIGHT
NEXT PEAK LEFT
SUM MKR ON OFF
SUMMARY MARKER
SEARCH LIM ON OFF
SELECT MARKER
ACTIVE MKR DELTA
SUMMARY MARKER
RMS
MEAN
PEAK HOLD ON OFF
AVERAGE ON OFF
SWEEP COUNT
ALL SUM MKR OFF
MARKER SEARCH
MIN
NEXT MIN
NEXT MIN RIGHT
NEXT MIN LEFT
EXCLUDE LO ON OFF
PEAK EXCURSION
SELECT MARKER
ACTIVE MKR DELTA
MARKER SEARCH
N DB DOWN
SHAPE FACT 3 /60 DB
SHAPE FACT 6 /60 DB
SELECT MARKER
ACTIVE MKR DELTA
VECTOR ANALYZER
MARKER SEARCH
PEAK
MIN
MAX |PEAK|
SUM MKR ON OFF
SUMMARY MARKER
SEARCH LIM ON OFF
SELECT MARKER
ACTIVE MKR DELTA
SUMMARY MARKER
MAX |PEAK|
+ PEAK
- PEAK
± PEAK/2
RMS
MEAN
PEAK HOLD ON OFF
AVERAGE ON OFF
SWEEP COUNT
ALL SUM MKR OFF



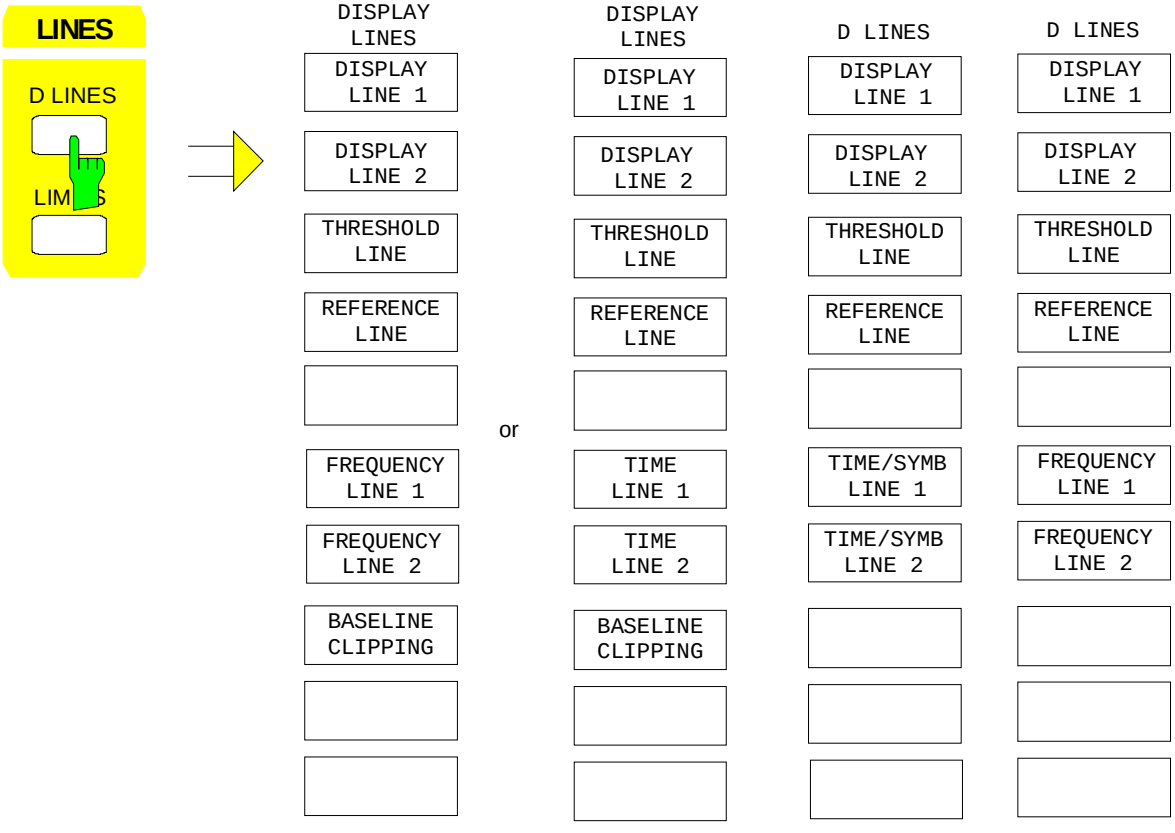
RECEIVER

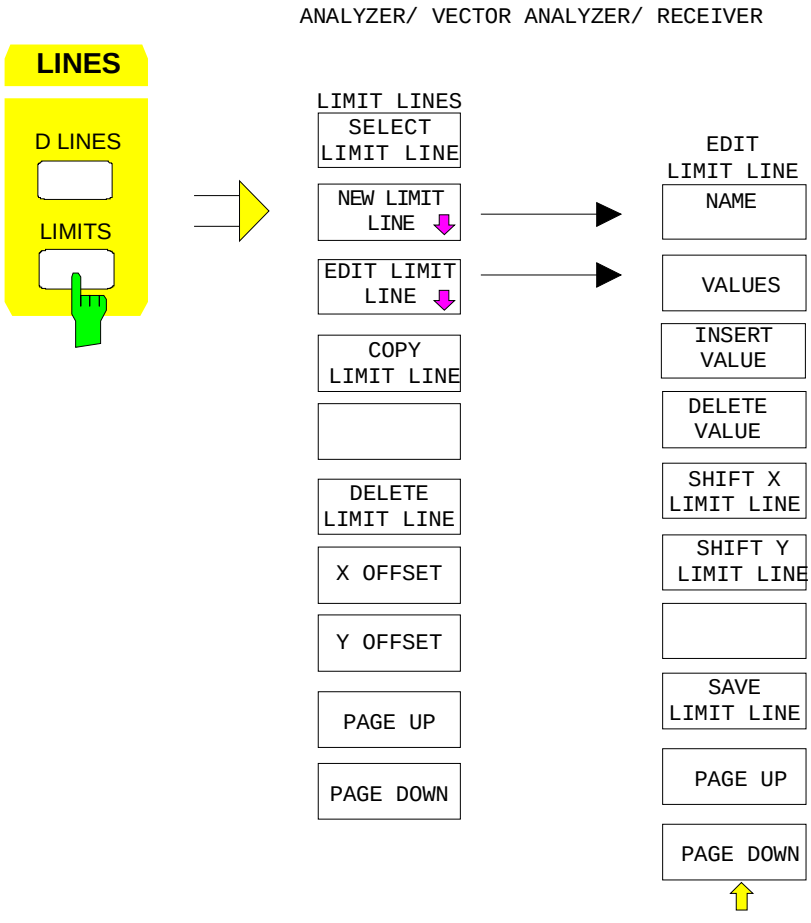
MARKER SEARCH	MARKER SEARCH
MIN	PEAK
NEXT MIN	NEXT PEAK
NEXT MIN RIGHT	NEXT PEAK RIGHT
NEXT MIN LEFT	NEXT PEAK LEFT
TUNE TO MARKER	TUNE TO MARKER
MARKER TRACK	MARKER TRACK
SETTINGS COUPLED	SETTINGS COUPLED
PEAK EXCURSION	SEARCH LIM ON OFF
SELECT MARKER	SELECT MARKER
ACTIVE MKR DELTA	ACTIVE MKR DELTA



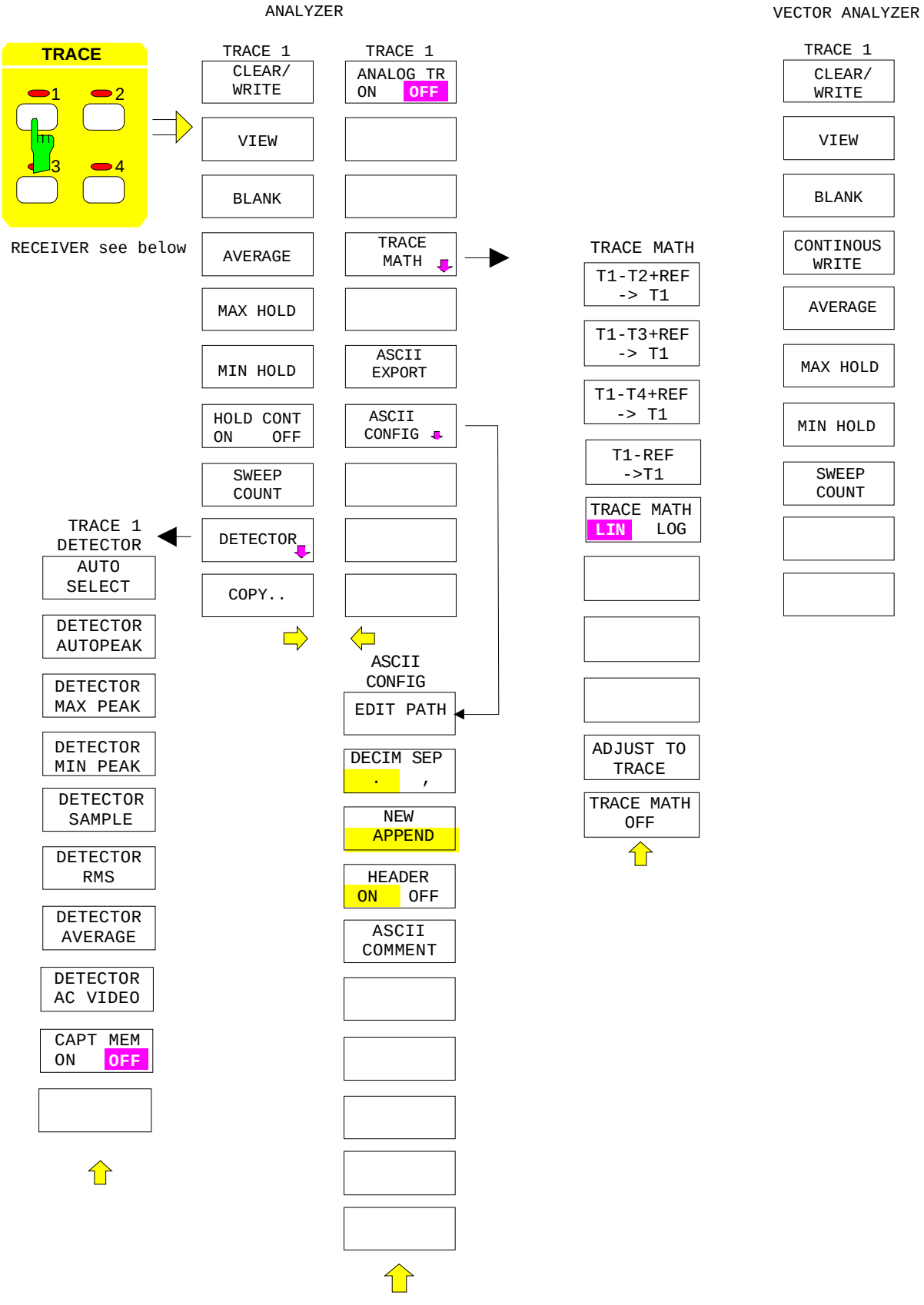
ANALYZER MARKER →	VECTOR ANALYZER MARKER →	RECEIVER MARKER →
PEAK	PEAK	PEAK
MKR→ CENTER		
MKR→ REF LEVEL		ADD TO PEAK LIST
ADD TO PEAK LIST		TUNE TO MARKER
MKR->CF STEPSIZE		MKR→ STEPSIZE
MKR→ START		MARKER TRACK
MKR→ STOP		SETTINGS COUPLED
MKR→ TRACE	MKR→ TRACE	MKR→ TRACE
SELECT MARKER	SELECT MARKER	SELECT MARKER
ACTIVE MKR DELTA	ACTIVE MKR DELTA	ACTIVE MKR DELTA

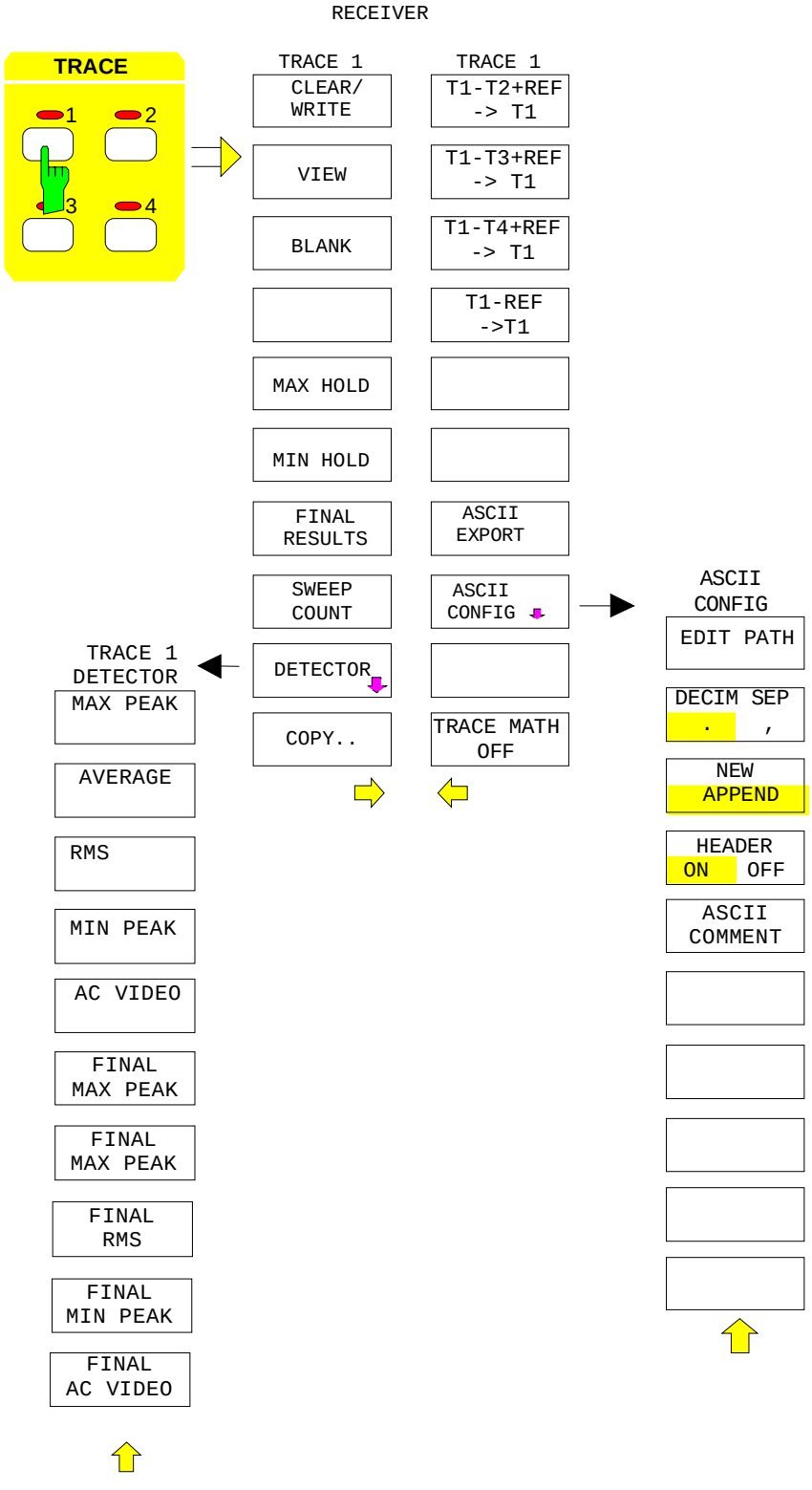
Lines Key Group



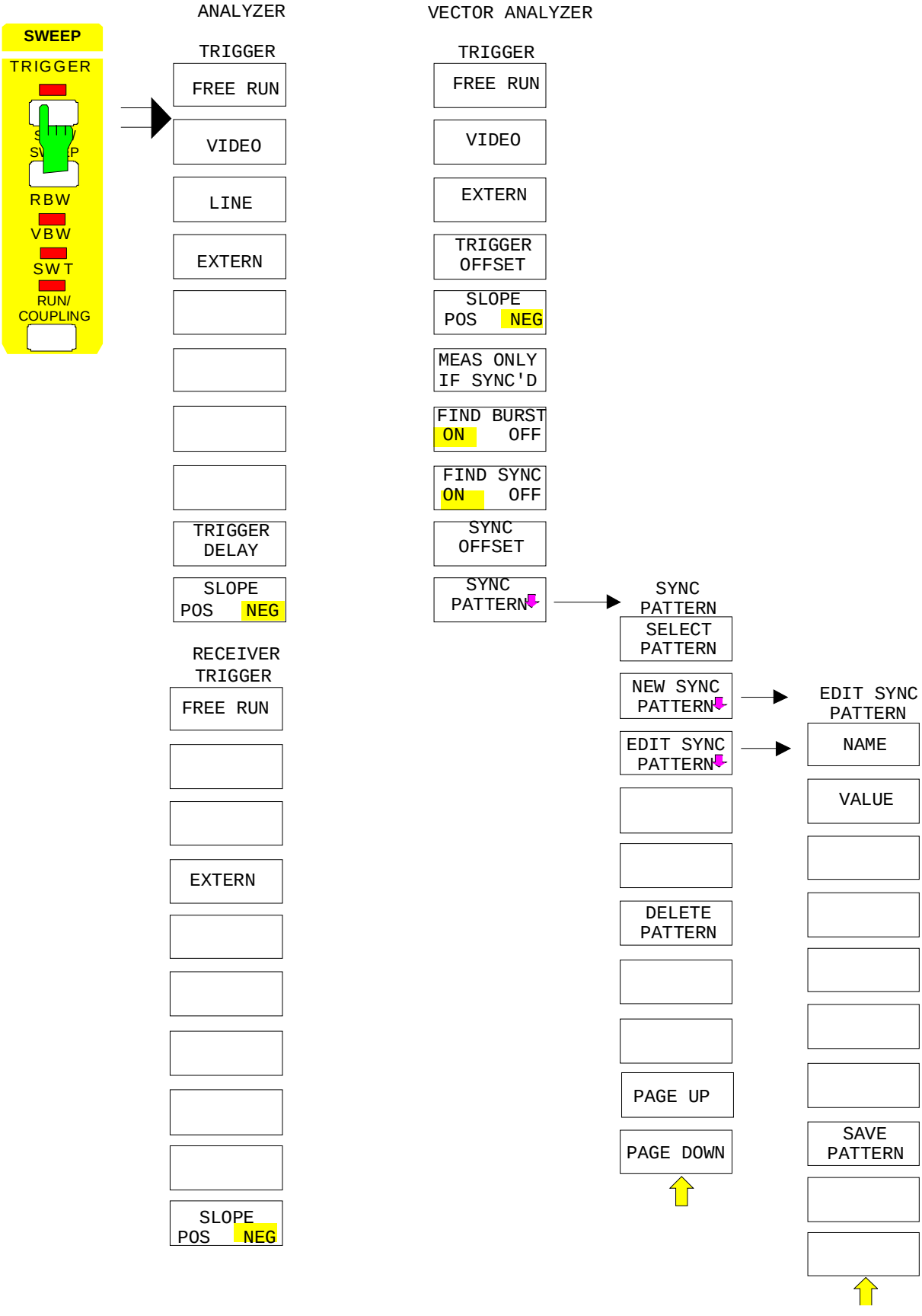

ANALYZER/ VECTOR ANALYZER/ RECEIVER
LINES
D LINES
LIMITS
LIMIT LINES
SELECT LIMIT LINE
NEW LIMIT LINE
EDIT LIMIT LINE
COPY LIMIT LINE
DELETE LIMIT LINE
X OFFSET
Y OFFSET
PAGE UP
PAGE DOWN
EDIT LIMIT LINE
NAME
VALUES
INSERT VALUE
DELETE VALUE
SHIFT X LIMIT LINE
SHIFT Y LIMIT LINE
SAVE LIMIT LINE
PAGE UP
PAGE DOWN

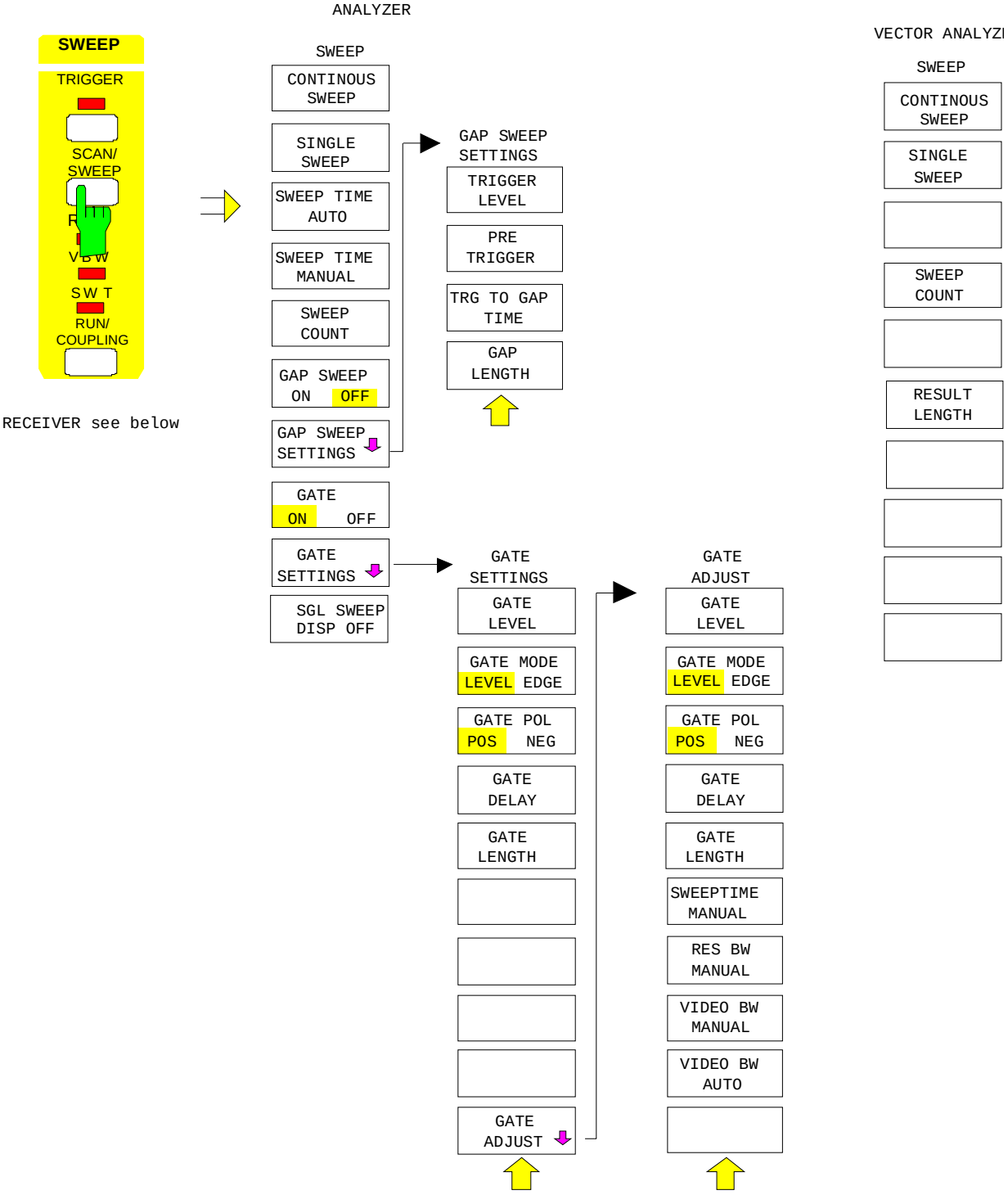
Trace Key Group

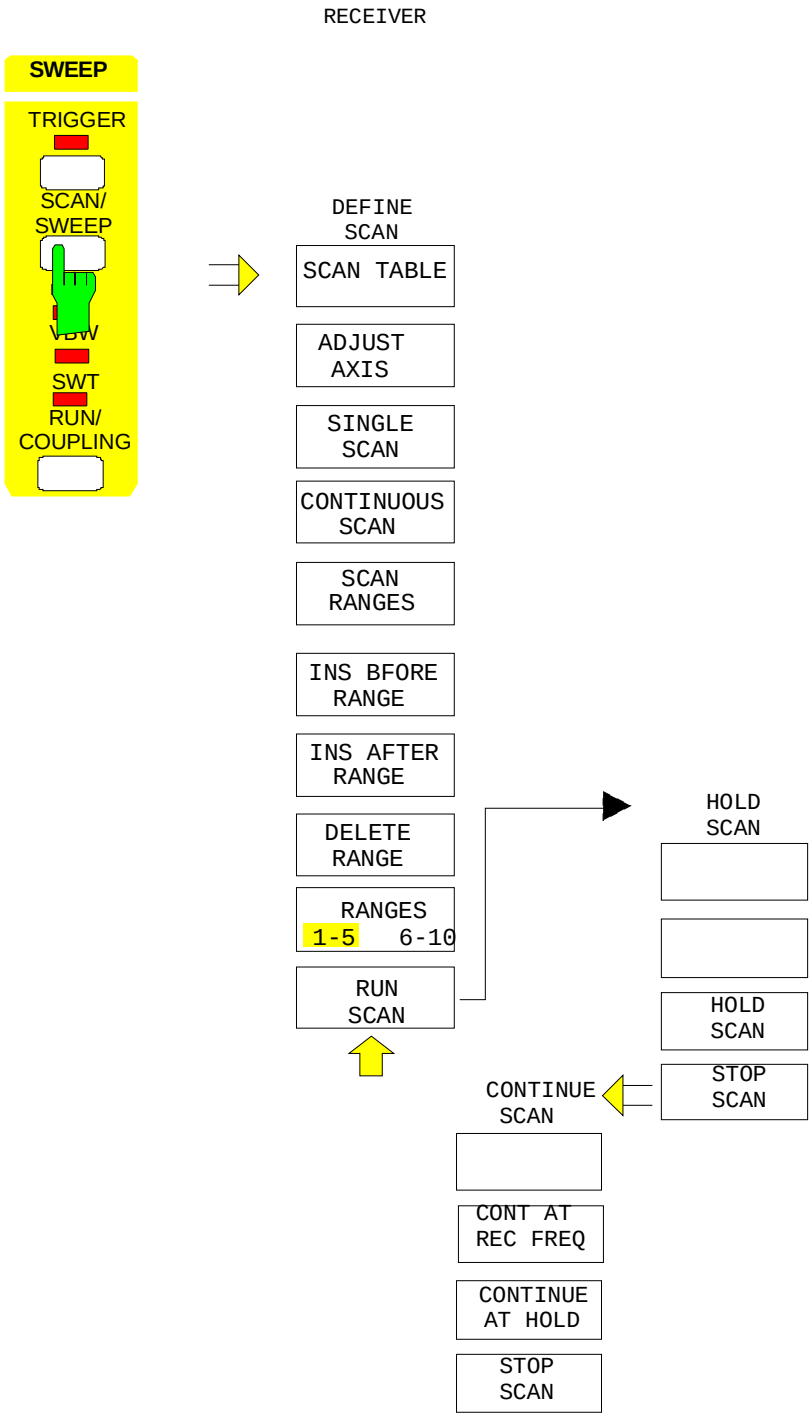


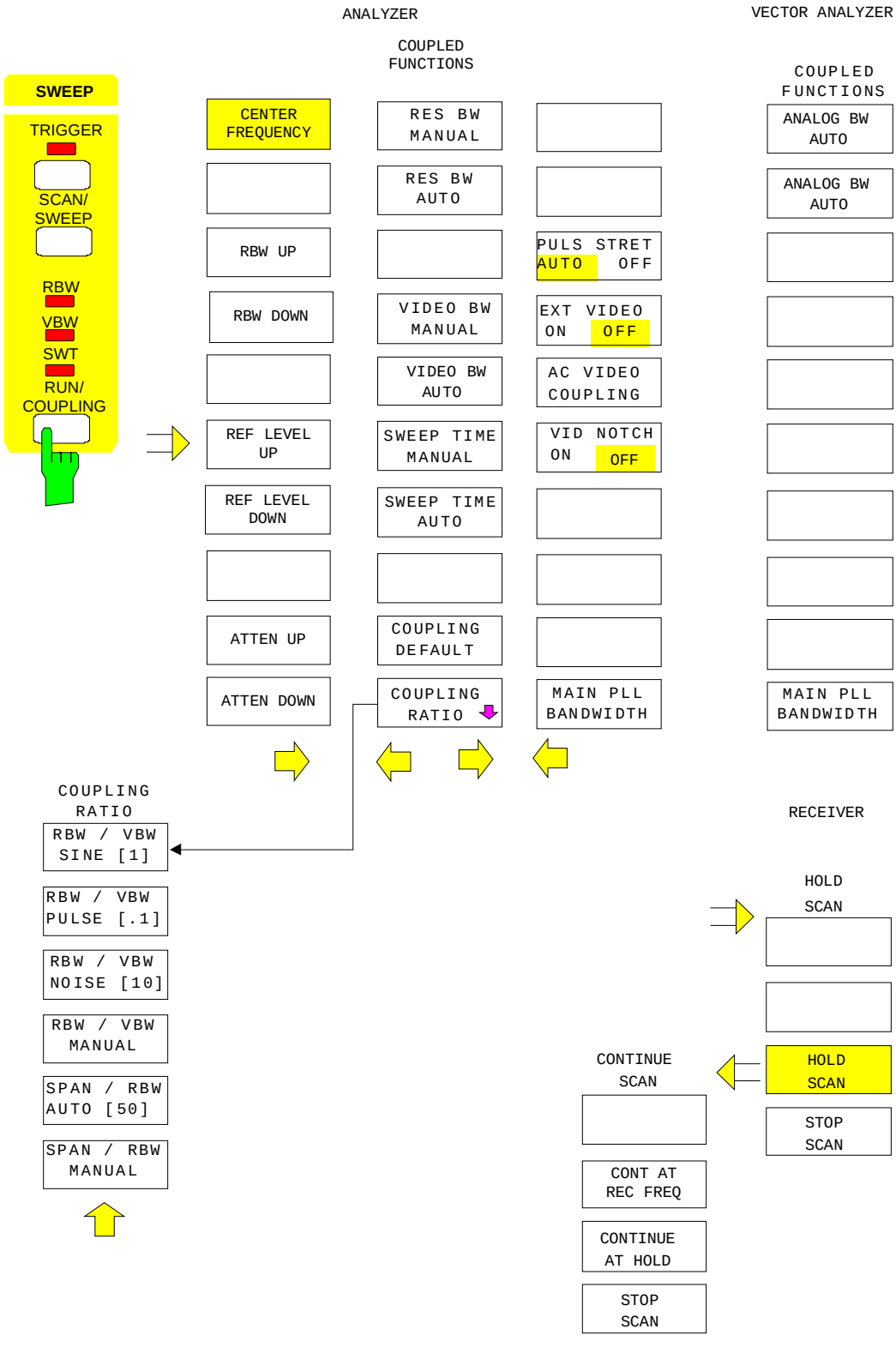

RECEIVER
TRACE
1
2
3
4
TRACE 1
CLEAR/ WRITE
VIEW
BLANK
MAX HOLD
MIN HOLD
FINAL RESULTS
SWEEP COUNT
DETECTOR
COPY..
TRACE 1
T1-T2+REF -> T1
T1-T3+REF -> T1
T1-T4+REF -> T1
T1-REF ->T1
ASCII EXPORT
ASCII CONFIG
TRACE MATH OFF
ASCII CONFIG
EDIT PATH
DECIM SEP . ,
NEW APPEND
HEADER ON OFF
ASCII COMMENT
TRACE 1 DETECTOR
MAX PEAK
AVERAGE
RMS
MIN PEAK
AC VIDEO
FINAL MAX PEAK
FINAL MAX PEAK
FINAL RMS
FINAL MIN PEAK
FINAL AC VIDEO

Sweep Key Group

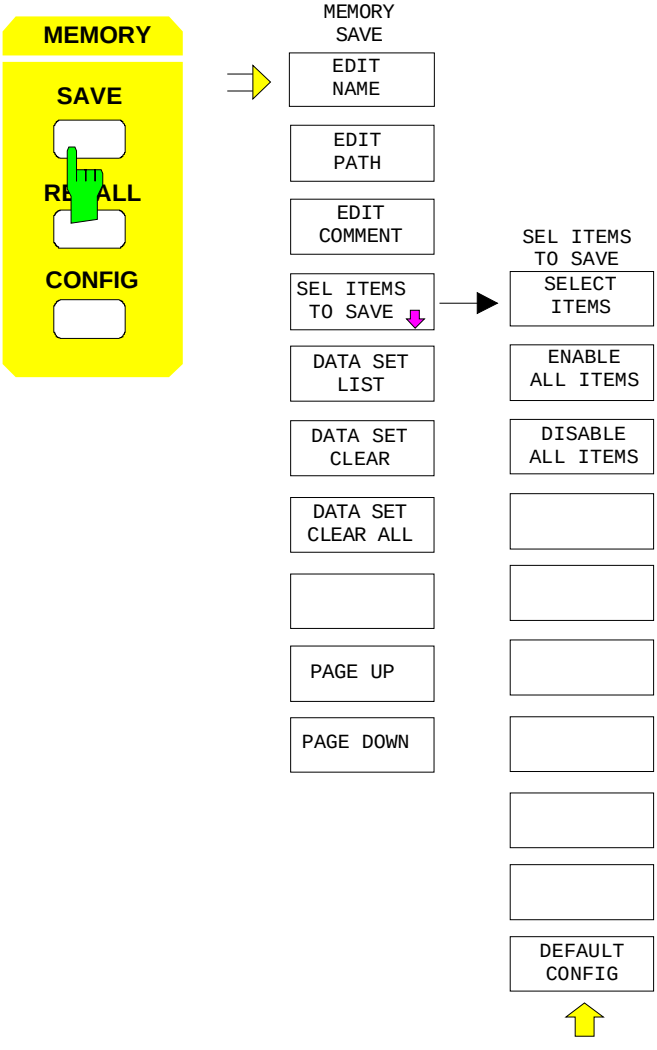


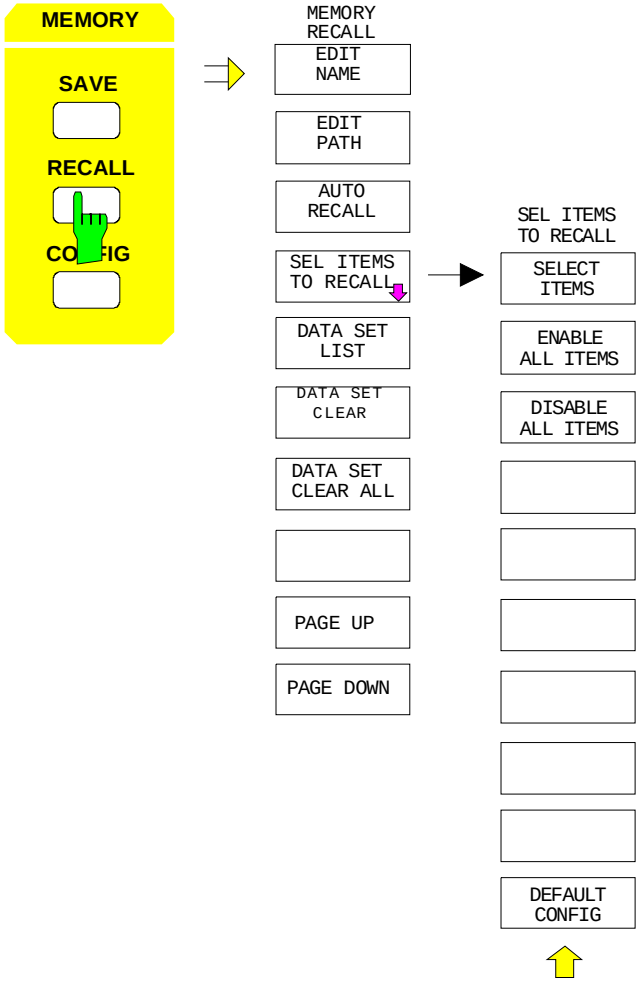

SWEEP
TRIGGER
SCAN/
SWEEP
SWT
RUN/
COUPLING
RECEIVER see below
ANALYZER
SWEEP
CONTINOUS SWEEP
SINGLE SWEEP
SWEEP TIME AUTO
SWEEP TIME MANUAL
SWEEP COUNT
GAP SWEEP ON OFF
GAP SWEEP SETTINGS
GAP SWEEP SETTINGS
TRIGGER LEVEL
PRE TRIGGER
TRG TO GAP TIME
GAP LENGTH
GATE ON OFF
GATE SETTINGS
SGL SWEEP DISP OFF
GATE SETTINGS
GATE LEVEL
GATE MODE LEVEL EDGE
GATE POL POS NEG
GATE DELAY
GATE LENGTH
GATE ADJUST
GATE ADJUST
GATE LEVEL
GATE MODE LEVEL EDGE
GATE POL POS NEG
GATE DELAY
GATE LENGTH
SWEEPTIME MANUAL
RES BW MANUAL
VIDEO BW MANUAL
VIDEO BW AUTO
VECTOR ANALYZI
SWEEP
CONTINOUS SWEEP
SINGLE SWEEP
SWEEP COUNT
RESULT LENGTH

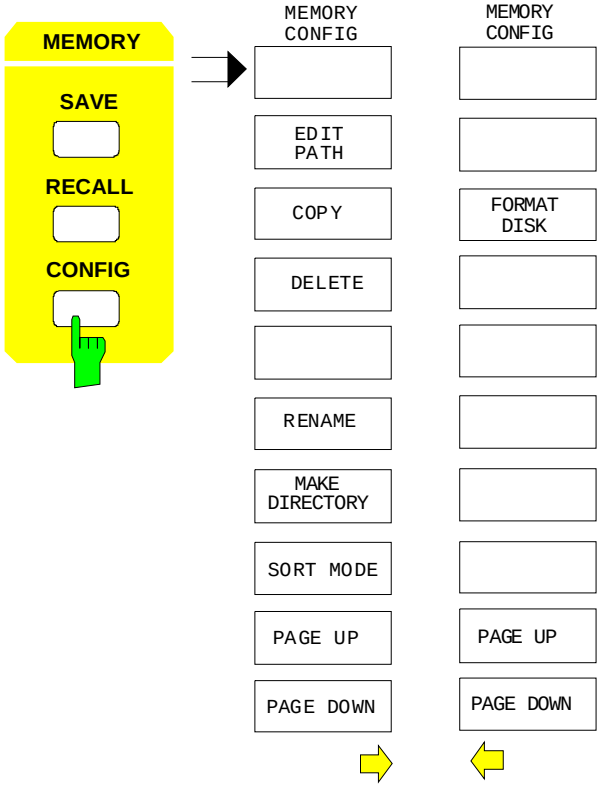

RECEIVER
SWEEP
TRIGGER
SCAN/
SWEEP
VBW
SWT
RUN/
COUPLING
DEFINE
SCAN
SCAN TABLE
ADJUST
AXIS
SINGLE
SCAN
CONTINUOUS
SCAN
SCAN
RANGES
INS BFORE
RANGE
INS AFTER
RANGE
DELETE
RANGE
RANGES
1-5 6-10
RUN
SCAN
HOLD
SCAN
HOLD
SCAN
STOP
SCAN
CONTINUE
SCAN
CONT AT
REC FREQ
CONTINUE
AT HOLD
STOP
SCAN


ANALYZER
VECTOR ANALYZER
COUPLED FUNCTIONS
COUPLED FUNCTIONS
SWEEP
TRIGGER
SCAN/ SWEEP
RBW
VBW
SWT
RUN/ COUPLING
CENTER FREQUENCY
RBW UP
RBW DOWN
REF LEVEL UP
REF LEVEL DOWN
ATTEN UP
ATTEN DOWN
RES BW MANUAL
RES BW AUTO
VIDEO BW MANUAL
VIDEO BW AUTO
SWEEP TIME MANUAL
SWEEP TIME AUTO
COUPLING DEFAULT
COUPLING RATIO
PULS STRET AUTO OFF
EXT VIDEO ON OFF
AC VIDEO COUPLING
VID NOTCH ON OFF
MAIN PLL BANDWIDTH
ANALOG BW AUTO
ANALOG BW AUTO
MAIN PLL BANDWIDTH
COUPLING RATIO
RBW / VBW SINE [1]
RBW / VBW PULSE [.1]
RBW / VBW NOISE [10]
RBW / VBW MANUAL
SPAN / RBW AUTO [50]
SPAN / RBW MANUAL
RECEIVER
HOLD SCAN
HOLD SCAN
STOP SCAN
CONTINUE SCAN
CONT AT REC FREQ
CONTINUE AT HOLD
STOP SCAN

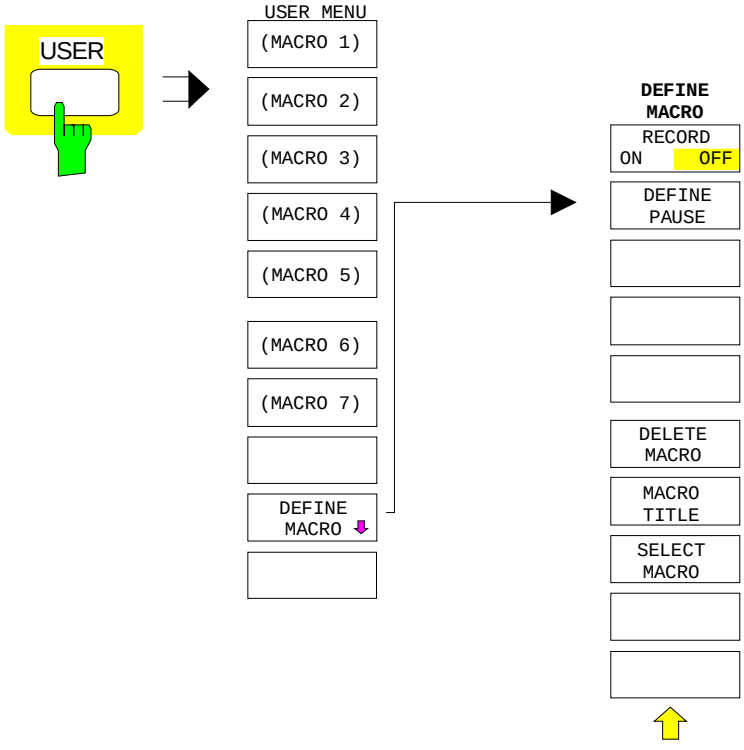
Memory Key Group




MEMORY
SAVE
RECALL
CONFIG
MEMORY RECALL
EDIT NAME
EDIT PATH
AUTO RECALL
SEL ITEMS TO RECALL
DATA SET LIST
DATA SET CLEAR
DATA SET CLEAR ALL
PAGE UP
PAGE DOWN
SEL ITEMS TO RECALL
SELECT ITEMS
ENABLE ALL ITEMS
DISABLE ALL ITEMS
DEFAULT CONFIG


MEMORY
SAVE
RECALL
CONFIG
MEMORY CONFIG
EDIT PATH
COPY
DELETE
RENAME
MAKE DIRECTORY
SORT MODE
PAGE UP
PAGE DOWN
MEMORY CONFIG
FORMAT DISK
PAGE UP
PAGE DOWN

User Key


USER
USER MENU
(MACRO 1)
(MACRO 2)
(MACRO 3)
(MACRO 4)
(MACRO 5)
(MACRO 6)
(MACRO 7)
DEFINE MACRO
DEFINE MACRO
RECORD
ON OFF
DEFINE PAUSE
DELETE MACRO
MACRO TITLE
SELECT MACRO

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4 Instrument Functions

All functions of the receiver are explained in detail in this chapter.

The instrument functions for general settings, printout and data management are described at the beginning of this chapter – key groups *SYSTEM*, *CONFIGURATION*, *HARDCOPY*, *MEMORY* and the *USER* key.

The sequence of the following key groups depends on their appearance on the front panel: key groups *FREQUENCY*, *LEVEL*, *MARKER*, *LINES*, *TRACE, SWEEP* and the *INPUT* key. The menus are described separately for the different operating modes.

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

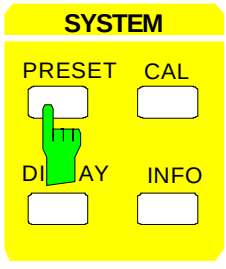
An overview of the menus is given in chapter 3 which also contains the description of the operating concept.

For fast reference 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 provides as further help for the user.

General Configuration – *SYSTEM* and *CONFIGURATION* Key Groups

FSET Initial Configuration – *PRESET* Key



Using the *PRESET* key, the FSET can be brought to a predefined initial state equivalent to the state after power on. All previous setting are deleted if they were not previously saved in memory. Returning to the *PRESET* state is not critical with regard to an arbitrary signal which may still be present at the input as long as the signal is within the specified voltage range.

Note: *The initial state set by the PRESET key can be adapted to the user requirements using the AUTO RECALL function. When the PRESET key is pressed, the AUTO RECALL dataset is loaded. For further information refer to Section "Saving and Recalling Data Sets".*

IEC/IEEE- bus command : *RST

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

Table 4-1 Initial state of the FSET

Parameter	Setting (with FSET-Z..)	Setting (without FSET-Z..)
Center Frequency	1.02 GHz	1 GHz
Center Freq Step	100 MHz	200 MHz
Span	1.96 GHz	2 GHz
Input	DC	-
RF ATT	35 dB auto	10 dB auto
RF ATT Step	10 dB	10 dB
Ref Level	-20 dBm	- 20 dBm
Ref Level Step	10 dB	10 dB
Level Range	100 dB LOG	100 dB LOG
Detector	Max Peak	Max Peak
Sweep Time	5 ms auto	5 ms auto
Res BW	2 MHz auto	2 MHz auto
Video BW	2 MHz auto	2 MHz auto
Sweep	cont	cont
Trigger	free run	free run
Trace	1 Clr Write	1 Clr Write
Trace	2, 3, 4 Blank	2, 3, 4 Blank
Freq Offset	0 Hz	0 Hz
Ref Level Offset	0 dB	0 dB
Preamplifier	20 dB	-
Preselector	Direct 40 MHz to 2 GHz	-

Display Configuration – *DISPLAY Key*

The measurement results are displayed on the screen of the FSET either in a full-screen window or in two spli-screen windows. In some cases, the two windows can be subdivided into two diagrams each, e. g. for the representation of the inphase and quadrature signal in the vector analyzer mode. In the RECEIVER mode, a selection can be made in the upper half of the screen (SCREEN A) between bargraph display of receiver mode and the spectrum analyzer mode.

If only one window is used, this window fills the complete display screen. Two measurement windows are always placed over each other. The axes labelling and measurement settings are defined independently in each measurement window.

When two measurement windows are used, the settings can be chosen to be either coupled or fully independent from each other (depending on the operating mode). The measurement procedure is always sequential.

New instrument settings can only be entered in the active measurement window. This window is marked on the upper right corner of the grid. Coupled settings are changed simultaneously in both windows at the time of entry.

The entry of the measurement parameters for each of the two windows can be either independent from one another using numerical inputs, or by graphical definition of the span through the use of level and frequency lines. The former case, e.g., may be used for harmonic or frequency converter measurements, and the latter case, for a zoom display of a frequency or level segment.

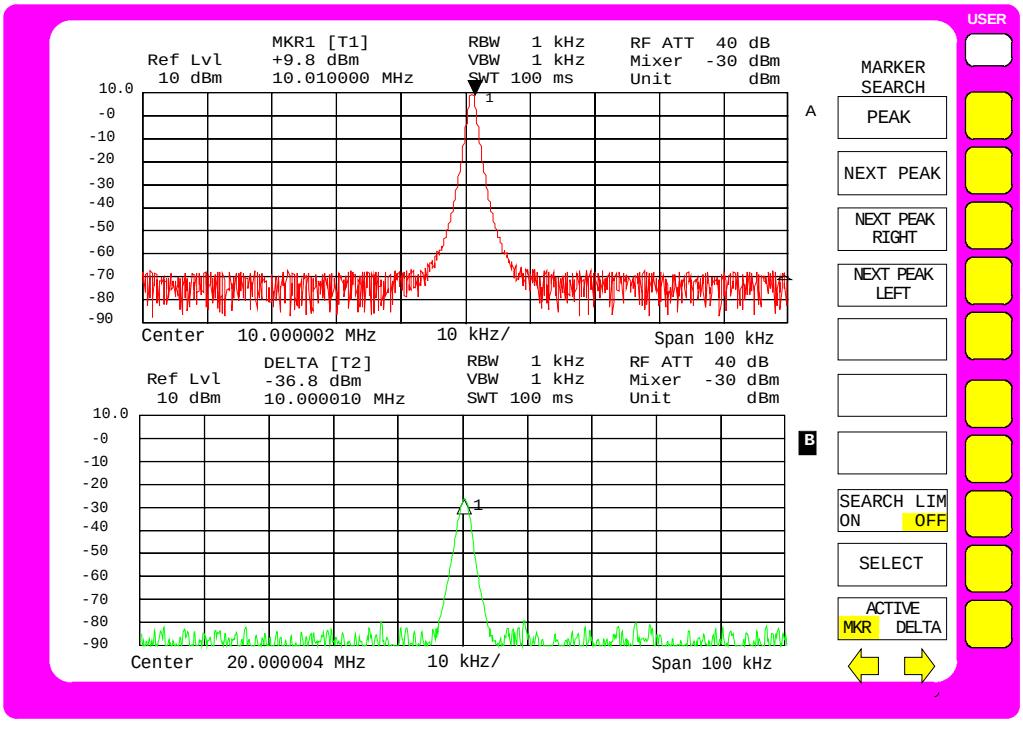
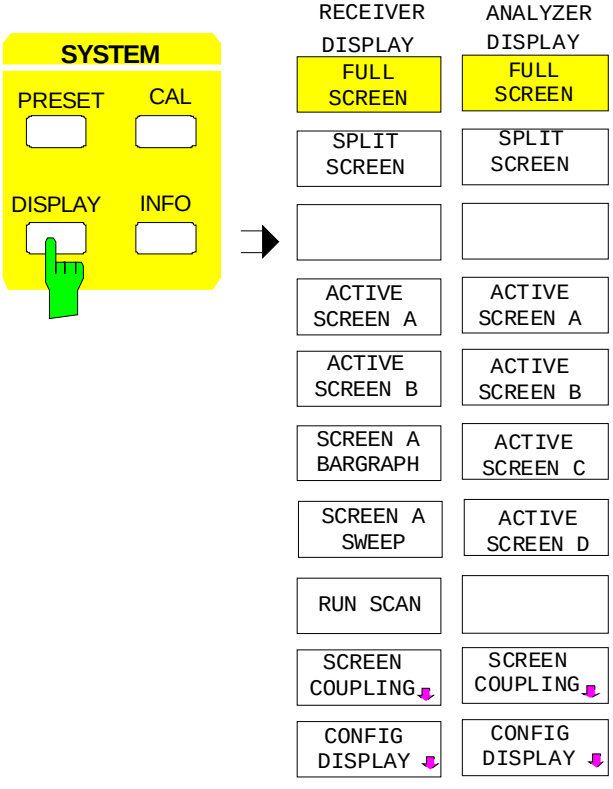


Fig. 4-1 Split screen mode, screens uncoupled

SYSTEM DISPLAY menu:

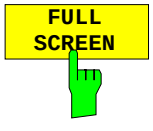


The *DISPLAY* key calls a menu which is used to configure the display screen and to select the active measurement window in SPLIT-SCREEN mode.

The menu differs for the two operating modes RECEIVER and ANALYZER.

Display Screen Mode Selection

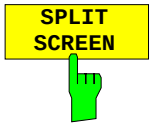
SYSTEM DISPLAY menu:



The *FULL SCREEN* softkey selects the full-screen display. This is the default setting of the FSET.

In this mode, the *ACTIVE SCREEN A* / *ACTIVE SCREEN B* and *SCREEN COUPLING* softkeys are not used.

IEC/IEEE- bus command `:DISPlay:FORMat SINGle`

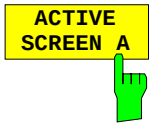


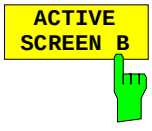
The *SPLIT SCREEN* softkey selects the split screen mode. The upper screen is designated *SCREEN A*, the lower screen *SCREEN B*.

IEC/IEEE- bus command `:DISPlay:FORMat SPLit`

RECEIVER mode:

In the RECEIVER mode, a selection can be made in the upper half of the screen (SCREEN A) between bargraph display of receiver mode and the spectrum analyzer mode.
With spectrum analyzer selected, the scan display in the lower half of the screen remains unchanged and the spectrum analyzer with all its measurement functions is available in the upper screen half.
It is therefore possible to perform first a premeasurement with a scan and then to further investigate suspect signals with the aid of the spectrum analyzer, eg in the zero span to determine time characteristics. The center frequency of the spectrum analyzer can be coupled to the marker frequency of the scan display so that the frequencies to be analyzed can be easily displayed in the spectrum analyzer.





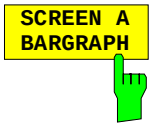
If *SPLIT SCREEN* display is activated, the *ACTIVE SCREEN A* and *ACTIVE SCREEN B* softkeys activate either screen A or screen B.

The entry of new settings is only possible for the active window.

When switching back to *FULL SCREEN* mode, the active measurement window is displayed.

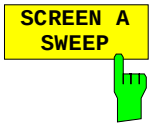
These softkeys are only displayed if operation with two independent channels and different softkey menus - receiver with scan display and spectrum analyzer - is selected (*SCREEN A SWEEP*). Only in this case will it be necessary to assign entries to the receiver or to the spectrum analyzer.

IEC/IEEE bus command - (the screen is selected via the numeric suffix)



The *SCREEN A BARGRAPH* softkey switches on the bargraph display of the receiver mode in the upper half of the screen (*SCREEN A*).

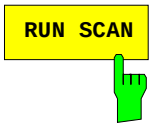
IEC/IEEE bus command `:INSTrument2[:SELect] RECeiver`



The *SCREEN A SWEEP* softkey switches on the analyzer mode in the upper half of the screen (SCREEN A).

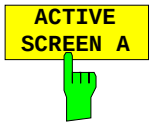
The softkeys of all menus are assigned the *ANALYZER* functions. An exception is the *DISPLAY* menu where the *SCREEN A BARGRAPH* softkey is displayed to allow a return to the bargraph display of the receiver mode.

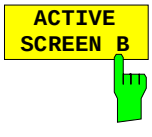
IEC/IEEE bus command `:INSTrument[:SELect] SANalyzer`



The *RUN SCAN* softkey starts the frequency scan with the selected settings. (see Section "Frequency Scan").

ANALYZER mode:





If *SPLIT SCREEN* display is activated, the *ACTIVE SCREEN A* and *ACTIVE SCREEN B* softkeys activate either screen A or screen B.

The entry of new settings is only possible for the active window.

When switching back to FULL SCREEN mode, the active measurement window is displayed.

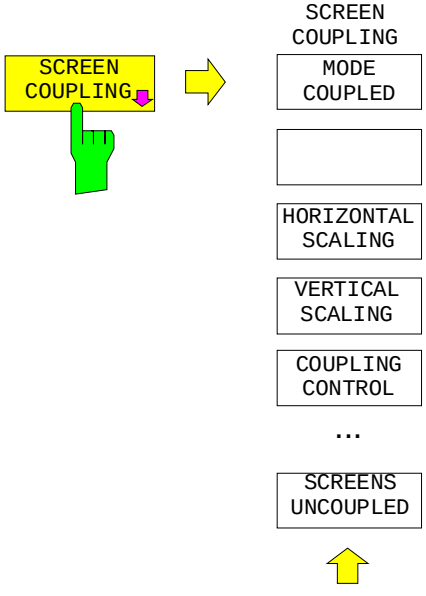
If, in addition, the two screens are both subdivided into two diagrams, the *ACTIVE SCREEN A/B* softkeys activate the upper diagram, *ACTIVE SCREEN C/D* the lower diagram in each screen.

IEC/IEEE- bus command - (the screen is selected via the numeric suffix)

Measurement Window Coupling

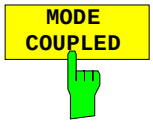
For the most part, the settings for the two windows can be either independently performed or coupled to one another. In many cases, when changes are made in one window (e.g., the reference level) it is desirable to also make the corresponding changes in the second window. The measurement window parameters which are to be coupled may be selected in the *SCREEN COUPLING* menu.

SYSTEM DISPLAY-SCREEN COUPLING submenu:



The *SCREEN COUPLING* softkey calls a sub-menu in which the coupling between the two measurement windows *SCREEN A* and *SCREEN B* can be defined. This coupling is only effective when both windows are displayed (*SPLIT SCREEN*).

In the default setting, all of the items which are selectable are also coupled.



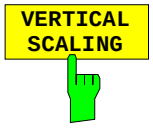
The *MODE COUPLED* softkey switches the coupling of the operating mode (Analyzer, Vector Analyzer) on/off.

IEC/IEEE- bus command `:INSTrument<1|2>:COUPle MODE`



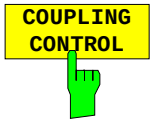
The *HORIZONTAL SCALING* softkey switches the coupled scaling of the horizontal axes on and off. In the frequency domain, the center frequency and the frequency span are identical. In the time domain, the sweep time for both windows is the same.

IEC/IEEE- bus command `:INSTrument<1|2>:COUPle X`



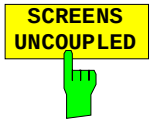
The *VERTICAL SCALING* softkey switches the coupled scaling of the vertical axes on and off. For a level measurement, this means that the reference level and the vertical resolution (*LEVEL RANGE*) are set to the same values in both windows.

IEC/IEEE- bus command `: INSTrument<1|2>:COUPle Y`



The *COUPLING CONTROL* softkey switches the coupling of the trigger and gate parameters and of SWEEP COUNT and SWEEP SINGLE/ CONTINOUS on/off.

IEC/IEEE- bus command `:INSTrument<1|2>:COUPle CONTrol`

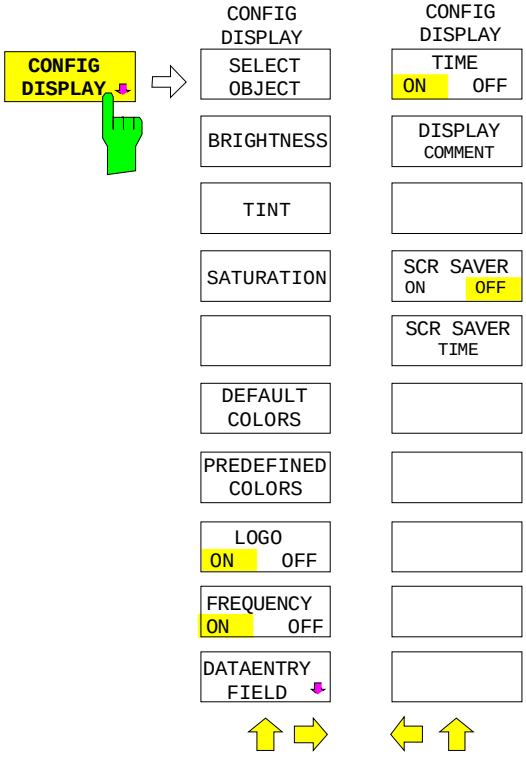


The *SCREENS UNCOUPLED* softkey switches all of the possible couplings between the measurement windows to off.

IEC/IEEE- bus command `: INSTrument<1|2>:COUPle NONE | ALL`

Display Screen Configuration

SYSTEM DISPLAY-CONFIG DISPLAY submenu:



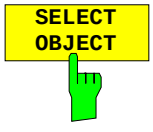
The *CONFIG DISPLAY* softkey calls a submenu, in which the selection of color and brightness for the individual elements on the display screen takes place. The actual selection of the elements takes place in the corresponding menu table.

The color assignment of the softkeys is coupled with the color assignment of other display elements.

Changing for example the color of *SOFTKEY STATE OFF* causes the color of the table background to be changed at the same time. The same applies to SOFTKEY *STATE DATA ENTRY* and display lines, and to *SOFTKEY STATE ON* and enhancement labels.

In the right side menu, date, time and a diagram label can be displayed on the screen and the energy saving mode can be activated.

The *FREQUENCY ON/OFF* softkey is not available in receiver mode.



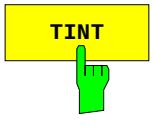
The *SELECT OBJECT* softkey activates the *SELECT DISPLAY OBJECT* table, with which a graphics element can be selected. After selection, the brightness, tint and saturation of the selected element can be changed using the softkeys of the same name. The color changes can be seen immediately on the display screen.

SELECT DISPLAY OBJECT
√ TRACE 1
TRACE 2
TRACE 3
TRACE 4
MARKER
GRID
SOFTKEY STATE ON
SOFTKEY STATE DATA ENTRY
SOFTKEY STATE OFF
SOFTKEY SHADE
TEXT
TITLE
BACKGROUND



The *BRIGHTNESS* softkey is used to enter the brightness of the color for the selected element. The range of input values is 0 to 100%.

IEC/IEEE- bus command `:DISPlay:CMAP:HSL <hue>,<sat>,<lum>`



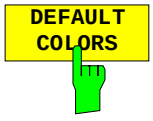
The *TINT* softkey is used to enter the color tint of the selected element. The percentage that is entered specifies a point in a color spectrum ranging from red (0%) to blue (100%).
The *TINT* function is not available for monochrome (black/white) displays.

IEC/IEEE- bus command `:DISPlay:CMAP:HSL <hue>,<sat>,<lum>`



The *SATURATION* softkey is used to enter the color saturation of the selected element.
The range is 0 to 100%.

IEC/IEEE- bus command `:DISPlay:CMAP:HSL <hue>,<sat>,<lum>`



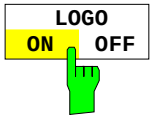
The *DEFAULT COLORS* softkey restores the default settings for brightness, color tint and color saturation for all display screen elements.

IEC/IEEE- bus command `:DISPlay:CMAP<1...13>:DEFault`



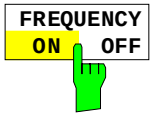
The *PREDEFINED COLORS* softkey activates a table, to select the predefined colors for the diplay screen elements can be selected.

IEC/IEEE- bus command `:DISPlay:CMAP<1...13>:PDEFined BLACk`



The *LOGO* softkey switches the Rohde & Schwarz company logo displayed in the upper left corner of the display screen on or off.

IEC/IEEE- bus command `:DISPlay:LOGO ON | OFF`

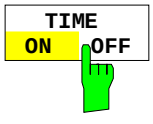


The *FREQUENCY* softkey switches the frequency information on the screen on and off. The softkey is available only in analyzer mode.

ON Frequency information is displayed.

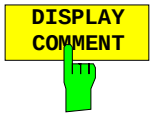
OFF Frequency information is not output to the display. This can be used for example to protect confidential data.

IEC/IEEE- bus command `:DISPlay:ANNotation:FREQuency ON|OFF`



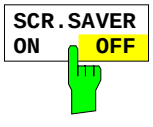
The *TIME* softkey switches on or off the date and time display at the lower edge of the diagram.

IEC/IEEE- bus command `:DISPlay[:WINDow<1|2>]:TIME ON | OFF`



The *DISPLAY COMMENT* softkey activates the entry of a label comprising a maximum of 50 characters. This label is displayed at the lower edge of the diagram.
Pressing the softkey again causes the label to be switched off. The stored text, however, is not deleted.

IEC/IEEE- bus command
`:DISPlay[:WINDow<1|2>]:TEXT[:DATA] <string>`
`:DISPlay[:WINDow<1|2>]:TEXT:STATe ON | OFF`



The *SCR. SAVER* softkey is used to switch the energy saving mode for the display on/off.
After the elapse of the shutdown time (*SCR. SAVER TIME)* the display is completely switched off, ie including backlighting.
The screen saver is deactivated by pressing any key or by sending the corresponding IEEE/IEC/IEEE- bus command.

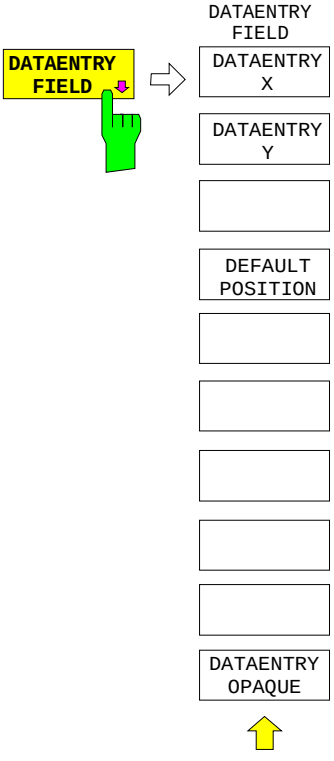
IEC/IEEE- bus command `:DISPlay:PSAVer[:STATe] ON | OFF`



The *SCR. SAVER TIME* softkey activates the entry of the time for the screen saver to respond. The shut-down time is entered in minutes between 1 to 100 minutes.

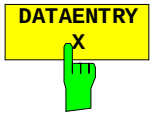
IEC/IEEE- bus command `:DISPlay:PSAVer:HOLDoff <num_value>`

SYSTEM DISPLAY-CONFIG DISPLAY DATAENTRY FIELD Untermenü:



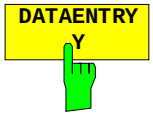
The *DATAENTRY FIELD* softkey displays a submenu used to specify the position and characteristics of the data entry field.

IEC/IEEE- bus command - -



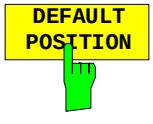
The *DATAENTRY X* softkey shifts the position of the data entry field horizontally.

IEC/IEEE- bus command - -



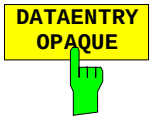
The *DATAENTRY Y* softkey shifts the position of the data entry field vertically.

IEC/IEEE- bus command - -



The *DEFAULT POSITION* softkey positions the data entry field automatically. In general, its position is the upper left edge of the grid on the active screen.

IEC/IEEE- bus command - -



The *DATAENTRY OPAQUE* softkey sets the data entry windows to opaque. This means that entry windows are underlayed with the background color for tables and that diagrams and traces behind an entry window can no longer be seen.

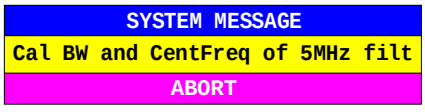
IEC/IEEE- bus command - -

Recording the Correction Data – *CAL Key*

The FSET maintains its high measurement accuracy thanks to its integrated system-error correction method. The *CAL* hard key provides a series of correction functions which allow not only the system error correction of the complete instrument, but also correction functions which are specifically applicable to the measurement requirements of relevant instrument sections.

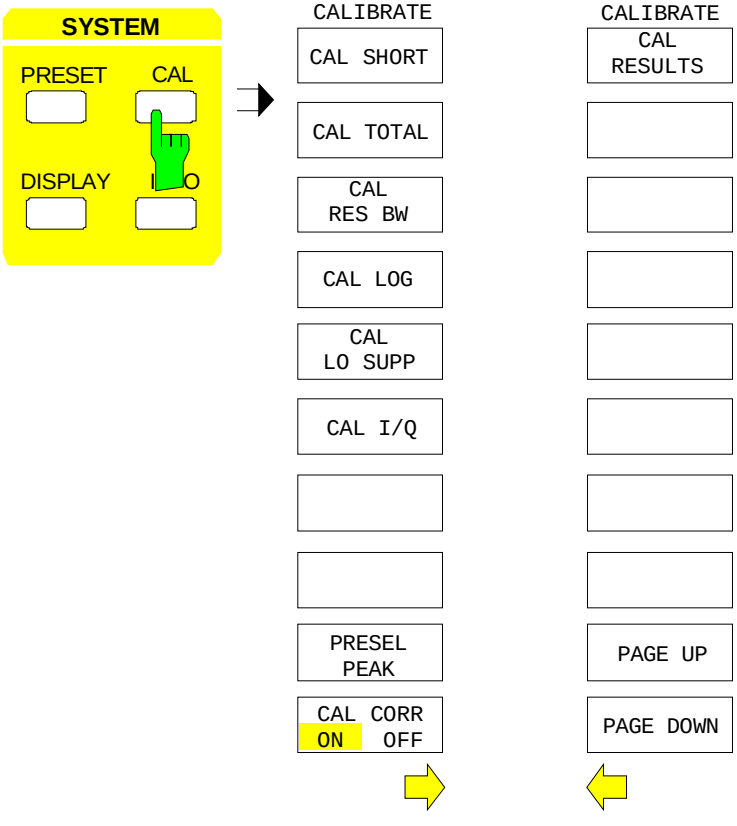
The measurement settings of the FSET are saved and, after system error correction, completely restored. The correction data valid before system error correction are saved and, in case of a correction abort, restored.

A window shows the progress of the correction data recording. *ABORT* can be used to abort the procedure at any time.



Note: *The term "Calibration" formerly used for integrated system error correction was often taken to be the "true" calibration of the instrument performed during production and service. It is, therefore, no longer used although it appears in abbreviated form in the name of keys ("CAL...").*

SYSTEM CAL menu:



The *CAL* key displays a menu with the system error correction functions.

Correction Function Calls

SYSTEM CAL menu:



The *CAL SHORT* softkey starts a short calibration, in which the absolute gain of the analyzer as well as the gain errors of the selected bandwidth are corrected.

IEC/IEEE- bus command `:CALibration:SHORt?`



The *CAL TOTAL* softkey starts a complete correction of the analyzer including additional partial corrections shown in the menu.

UNCAL is displayed in the status line if the correction data recording has failed or if the correction values are deactivated (*CAL CORR* softkey= *OFF*).

IEC/IEEE- bus command `:CALibration[:ALL]?`



The *CAL RES BW* softkey starts the correction of the gain of the resolution filter.

IEC/IEEE- bus command `:CALibration:BANDwidth[:RESolution]?`



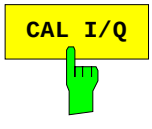
The *CAL LOG* softkey starts the correction of the linearity of the logarithmic amplifier.
Both the broadband and the narrow-band log module are calibrated.

IEC/IEEE- bus command `:CALibration:LDETector?`



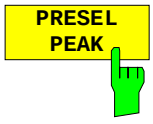
The *CAL LO SUPP* softkey starts the correction of the compensation of the first oscillator at low frequencies. After correction, the display of the internal oscillator at the frequency 0 Hz is very small.

It is recommended that the correction be performed whenever sensitive measurements are to be made at low frequencies.



The *CAL I/Q* softkey starts the correction of the gain error of the I/Q demodulator.

IEC/IEEE- bus command `:CALibration:IQ?`

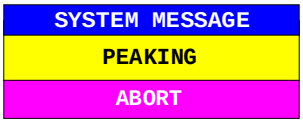


The *PRESEL PEAK* softkey optimizes the tuning of the preselector for input signals in the frequency range above 7 GHz (FSET22 only).

This calibration should be used whenever signal levels in the frequency range above 7 GHz are to be measured and high accuracy is desired.

If a marker is not active when the *PRESEL PEAK* softkey is pressed, marker 1 is activated as the reference marker and placed on the signal maximum in the active trace. Otherwise the active marker is used.

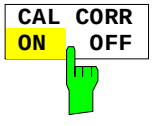
The following window is displayed on the screen while the peaking function is running. The function can be aborted at any time using the *ABORT* line. In this case, the correction value determined at the factory is restored.



The input signal's signal-to-noise ratio must be at least 10dB in order that the peaking function runs properly. Otherwise, the preselector may be set incorrectly, which would cause level errors by subsequent measurements.

If the instrument setting (start/stop frequency, sweep time) is changed after *PRESEL PEAK* has been called, the correction value for the preselector determined by the function is no longer used. Instead, the correction value determined at the factory is restored.

IEC/IEEE- bus command `:CALibration:PPEak?`



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

ON The status message depends upon the results of the total correction

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

IEC/IEEE- bus command `:CALibration:STATe ON | OFF`

Results of System Error Correction

SYSTEM CAL menu:



The *CAL RESULTS* softkey in the right-hand supplementary menu calls the *CALIBRATION RESULTS* table, which displays the correction data that has been recorded.

The *CALIBRATION RESULTS* table contains the following information:

page 1:

- date and time of the last recorded correction values
- overall results of the correction value recording
- list of the correction procedures according to function/module, including the correction values, the measured results and the individual results for each of the correction procedures

The results for the individual correction procedures are categorised and displayed as follows:

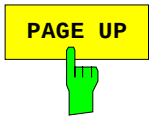
PASSED	system error correction was completely successful
CHECK	deviations larger than expected, however, corrections could be performed
FAILED	deviations too large, no corrections were possible
ABORTED	correction aborted

CALIBRATION RESULTS

```
CALIBRATION: PASSED
Last cal total: 05.Jun 1997 16:24:54

Calibration of IF Filters   PASSED
IF GAIN Adjust              PASSED
Bandwidth:
Filter  Cal Val [Hz] DAC Val State
  1kHz   2.806e+01   1679   PASSED
  2kHz   1.603e+01   2887   PASSED
  3kHz  -6.012e+00   3238   PASSED
  5kHz  -1.002e+01   3514   PASSED
 10kHz   1.804e+02   3703   PASSED
 20kHz   3.607e+02   3801   PASSED
 30kHz   8.417e+02   3831   PASSED
 50kHz   1.403e+03   3743   PASSED
100kHz   1.804e+03   3698   PASSED
200kHz   3.607e+03   3606   PASSED
300kHz   8.417e+03   3516   PASSED
500kHz   1.403e+04   3329   PASSED
  1MHz   2.806e+04   2881   PASSED
```

IEC/IEEE- bus command - -

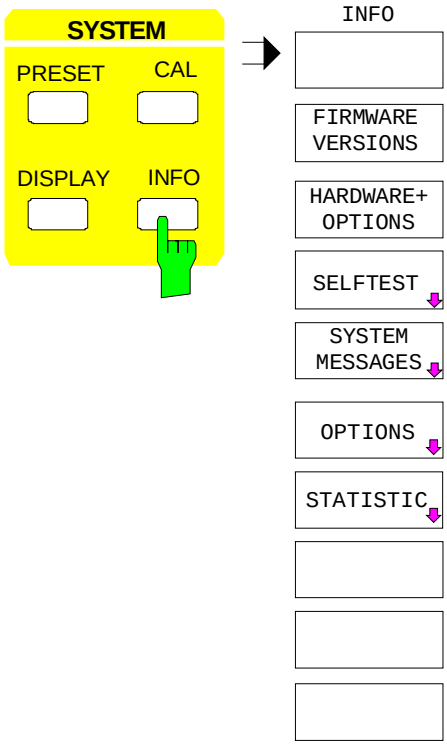




The *PAGE UP* and *PAGE DOWN* softkeys can be used to page through the table of correction results.

Instrument Status and Measurement Parameters – INFO Key

SYSTEM INFO menu:



The *INFO* key is used to request general information concerning the instrument. These include:

- firmware version
- installed hardware and hardware options
- modification level of the individual modules
- self-test results with the option of calling self-test functions
- list of generated system messages
- installed firmware and hardware options.
- Statistical evaluations

Firmware Versions

SYSTEM INFO menu:



The *FIRMWARE VERSIONS* softkey opens two tables, which provide the following informations:

- Table *MODEL* displays the exact instrument model.

MODEL
FSET 22

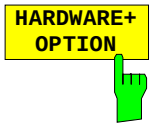
- In the FIRMWARE VERSION table, the version of each software component installed in the instrument is listed. The versions of programmable logic devices are also included if the firmware version of the device can be determined.

FIRMWARE VERSION	
BIOS	1.2
ANALYZER	1.80
SERIAL NUMBER	101379/005

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

Hardware Configuration and Options

SYSTEM INFO menu:



The *HARDWARE+OPTIONS* softkey opens two tables in which the modules (INSTALLED COMPONENTS) installed in the instrument are listed.

- Table *MODEL* lists the instrument name and model:

MODEL
FSET 22

- Table *INSTALLED COMPONENTS* consists of four columns:

  COMPONENT name of module

  MODEL INDEX model number of the module

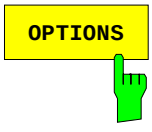
  MODIF INDEX main modification index of the module

  HW CODE secondary modification index of the module

  These lists contain only the modules which are actually present in the instrument, i.e., the modules which were identified by the module recognition software.

INSTALLED COMPONENTS			
COMPONENT	MODEL INDEX	MODIF INDEX	HW CODE
Main Processor	5	n/a	0
Graphic Board	0	n/a	0
I/O Board	5	n/a	0
FRAC SYN	2	5	12
RF Module	6	0	0
2nd IF Converter	2	3	2
LO Phase	3	4	9
MW Converter	2	0	0
MW YIG Filter	2	0	0
RF Attenuator	4	4	0
Digital IF	2	5	0
I/Q Demod	2	5	6
FSET-IF1	2	3	1
FSET-IF2	2	2	2
FSET-IF741	2	2	2
FSET-Video	2	3	2

IEC/IEEE- bus command `*OPT?`
`:SYSTem:BINFo?`



The *OPTIONS* softkey opens two tables listing the options installed.

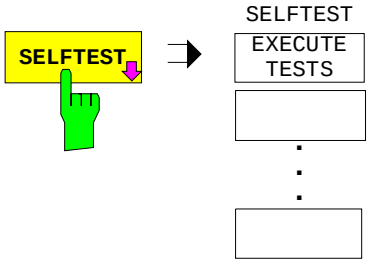
Note: *New firmware options can be enabled in the SETUP menu.*

HARDWARE OPTIONS	
DESIGNATION	CODE
Low Phase Noise & OCXO	B4
Vector Signal Analysis	B7

IEC/IEEE- bus command `*OPT?`

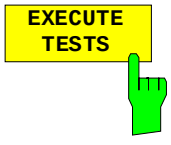
Self Test

SYSTEM INFO-SELFTEST submenu:



The *SELFTEST* softkey opens a submenu with which the self test can be started.

The instrument has extensive self test functions which comprehensively test instrument functionality. In case of a fault, the instrument can locate a defective module on its own. The self test sequence is described in more detail in the service manual instrument (supplied with the FSET).



The *EXECUTE TESTS* softkey starts the test of the complete instrument. During the self test a window is displayed:



The functions are tested in the following order:

1. Modules main CPU, digital motherboard, graphics and the interfaces
2. Reference frequency conditioning, the synthesizer modules and all LO signals
3. All RF, IF and signal-weighting modules

If no failure occurs during the execution of the self test, the following message is displayed when the complete self test is finished:



If a failure occurs during the execution of the self test, the self test is immediately aborted and a message indicating the defective module and the defective function is displayed:



Further testing should be performed by an R&S service department.

IEC/IEEE- bus command : *TST?

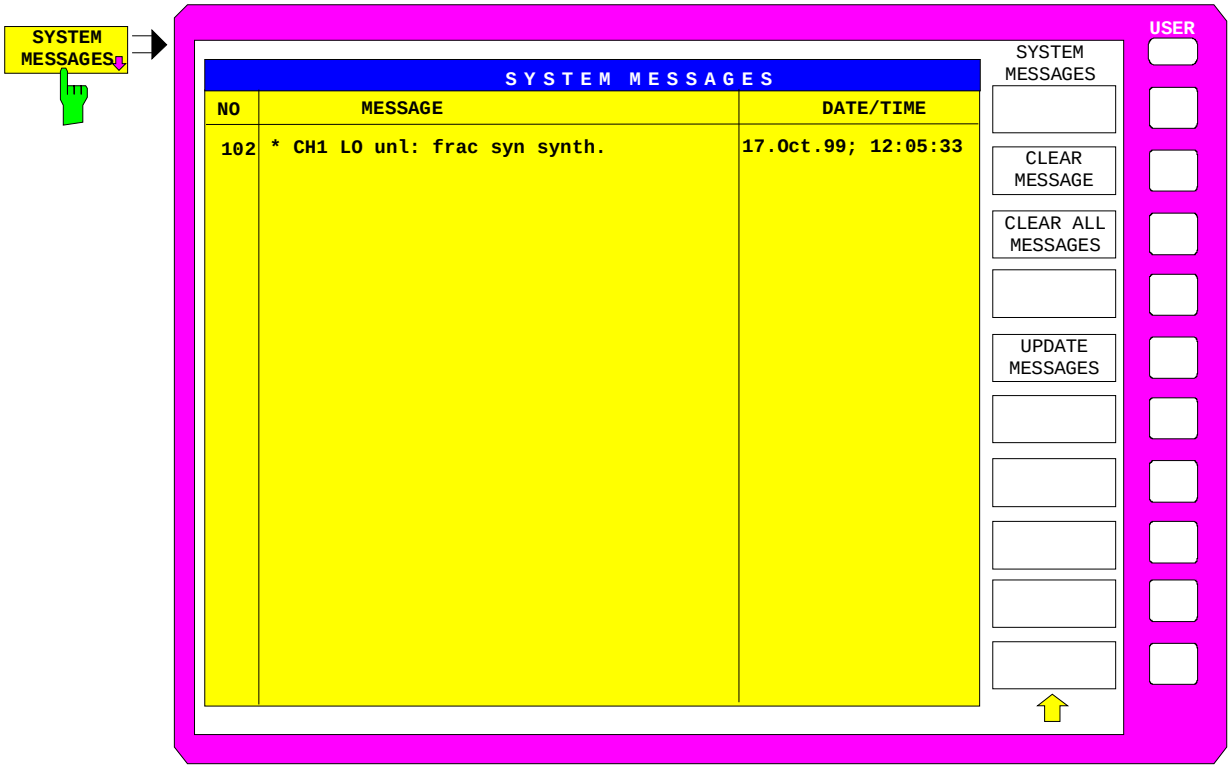
System Messages

The *SYSTEM MESSAGES* softkey opens a submenu with a table in which the generated system messages are displayed. The most recent messages are at the top of the list.
The following information is presented:

NO	Device-specific three-digit error code (shown as XXX in the figure)
MESSAGE	Brief description of the reason for the message
DATE/TIME	Date and time of the message

Error messages that have occurred since the *SYSTEM MESSAGES* menu was last called are marked by an asterix "*".

SYSTEM INFO-SYSTEM MESSAGES submenu:



IEC/IEEE- bus command `:SYSTem:ERRor?`

CLEAR MESSAGE

The *CLEAR MESSAGE* softkey deletes the message just selected.
All subsequent messages are shifted automatically one line upwards so that no empty lines exist. When the last message has been deleted, the selection bar also disappears.

IEC/IEEE- bus command `:SYSTem:ERRor?`

CLEAR ALL MESSAGES

The *CLEAR ALL MESSAGES* softkey deletes all messages.

IEC/IEEE- bus command - -

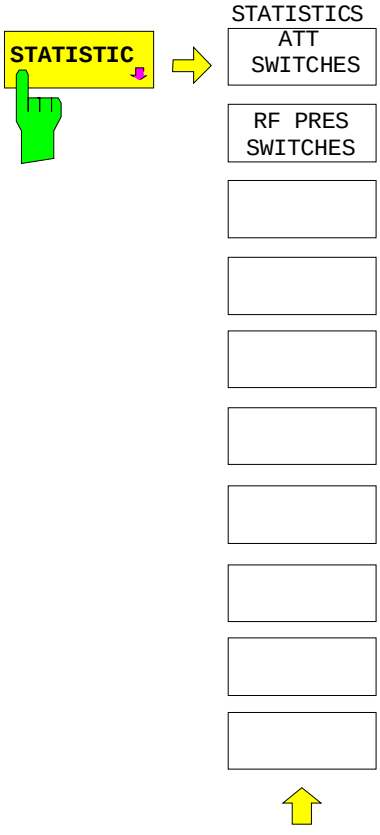
UPDATE MESSAGES

The *UPDATE MESSAGES* softkey causes all newly arrived messages to be entered at the top of the table. At this time, all messages previously indicated as "new" are displayed as "old" messages

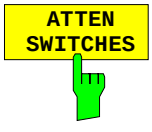
IEC/IEEE- bus command - -

Statistics Function for Input Attenuator Switching

SYSTEM INFO menu:



The *STATISTICS* softkey calls a submenu for indication of device statistics.

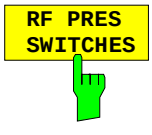


The *ATT SWITCHES* softkey displays various tables listing the mechanical switches and attenuators fitted in the instrument, plus the number of switching operations for the respective switch or attenuator.

INPUT ATTENUATOR	
Date	5 Aug 1999
Calibration Input	6
10 dB	121
20 dB	217
30 dB	137

IEC/IEEE- bus command

```
:DIAGnostic:INFO:CCOunt:ATTenuation<1|3>
```



The *RF PRES SWITCHES* softkey activates various tables indicating the counts of preamplifier FSET-Zxx attenuator.

.

Z2/Z22 ATTENUATOR 1	
Date	09 Jan 1970
RANGE SELECTOR	51027
10 dB	5167
20 dB	2948
40 dB	1585

Z2/Z22 LOW PASS	
Date	09 Jan 1970
20 kHz	874
50 kHz	2918
100 kHz	2704
500 kHz	534
1 MHz	850
5 MHz	504
40 MHz	949

Z2/Z22 BAND PASS	
Date	09 Jan 1970
40 - 65 MHz	649
65 - 100 MHz	5439
100 - 160 MHz	12761
160 - 250 MHz	518
40 - 100 MHz	734
100 - 200 MHz	438
200 - 500 MHz	653
500 - 1000 MHz	743
1 - 2 GHz	1256
40 - 2000 MHz	17617
Bypass	18243

Z2/Z22 ATTENUATOR 2	
Date	09 Jan 1970
1 dB	11613
2 dB	10225
4 dB	0
8 dB	2705
10 dB	16808
20 dB	15819
40 dB	11359

Z2/Z22 HIGH PASS	
Date	09 Jan 1970
100 Hz	1544
1 kHz	6149
5 kHz	1738
20 kHz	623
50 kHz	621
100 kHz	406
200 kHz	490
1 MHz	572
2 MHz	758
5 MHz	604

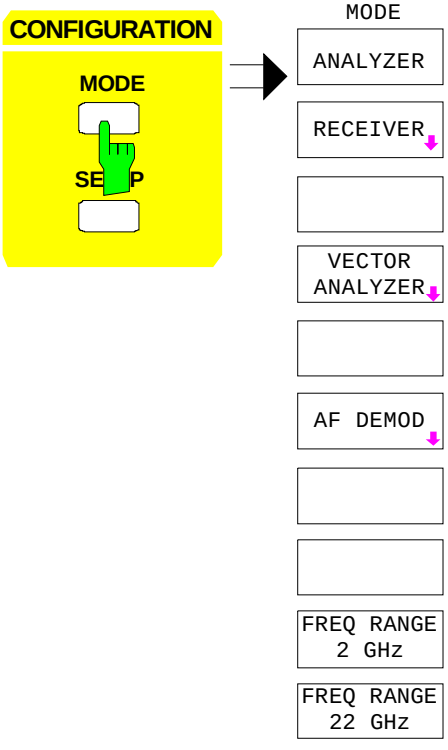
Z2/Z22 MICROWAVE	
Date	09 Jan 1970
100 Hz - 2 GHz	1323
2 - 4 GHz	2609
4 - 7 GHz	508
7 - 15 GHz	406
15 - 22 GHz	681
Direct (0 - 22 GHz)	871

IEC/IEEE- bus command `:DIAGnostic:INFO:CCOunt::PRESelector<1..6>`

Mode Selection – *MODE* Key

The FSET can be operated in one of several modes, each of which is different with respect to functionality and control. The differences in control, however, consist not only in the enabling/disabling of additional softkeys within existing softkey menus, but rather in the fact that existing menus are completely replaced by new menus and menu trees which are tailored to the functional requirements. In the simultaneous application of two measurement diagrams, two modes may also simultaneously enabled. Each mode can be assigned to a measurement window.

CONFIGURATION MODE menu



The *MODE* key opens the menu for selection of the mode.

The analyzer (softkey *ANALYZER*), the receiver (softkey *RECEIVER*) and the vector analyzer mode (softkey *VECTOR ANALYZER*) are offered.

The *AF DEMOD* softkey switches the AF demodulation of FSET on and opens a sub menu for configuration.

The *FREQ RANGE 2 GHZ* and *FREQ RANGE 22 GHZ* softkeys determine the upper frequency limit of FSET22 when preselection FSET-Z22 is used.

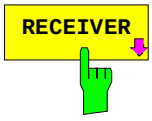


The *ANALYZER* softkey selects the *ANALYZER* mode.

This mode is the default setting of the FSET.

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.

IEC/IEEE-bus command `:INSTrument[:SELect] SANalyzer`

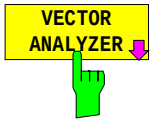


The *RECEIVER* softkey selects the *Test Receiver* mode.

In the receiver mode, FSET behaves like a test receiver, ie if the basic settings are active, it measures the level with the selected bandwidth and measurement time at the set frequency. The signal is evaluated by means of the three detectors average, peak, and rms.
A frequency sweep may be carried out with the start and stop frequencies and the stepwidth.

The main menu of the *RECEIVER* mode is described in detail in Section 'Receiver Mode'.

IEC/IEEE-bus command `:INSTrument[:SELect] RECeiver`

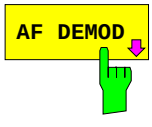


Softkey *VECTOR ANALYZER* selects the vector analysis mode.

In the vector analyzer mode the FSET is automatically set to a fixed frequency (center frequency) since vector analysis can only be carried out on one frequency.
The IF signal is digitized by the selected resolution bandwidth after filtering and mixed into the baseband by a digital mixer. Further processing is via digital signal processors which display the time characteristic of the amplitude or phase. As an option, the baseband can also be demodulated and the demodulated signal can be displayed. Principally any type of modulation (digital and analog) can be processed.

The functions of the analyzer mode are supplemented by the vector analysis functions which are described in detail in Section 'Vector Analyzer Mode'.

IEC/IEEE-bus command `:INSTrument[:SELect] DDEMod`

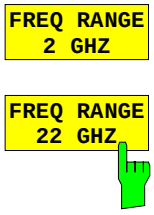


The *AF DEMOD* softkey switches the AF demodulation of FSET on.

The available types of demodulation are offered in the submenu.

The AF demodulation is switched on irrespective of the other settings, ie the demodulation is switched on permanently, even if FSET carries out a sweep. Operation of AF demodulation is described in section 'AF Demodulation'.

IEC/IEEE bus command `[:SENSe]:DEMOD AM | PM | FM | ACVideo`



The *FREQ RANGE 2 GHZ* and *FREQ RANGE 22 GHZ* softkeys determine the upper frequency limit of FSET22 with preselector FSET-Z22.

With FSET22 equipped with Option FSET-Z22, preselector and preamplifier, the frequency of 2 GHz is a limit at which different settings are available:

	up to 2 GHz	**from 2 GHz**
RF attenuation	0 to 80 dB in 1-dB steps	0 to 70 dB in 10-dB steps
Preamplifiers	0dB, 10 dB, 20 dB and 30 dB	fixed 20-dB
Input	AC or DC coupling	always DC coupling

To keep operation of FSET22 transparent, the user can preset the frequency range, in which he wants to perform the measurement by means of the *FREQ RANGE 2 GHZ* and *FREQ RANGE 22 GHZ* softkeys.

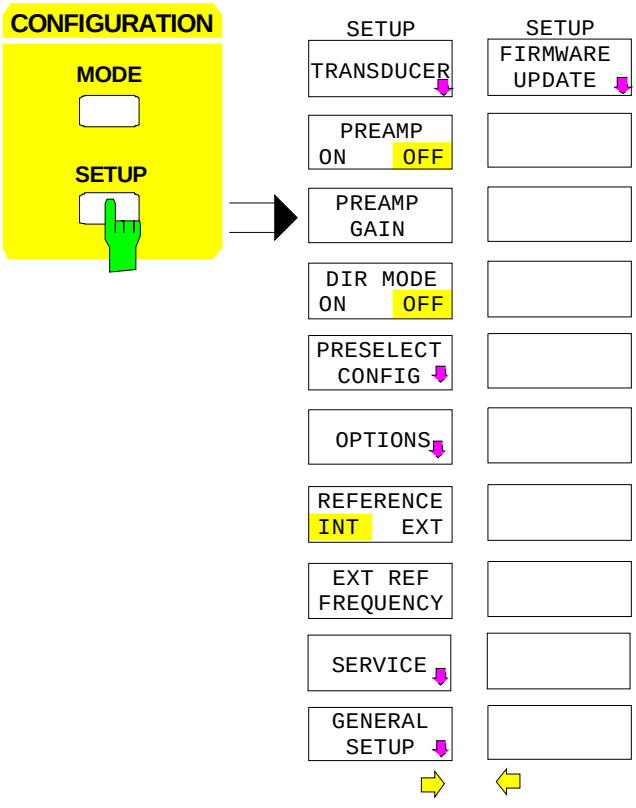
With the frequency range up to 2 GHz selected, all the possibilities available in this range can be set. With the full frequency range up to 22 GHz selected, however, only those settings are possible in the full frequency range - ie below 2 GHz - that are also available above 2 GHz.

For FSET22 operated without Option FSET-Z22, the softkeys have no relevance as the differentiation of the setting possibilities for the basic unit does not apply. The softkeys are thus not available.

IEC/IEEE bus command `[:SENSe]:FREQuency:RANGe 2E9 | 22E9`

Preliminary Setup and Interface Configuration – *SETUP* Key

CONFIGURATION SETUP menu:



The *SETUP* key opens the menu for configuration of the FSET.

The *TRANSDUCER* softkey opens a submenu for entering correction characteristics for the measurement transducer.

With the Preselector FSET-Z.. operated with FSET, the *DIR MODE ON/OFF* softkey activates the preselector and the preamplifier.

The *PREAMP GAIN* softkey switches on the gain.

The *PRESELECT CONFIG* softkey opens the submenu to configure the preselection.
These settings are independent of the other operating modes.

The *OPTIONS* softkey allows the enabling of firmware options (Application Firmware Modules).

The *REFERENCE INT/EXT* and *EXTERNAL REF FREQUENCY* softkeys determine the reference to be used.

The *SERVICE* softkey provides special setup functions which, although not necessary in normal use, are useful in instrument service.

The *GENERAL SETUP* softkey opens a submenu for all the general settings such as date and time as well as the configuration of the device interfaces.

The *FIRMWARE UPDATE* softkey opens a submenu for the installation of a firmeware update.

Using Transducers

A transducer is often connected ahead of FSET both during the measurement of useful signals and EMI and converts the useful or interference variable such as field strength, current or RFI voltage into a voltage across 50 Ohm. Transducers with a frequency-independent transducer factor can be coded in 10-dB steps together with the unit at connector *PROBE CODE*. They are supplied at the same time by this connector. Transducers such as antennas, probes or current probes mostly have a frequency-dependent transducer factor which can be stored in FSET and automatically has the correct unit during level measurement.

If a transducer is switched on it is considered as part of the unit during the measurement, ie the measured values are displayed in the correct unit and magnitude. When working with two measurement windows, the transducer is always assigned to two windows.

FSET distinguishes between **transducer factor** and **transducer set**. A transducer factor takes the frequency response of a single transfer element, eg an antenna into consideration. A transducer set can summarize different transducer factors in several subranges (several transducer factors at the same time), eg an antenna, a cable and a diplexer.

A transducer factor consists of max. 50 reference values defined with frequency, transducer factor and the unit. For the measurement between frequency values linear or logarithmic interpolation of the transducer factor can be chosen.
Several factors can be compiled in a transducer set provided that all factors have the same unit or unit "dB". The frequency range covered by a set can be subdivided into max. 10 subranges (each with up to 4 transducer factors) which follow each other without a gap, ie the stop frequency of a subrange is the start frequency of the next subrange.

The transducer factors used in a subrange have to fully cover the subrange.

The definition of a transducer set is recommended if different transducers are used in the frequency range to be measured or if a cable attenuation or an amplifier has to be taken into consideration.

If a transducer set is defined during a frequency sweep, the latter can be stopped at the interface between two transducer ranges and the user is asked to exchange the transducer.
The following message informs the user that the limit has been reached:

TDS Range # reached, CONTINUE / BREAK

He can continue the sweep by confirming the message (*CONTINUE*) or he can switch off the transducer (*BREAK*).

With the automatic switchover of the transducer used, the frequency sweep is not interrupted.

Note: *Transducers cannot be used in vector analyzer mode.*

Activating Transducer Factors and Transducer Sets

The *TRANSDUCER* softkey opens a submenu in which already defined transducer factors or sets can be activated or deactivated, new transducer factors or sets can be generated or existing transducer factors or sets can be edited. Tables with the defined transducer factors and sets are displayed. The table (factor or set) in which a transducer is active is set.

By switching on the transducers all the level settings and outputs are automatically made in the unit of the transducer. A change of the unit in menu *LEVEL REF* is no longer possible as FSET together with the transducer used is regarded as a measuring instrument. Only if the transducer has the unit dB, can the original unit at FSET be maintained and changed.

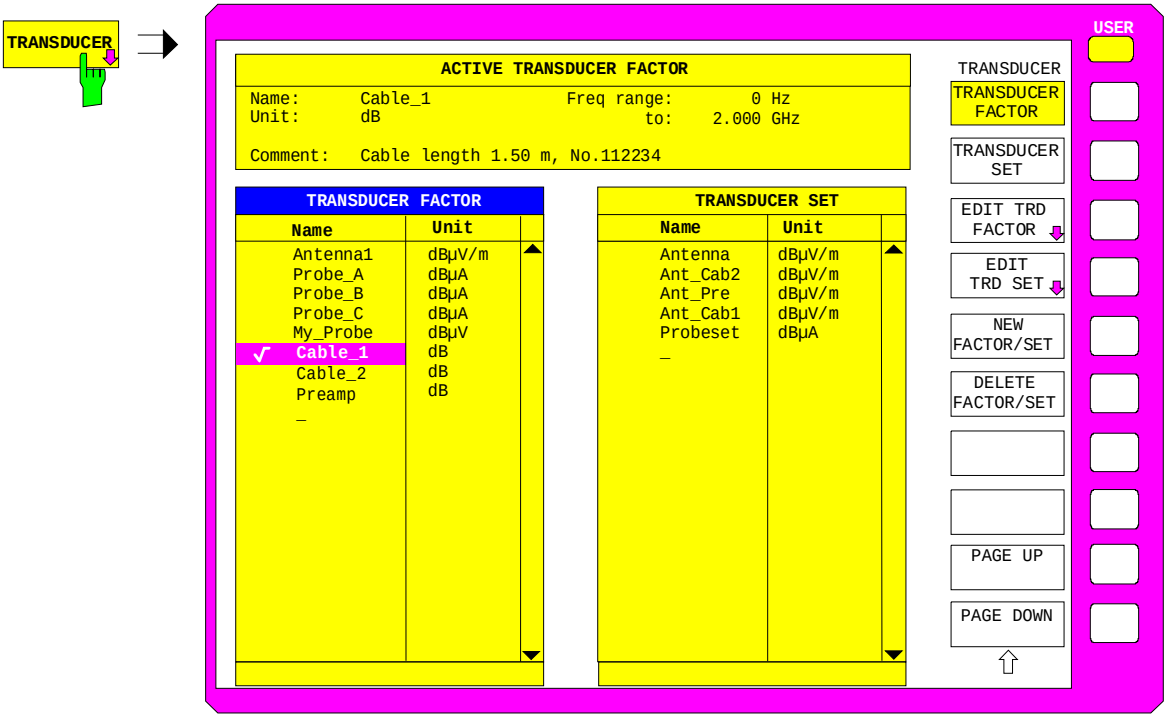
Note: *If one of the units dBµV, dBµV/m, dBµA, or dBµA/m is selected, the LEVEL REF key (see UNIT-submenu) can be used to switch to the corresponding units referred to the bandwidth, i.e. dBµV/MHz, dBµV/mMHz, dBµA/MHz, dBµA/mMH.*

If a transducer factor is active, TDF is displayed in the column of the enhancement labels and TDS if the transducer set is active.
After switching off all the transducers, FSET continues to use the unit which was selected before a transducer was switched on.

In the analyzer mode, an active transducer for a sweep is uniquely calculated for each point displayed after its setting and added to the result of the level measurement during the sweep. If the sweep range is changed, the correction values are recalculated. If several measured values are combined, only a single value is taken into consideration.

If an active transducer factor/set is not defined over the whole sweep or scan range during the measurement, the missing values are replaced by zero.

CONFIGURATION SETUP Menu



The upper table *ACTIVE TRANSDUCER FACTOR / SET* indicates the active transducer factor or the set with the associated name, frequency range and unit. If no factor or set is active, *none* is displayed in the table. Additional information can be entered in a comment line. If a transducer factor is active, the selected interpolation is displayed in addition, if a set is active, the break setting is displayed.

The left table *TRANSDUCER FACTOR* comprises all the defined factors with name and unit. If the number of defined transducer factors exceeds the number of possible lines in the table, the table will be scrolled.

The right table *TRANSDUCER SET* comprises all the defined transducer sets with the corresponding information.

Only one set or transducer can be activated. An already active transducer factor or set is switched off automatically if another one is switched on. An activated transducer factor or set is marked with a check sign.

TRANSDUCER FACTOR

The *TRANSDUCER FACTOR* softkey sets the selection bar to the position of the active transducer factor.
If no transducer factor is switched on, the bar is positioned to the first line of the table.

IEC/IEEE bus commands

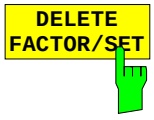
```
:[SENSe<1|2>:]CORRection:TRANsducer:SELect <name>
:[SENSe<1|2>:]CORRection:TRANsducer[:STATe] ON | OFF
```

TRANSDUCER SET

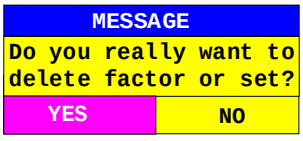
The *TRANSDUCER SET* softkey sets the selection bar to the position of the active transducer set.
If no transducer set is switched on, the bar is set to the first line of the table.

IEC/IEEE bus commands

```
:[SENSe<1|2>:]CORRection:TSET:SELect <name>
:[SENSe<1|2>:]CORRection:TSET[:STATe] ON|OFF
```

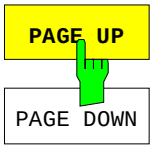


The *DELETE FACTOR/SET* softkey deletes the marked factor or set. To avoid deletion by mistake, deletion has to be confirmed.



IEC/IEEE-bus command

```
:[SENSe<1|2>:]CORRection:TRANsducer:DELete
:[SENSe<1|2>:]CORRection:TSET:DELete
```



The *PAGE UP* and *PAGE DOWN* softkeys are used to scroll in large tables which cannot fully be displayed on the screen.

New Entry and Editing of Transducer Factors

A transducer factor is characterized by

- reference values with frequency and transducer factor (*Values*)
- the unit of the transducer factor (*Unit*) and
- the name (*Name*) to distinguish between the different factors.

During the entry, FSET checks the transducer factor according to specific rules that have to be met to ensure trouble-free operation.

- The frequencies for the reference values always have to be entered in ascending order. Otherwise, the entry is not accepted and the following message is displayed:

  Frequency Sequence!

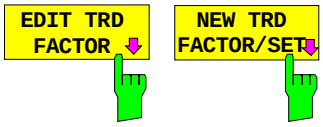
- The entered frequencies do not necessarily have to be set at FSET, as only the values for the frequency display range are considered for a set sweep or scan. The minimum frequency for a reference value is 0 Hz, the maximum frequency 200 GHz.

- The minimum or maximum value for a transducer factor is -200 dB or 200 dB. The unit "dB" means that the transducer factor is always logarithmic and has nothing to do with the physical transducer factor, which, for example, establishes the relationship between field strength and voltage into 50 Ohm. If the minimum or maximum value is exceeded, FSET signals:

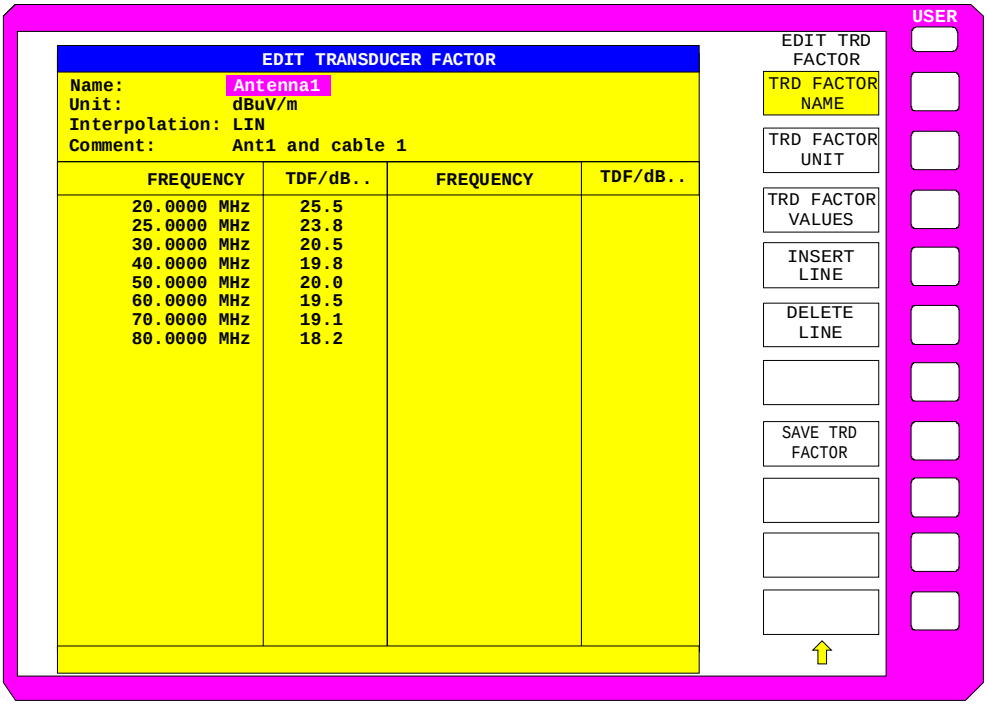
  Min Level -200 dB or
  Max Level 200 dB.

- Amplifiers have a negative transducer factor, attenuation values have to be entered as a positive transducer factor.

Note: *A unit activated by switching on the transducer has priority over a coded unit of the connected probe.*
With the exception of dB/MHz, the softkeys for the unit in the menu under key LEVEL REF are inoperative with the transducer switched on.*



The *EDIT TRD FACTOR* and *NEW FACT/SET* softkeys both open the submenu for editing and entering new transducer factors. A precondition for the *NEW FACTOR/SET* softkey is that the selection bar is located in the table when the table *TRANSDUCER FACTOR* is called up.



The table with the data of the marked factor (the *EDIT TRD FACTOR* softkey) or an empty table is displayed in which the following entries are preset (the *NEW FACTOR/SET* softkey):

Unit: dB

Interpolation: LIN for linear frequency scaling
LOG for logarithmic frequency scaling

The characteristics of the factor can be entered in the header field of the table, the frequency and the transducer factor in the columns of the table.

Name Entry of the name

Unit Selection of unit

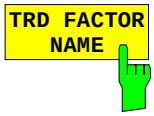
Interpolation Selection of interpolation

Comment Entry of a comment

FREQUENCY Entry of the frequency of the reference points

TDF/dB Entry of the transducer factor.

An overwritten transducer factor remains stored in the background as long as the edited factor is stored with the *SAVE TRD FACTOR* softkey or until the table is closed. A factor overwritten by mistake can be restored by leaving the entry.



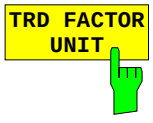
The *TRD FACTOR NAME* softkey activates the entry of the transducer factor characteristics in the header field of the table.

***Name* - Entry of name**

A maximum of 8 characters is permissible for the name. The characters have to comply with the convention of DOS file names. The unit automatically stores all transducer factors with the extension .TDS.

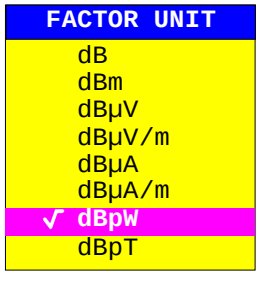
If an existing name is changed, the factor stored under the previous name is retained and will not be overwritten automatically with the new name. The previous factor can be deleted at a later time, using *DELETE FACTOR/SET*. Thus, factors can be copied.

IEC/IEEE-bus command `:[SENSe<1|2>:]CORR:TRAN:SELect <name>`



***Unit* - Selection of unit**

The unit of the transducer factor is selected from a selection box activated by the *TRD FACTOR UNIT* softkey.



The default setting is dB.

IEC/IEEE-bus command `:[SENSe<1|2>:]CORR:TRAN:UNIT <string>`

***Interpolation* - Selection of interpolation**

Linear or logarithmic interpolation can be carried out between the frequency reference points of the table. Selection is via the ENTER key which is toggled between LIN and LOG (toggle function).

The following diagrams indicate the effect of the interpolation on the calculated characteristic:

IEC/IEEE-bus command `:[SENSe<1|2>:]CORR:TRAN:SCAL LIN|LOG`

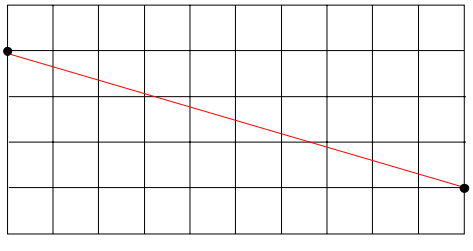


Fig. 4-1 Linear frequency axis and linear interpolation

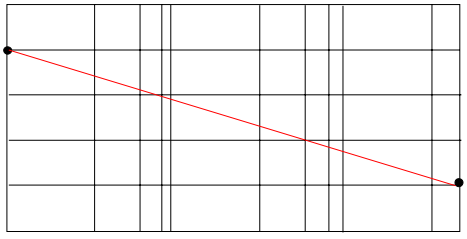


Fig. 4-2 Logarithmic frequency axis and logarithmic interpolation

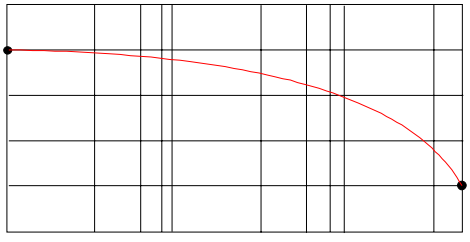
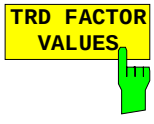


Fig. 4-3 Logarithmic frequency axis and linear interpolation

***Comment* - Entry of a comment**

The comment can be freely selected. It can have a maximum number of 50 characters.

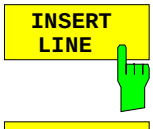
IEC/IEEE-bus command `:[SENS<1|2>:]CORR:TRAN:COMM <string>`



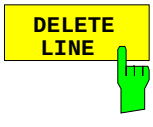
The *TRD FACTOR VALUES* softkey activates the entry for the reference values of the transducer factor.

The selection bar marks the first reference value. The desired reference values have to be entered in ascending frequency sequence.
After entering the frequency the selection bar automatically jumps to the corresponding level value. After entering the first reference value the table can be edited. The two *INSERT LINE* and *DELETE LINE* softkeys are displayed. Individual values are changed at a later time by marking the field and by entering the new value.

IEC/IEEE-bus command `:[SENS<1|2>:]CORR:TRAN:DATA <freq>,<level>`

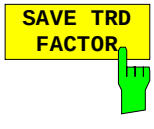


The *INSERT LINE* softkey inserts a free line above the marked reference value. When entering a new reference value into this line watch out for the ascending frequency sequence.



The *DELETE LINE* softkey deletes the marked reference value (the whole line). The following reference values move up.

IEC/IEEE-bus command - -



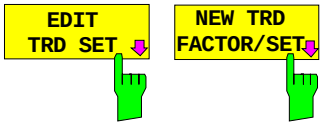
The *SAVE TRD FACTOR* softkey saves the changed table in a file on the internal hard disk.

If a transducer factor with the same name already exists, a corresponding query is performed beforehand.
If the factor to be newly saved is currently switched on, the new values will immediately be valid. If a transducer set is switched on comprising the factor, the values will only be used when the set is switched on next time.

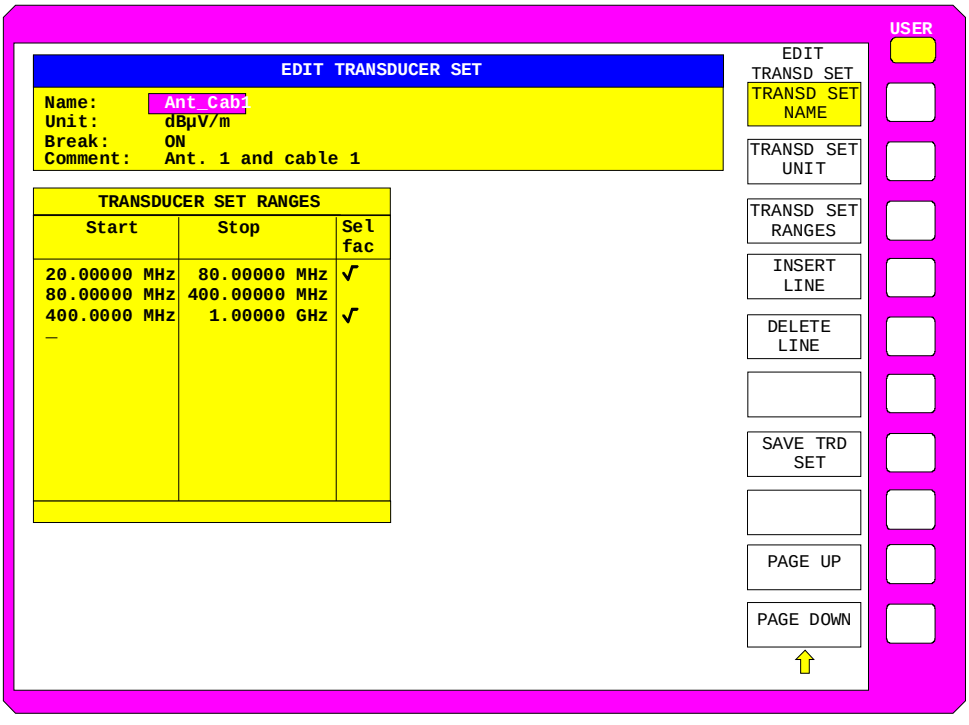
IEC/IEEE-bus command - (executed automatically)

New Entry and Editing of Transducer Sets

A transducer set is characterized by:
- maximum 10 ranges (*Ranges*) in which different transducer factors can be active
- the combination of several transducer factors per range (*Factor*)
- a transducer-set name *(Name)*



The *EDIT TRD SET* and *NEW FACTOR/SET* softkeys both open the submenu for editing and entering new transducer factors. A precondition for the *NEW FACTOR/SET* softkey is that the selection bar is located in the table *TRANSDUCER SET*.



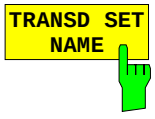
The table with the data of the marked set (the *EDIT TRD SET* softkey) or an empty table in which the following entries are preset (the *NEW FACTOR/SET* softkey) is displayed:

Unit: dB
Break: NO

The characteristics of the set can be entered in the header field of the table, the subranges in the columns of the set.

Name	Entry of the name
Unit	Selection of unit
Break	Activating the query when changing the subrange
Comment	Entry of a comment
Start	Entry of the start frequency of the subrange
Stop	Entry of the stop frequency of the subrange
Sel Fac	Selection of the transducer factors for the subrange

An overwritten transducer set remains stored in the background as long as the edited factor is stored with the *SAVE TRD SET* softkey or until the table is closed. A set overwritten by mistake can be restored by leaving the entry.



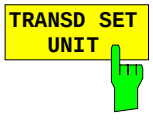
The *TRD SET NAME* softkey activates the entry of the transducer set characteristics in the header field of the table.

***Name* - Entry of name**

A maximum of 8 characters is permissible for the name. The characters have to comply with the convention of DOS file names. The unit automatically stores all transducer sets with the extension .TDS.

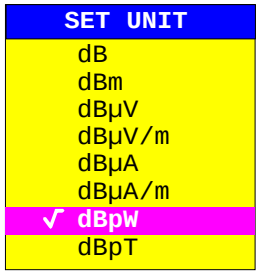
If an existing name is changed, the set stored under the previous name is retained and will not be overwritten automatically with the new name. The previous set can be deleted at a later time using *DELETE FACTOR/SET*. Thus, sets can be copied.

IEC/IEEE-bus command `:[SENSe<1|2>:]CORR:TSET:SELect <name>`



***Unit* - Selection of unit**

The unit of the transducer set is selected from a selection box activated by the *TRANSD SET UNIT* softkey.
The unit should be selected prior to the entry as it determines the settable transducer factors. The preset unit for new sets is "dB". The unit can no longer be changed when editing a set as the set of selected transducer factors will otherwise become inconsistent.



IEC/IEEE-bus command `:[SENSe<1|2>:]CORR:TSET:UNIT <string>`

***Break* - Activation of query when changing a subrange**

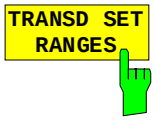
The sweep can be stopped if the user changes the subrange and selects a new subrange of the transducer. A message informs the user that the limit has been attained. He can continue the sweep or switch off the transducer.
The interruption is activated by setting Break to ON. Selection is by the ENTER key which toggles between ON and OFF (toggle function).

IEC/IEEE-bus command `:[SENSe<1|2>:]CORR:TSET:BREak ON|OFF`

***Comment* - Entry of a comment**

The comment can be freely selected. It can have a maximum number of 50 characters.

IEC/IEEE-bus command
`:[SENSe<1|2>:]CORR:TSET:COMMent <string>`



Softkey *TRANSD SET RANGES* activates the entry of subranges and the associated transducer factors. The selection bar marks the frequency values last active.

***Start* - Entry of start frequency of subrange**
***Stop* - Entry of stop frequency of subrange**

The individual subranges have to be linked without a gap. That is why the start frequency is already defined from the second subrange (= stop frequency of previous range).

After entering the first frequency value the table can be edited. The two *INSERT LINE* and *DELETE LINE* softkeys are displayed. Some values are changed at a later time by marking the field and by entering the new value. It should be noted that both the stop frequency of a particular subrange and the start frequency of the subsequent subrange are changed to the same extent.

IEC/IEEE-bus command

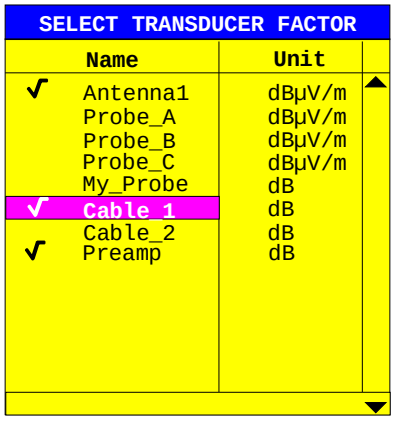
```
:[SENSe<1|2>:]CORRection:TSET:RANGe<1..10>
                                <freq>,<freq>,<name>..
```

***Sel fac*- Selection of factors for the subrange**

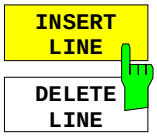
A check sign in column *Sel Fac* (select factor) indicates whether one or several transducer factors were selected for the subrange.

The permissible transducer factors for the marked subrange can be selected in a selection box. Only factors matching with the unit of the set and fully covering the selected subrange are permissible.
After each change of range limits, FSET thus checks the factor list and, if required, rebuilds it.
After reducing the start frequency or increasing the stop frequency of a range it may happen that the factors defined for this range no longer fully cover the range. These factors are deleted for this range when the transducer factor table is opened next time.

A maximum of 4 transducer factors can be switched on at the same time in each subrange. If none of them is switched on, 0 dB is assumed as a factor for the whole subrange.



IEC/IEEE-bus command - -



The *INSERT LINE* softkey inserts a free line above the marked subrange.

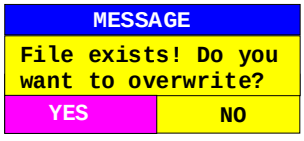
The *DELETE LINE* softkey deletes the marked subrange (whole line). The following subranges move up.

In both cases FSET checks that the ranges follow each other without a gap.

IEC/IEEE-bus command - -

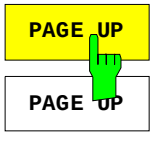


The *SAVE TRD SET* softkey saves the changed table in a file on the internal hard disk. If a transducer name with the same name already exists, a corresponding query is performed beforehand:



After pressing ENTER, the data set is overwritten on the hard disk.
If the saved set is switched on, the new values will be used immediately.

IEC/IEEE-bus command - - (executed automatically)



The *PAGE UP* and *PAGE DOWN* softkeys set the table to the next or previous page.

The softkeys are locked during selection of factors in the right table.

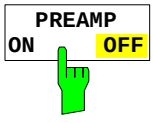
Preamplifier

With FSET equipped with the Option Preselector and Preamplifier FSET-Z.., the noise of FSET can be greatly reduced depending on the gain. The preamplifiers are located after the preselector so that the risk of overloading caused by strong out-of-band signals is minimized.

The preselector has to be activated for the preamplifier to become effective (*DIRECT MODE OFF* softkey).

For FSET7, the preamplifier can be switched between 10 dB, 20 dB and 30 dB.
For FSET22, the preamplifier can be switched between 10 dB, 20 dB and 30 dB. in the 2-GHz frequency range. With the 22-GHz frequency range selected, the preamplifier is fixed to 20 dB over the whole frequency range, ie also for frequencies below 2 GHz.
In the 22-GHz frequency range, the 20-dB preamplifiers are coupled to the preselector. Therefore, the 20-dB preamplifier gain will be switched on automatically once the preselector is activated.
The frequency range of FSET22 is selected in menu *CONFIGURATION MODE* (*FREQ RANGE 2 GHZ* and *FREQ RANGE 22 GHZ* softkeys*)*.

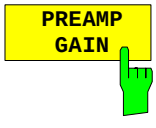
CONFIGURATION SETUP menu:



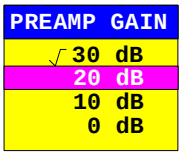
The *PREAMP ON/OFF* softkey switches the preamplifier of option FSET-Z.. on or off.

The softkey is only available, if the preselector measurement has been activated and, for FSET22, if the 2-GHz frequency range has been selected. In the 22-GHz frequency range, the 20-dB preamplifier gain is always switched on if the preselector is active.

IEC/IEEE- bus command `:INPut<1|2>:GAIN[:STATe] ON | OFF`



The *PREAMP GAIN* softkey opens a table for selecting the preamplifier gain.



The softkey is only available if the preselector measurement has been activated and, for FSET22, if the frequency range of 2 GHz has been selected.

Default value is 20 dB.

If the preset reference level cannot be set at the given RF gain, it will be adapted and a corresponding warning will be output.

IEC/IEEE- bus command `:INPut<1|2>:GAIN 20 dB`

Preselector

With FSET equipped with the Option Preselector and Preamplifier FSET-Z.., 10 highpass filters (HP) and 7 lowpass filters (LP) are available in the frequency range from 100 Hz to 40 MHz which can be configured to form bandpass filters.
In the frequency range from 40 MHz to 2 GHz, narrowband suboctave filters, normal filters or a broadband path can be selected with 10 bandpass filters.
The frequency range from 2 GHz to 22 GHz (22-GHz model only) is subdivided into 4 fixed subranges with bandpass characteristic.

Below 40 MHz, the filters are switched by means of relays, from 40 MHz to 2 GHz by means of microwave attenuator switches and above this range by means of coaxial switches.

The configuration of the preselector is via preselector sets. In these files, the required filters can be assigned to the individual frequency ranges. The frequency range of the direct path is 100 Hz to 7 GHz (2-GHz model) or 100 Hz to 22 GHz (22-GHz model).

A direct path bypasses the preselector and the preamplifier.

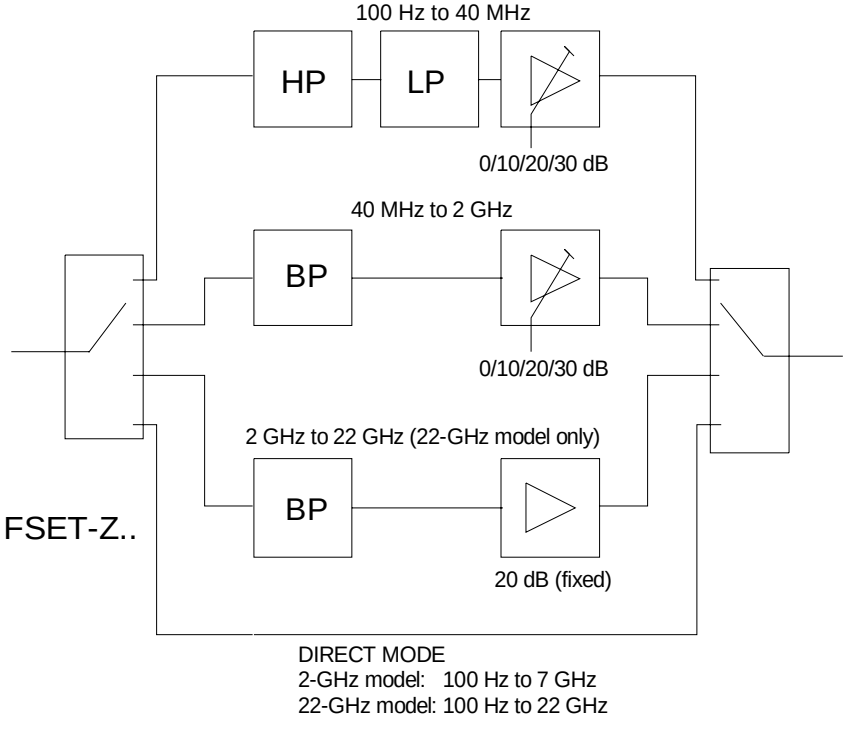
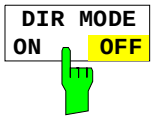


Fig. 4-4 Option Preselector and Preamplifier FSET-Z..

CONFIGURATION SETUP menu



The *DIRECT MODE ON/OFF* softkey switches over between the direct mode and the preselector. The softkey is only available if the FSET is equipped with Option Preselector and Preamplifier FSET-Z...

ON The direct path is selected, all preselector filters and amplifiers are bypassed. The input signal is directly switched to the RF input of the FSET basic unit via the attenuator.

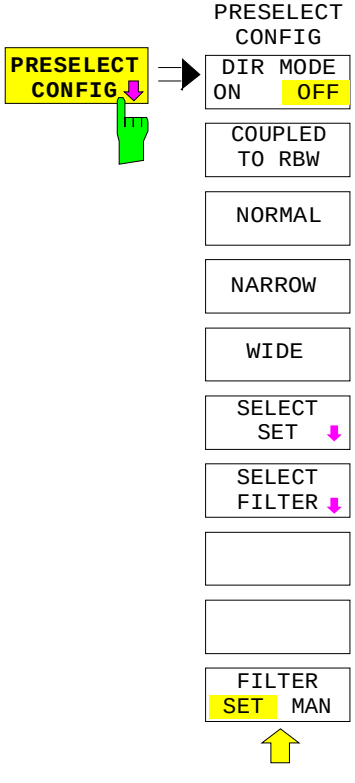
OFF The preselector is switched on. The predefined preselector set is used.
For FSET7 and FSET22 in the 2-GHz frequency range, the preamplifier gain can be switched on and selected by means of the *PREAMP ON/OFF* and *PREAMP GAIN* softkeys.
In the 22-GHz frequency range, the 20-dB preamplifier gain is automatically activated (22-GHz model only).

IEC/IEEE- bus command

```
:INPut<1|2>:PRESelection[:STATe] ON | OFF
```

Selection of Preselector Set

CONFIGURATION SETUP menu

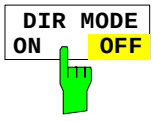


The *PRESELECT CONFIG* softkey opens a submenu in which a user-specific configuration of the preselector is possible.

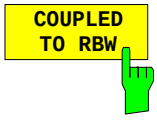
Predefined preselector sets can be selected or user-defined sets with freely selectable filter combinations can be created and saved (max. 20).

The *COUPLED TO RBW, NORMAL, NARROW* and *WIDE* softkeys are selection switches of which only one can be active.

The selection of a standard or user-defined preselector set or the selection of the direct setting using the *SELECT FILTER* softkey automatically activates the preselector (ie sets the *DIRECT MODE* softkey to *OFF*)-



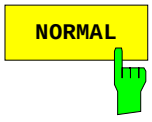
See previous section



The *COUPLED TO RBW* softkey couples the preselector set to the resolution bandwidth, ie different preselector sets are activated depending on the set bandwidth RBW. This coupling can be configured in the *SELECT SET* submenu.

IEC/IEEE- bus command

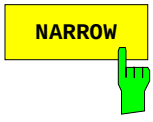
```
:INPut<1|2>:PRESelection:COUPling ON | OFF
```



The *NORMAL* softkey selects a set of preselector filters of medium bandwidth. The set is described in section "Standard Preselector Sets".

IEC/IEEE- bus command

```
:INPut<1|2>:PRESelection:SET 'NORMAL'
```

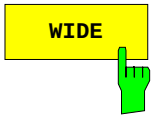


The *NARROW* softkey selects the preselector set with the narrowest band.

In the frequency range from 100 Hz to 40 MHz, bandpass filters are configured with the highpass and lowpass filters, in the medium frequency range from 40 MHz to 2 GHz, suboctave filters are used, if possible and in the upper range from 2 GHz to 22 GHz , 4 bandpass filters.
The set is described in section "Standard Preselector Sets".

IEC/IEEE- bus command

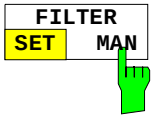
```
:INPut<1|2>:PRESelection:SET 'NARROW'
```



The *WIDE* softkey selects the broadband preselector set from the 3 ranges 100 Hz to 40 MHz, 40 MHz to 2 GHz and (22-GHz model only) the 4 bandpass filters in the range from 2 GHz to 22 GHz.
The set is described in Section "Standard Preselector Sets".

IEC/IEEE- bus command

```
:INPut<1|2>:PRESelection:SET 'WIDE'
```



The *FILTER SET/MAN* softkey switches between the selection of the filter via a preselector set (SET) in the *SELECT SET* submenu (see section "Selection of Preselector Set") and a direct selection of the filters (MAN) in the *SELECT FILTER* submenu (see section "Direct Selection of Filters").

IEC/IEEE- bus command

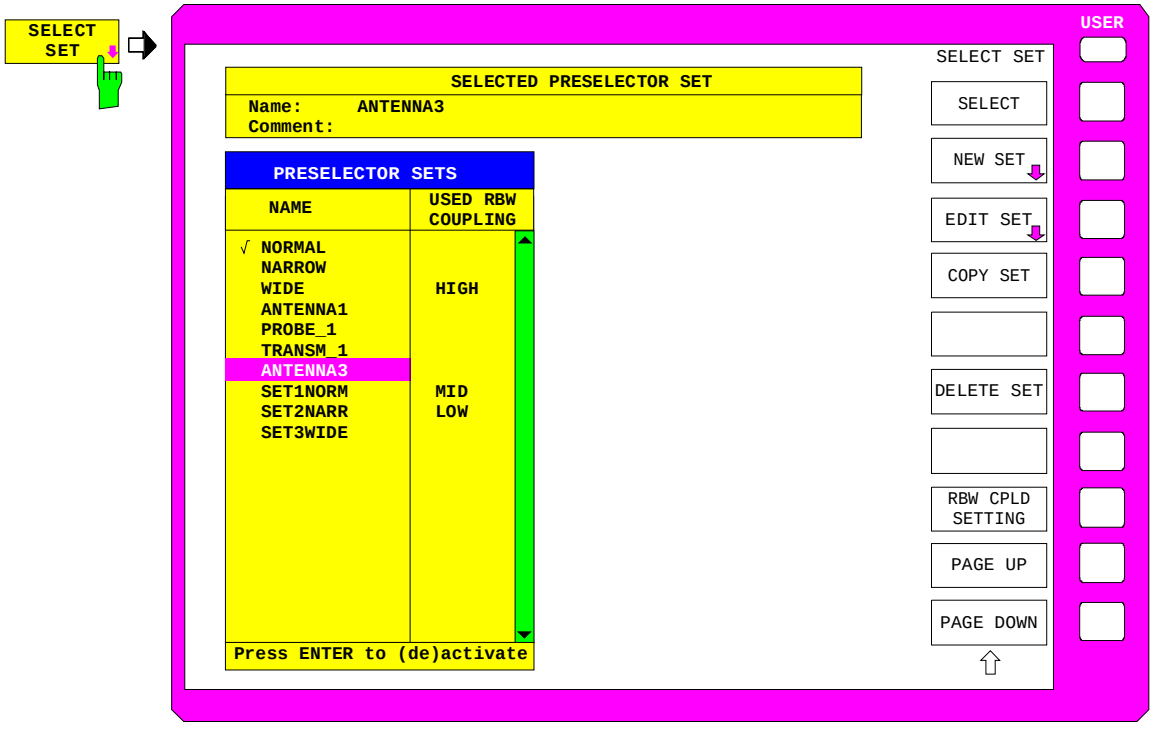
```
:INPut<1|2>:PRESelection:FILTer[:STATe] ON | OFF
```

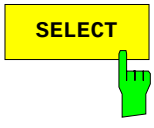
Display and Selection of Preselector Sets

The *SELECT SET* softkey opens a submenu in which user-specific preselector sets can be defined, available sets viewed in detail and changed, if required, and in which the coupling to the resolution filters *COUPLED TO RBW* can be configured.

The defined and saved preselector sets (maximum 20) as well as the standard sets are displayed in a list. If the user has not generated any set, only the standard sets will be displayed.
Only one set is active (check sign). If no set is active when leaving the submenu, the preselector is automatically switched off (softkey).

The sets marked with LOW, MID or HIGH in the USED RWB COUPLING coupling are used when the preselector is coupled to the resolution bandwidth (softkey *COUPLED TO RBW*). In this case, the selection bandwidth automatically controls the selection of sets.
CONFIGURATION SETUP - PRESELECT CONFIG menu





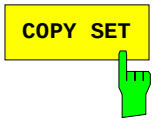
The *SELECT* softkey activates the table *PRESELECTOR SETS* and sets the selection bar to the column *NAME*.
The table *SELECTED PRESELECTOR SET* indicates the name and comment of the marked set.

A marked preselector set is switched on by pressing the ENTER key (ie one of the unit keys) and is then marked with a check sign √.

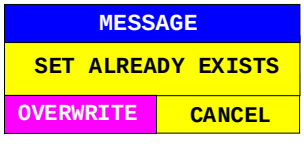
Note:
With the coupling of the preselector to the resolution bandwidth activated (COUPLED TO RBW active), switching on the preselector set in the SELECT SET menu switches off the bandwidth coupling.

IEC/IEEE- bus command

```
:INPut<1|2>:PRESelection:USET[:SELect] 'name'
```



The *COPY SET* softkey copies the data set of the marked preselector set and saves it under a new name.
It is thus very easy to generate a new set from an already existing set. The name of the new set is entered into the data input field and can have a maximum of 8 characters.
If a preselector set with the same name is already saved on the hard disk, the following message will be displayed:



With OVERWRITE selected, the existing preselector set is overwritten. With CANCEL selected, storage can be cancelled and repeated after changing the name.

IEC/IEEE- bus command --



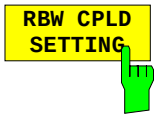
The *DELETE SET* softkey deletes a marked set. The following query is displayed prior to deletion:

MESSAGE	
Delete Set?	
YES	NO

Note:
The predefined sets NORMAL, NARROW and WIDE as well as the sets used for coupling to the resolution bandwidth (COUPLED TO RBW active) cannot be deleted.

IEC/IEEE- bus command

```
:INPut<1|2>:PRESelection:USET[:SELect] 'name'
:INPut<1|2>:PRESelection:USET:CLEar
```



The *RBW CPLD SETTING* softkey activates the table *RBW COUPLED SETTING* displaying the preselector sets used for the coupling to the resolution bandwidth (*COUPLED TO RBW* active).

RBW COUPLED SETTING		
	RBW	SET NAME
LOW ≤	2 MHz	SET1NARR
MID		SET2NORM
HIGH ≥	50 MHz	WIDE

IEC/IEEE- bus command

```
:INPut<1|2>:PRESelection:COUPling:LOW:FREQuency
:INPut<1|2>:PRESelection:COUPling:LOW:SET ‘set_name’
:INPut<1|2>:PRESelection:COUPling:MID:SET ‘set_name’
:INPut<1|2>:PRESelection:COUPling:HIGH:FREQuency
:INPut<1|2>:PRESelection:COUPling:HIGH:SET ‘set_name’
```

The range limit (column RBW) and a preselector set (column SET NAME) can be assigned to the 3 subranges LOW, MID and HIGH of the resolution bandwidths.

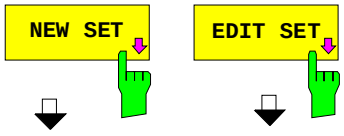
Line *LOW* contains the entries for the range of low resolution bandwidths (band limit ≤2 MHz and set NARR_BSI). Line MID contains the entries for the range of medium resolution bandwidths (Set NORM_BSI; the range limits are defined according to the entries for LOW and HIGH)
Line *HIGH* contains the entries for the range of high resolution bandwidths (range limit ≥50 MHz and Set WIDE).

The use of a preselector set for resolution filter ranges *LOW*, *MID* or *HIGH* is displayed in table *PRESELECTOR SETS* in column *USED RBW COUPLING*.

When entering the range limits the next possible value is rounded up to. If an RBW field is not filled, it will be filled with some value during the consistency check.
The list of defined sets is offered for selecting the corresponding preselector sets.

Generating and Editing a Preselector Set

CONFIGURATION MODE - PRESELECT CONFIG menu

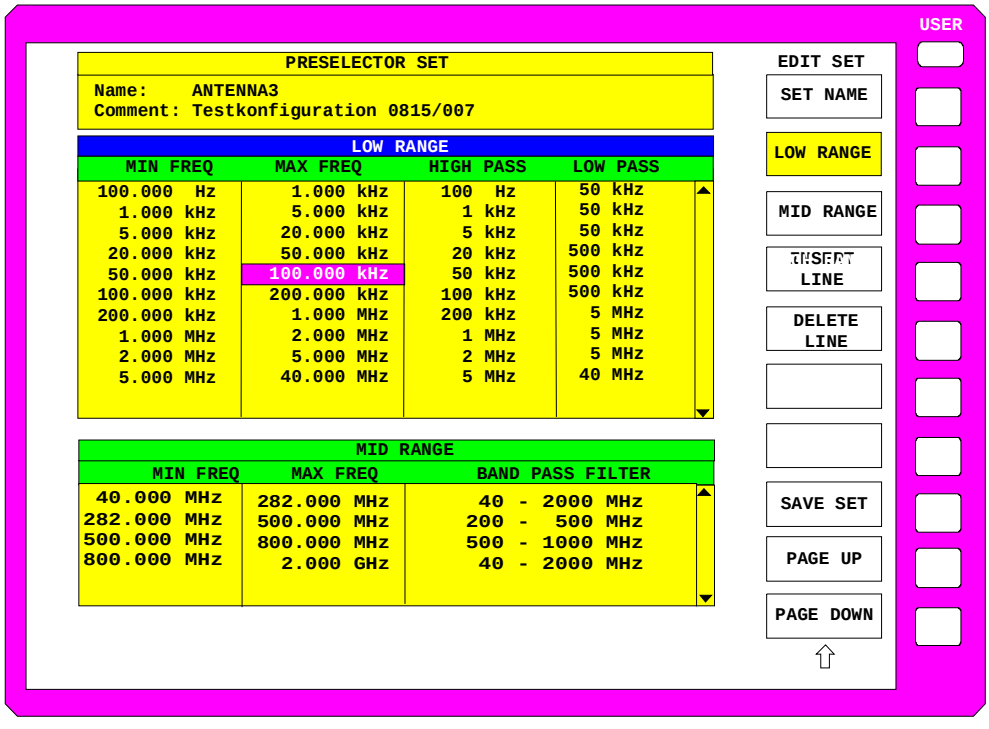


The *NEW SET* and *EDIT SET* softkeys open a submenu for editing the selected preselector set for generating a new set.

The predefined sets NORMAL, NARROW and WIDE can only be displayed but not changed.

In table *PRESELECTOR SET* the name and a comment can be entered.
In tables LOW RANGE and MID RANGE the frequency range from 100 Hz to 2 GHz can be divided in a maximum of 20 subranges (columns MIN FREQ and MAX FREQ).
The frequency range above 2 GHz cannot be configured.

For each subrange, it is possible to select a highpass, lowpass or bandpass filter (columns HIGH PASS, LOW PASS and BAND PASS FILTER).



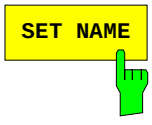


If the edit menu is quit after changing the preselector set (eg using *MENU UP*), a query of whether the changed set is to be saved or not is displayed.



With *SAVE* selected, the previous data set is overwritten, with *CANCEL* selected, the previous data set remains unchanged.

Note:
When the data set is saved, it is checked for consistency. For further details regarding checking and the corresponding error messages and notes see SAVE SET.



The *SET NAME* softkey activates the entry of the preselector set name.

Name - entry of name

A maximum of 8 characters is permissible. These characters have to conform to the MS-DOS file name conventions. The unit automatically *saves* all the preselector sets with the extension '.SEL'.

IEC/IEEE- bus command

```
:INPut<1|2>:PRESelection:USET:NAME 'name'
```

Comment - entry of comment

Any comment with a maximum of 40 characters can be entered for each preselector set in the comment line.

IEC/IEEE- bus command

```
:INPut<1|2>:PRESelection:USET:COMMent 'comment'
```



The *LOW RANGE* and *MID RANGE* softkeys activate the associated table used for editing. LOW RANGE covers the lower frequency range from 100 Hz to 40 MHz, MID RANGE from 40 MHz to 2 GHz.

IEC/IEEE- bus command

```
:INPut<1|2>:PRESelection:USET:LRANge[:DATA]  <num>, num>
:INPut<1|2>:PRESelection:USET:MRANge[:DATA]  <num>, num>
```

***MIN FREQ* and *MAX FREQ* - entry of subranges**

A maximum of 20 subranges can be defined.

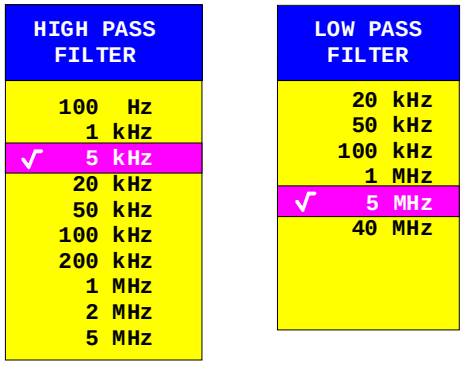
The permissible setting range is defined as:
MIN FREQ ≤ setting frequency < MAX FREQ

Exception: The frequency of 22 GHz (22 GHz model only) is contained in the last subrange (MAX FREQ 22GHz).

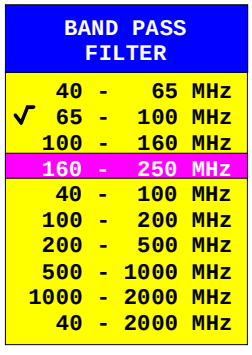
***HIGH/LOW PASS* and *BAND PASS FILTER* - selection of filters**

The following filters can be selected depending on the frequency range:

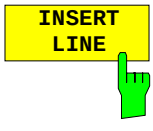
Range 100 Hz to 40 MHz:



Range 40 MHz to 2 GHz:

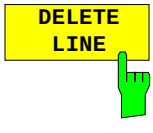


Range 2 GHz to 22 GHz (22-GHz model):
In the range above 2 GHz, the preselector cannot be configured.



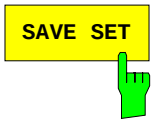
The *INSERT LINE* softkey inserts a blank line in front of the current cursor position.

IEC/IEEE- bus command - -



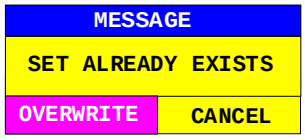
The *DELETE LINE* softkey deletes the line in which the cursor is currently positioned.

IEC/IEEE- bus command - -



The *SAVE SET* softkey saves the preselector set.

If the preselector set to be saved already exists, the following message is displayed:



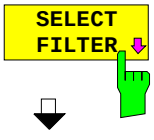
With *OVERWRITE* selected, the existing file is overwritten. With *CANCEL* selected, the name of the set can be changed and saved again or storage be cancelled. For the latter, the changes to the preselector set are lost.

A faulty preselector set cannot be saved. A consistency check is performed prior to saving the set on hard disk. For a detailed description of the tests and the associated error messages see next section.

IEC/IEEE- bus command - -

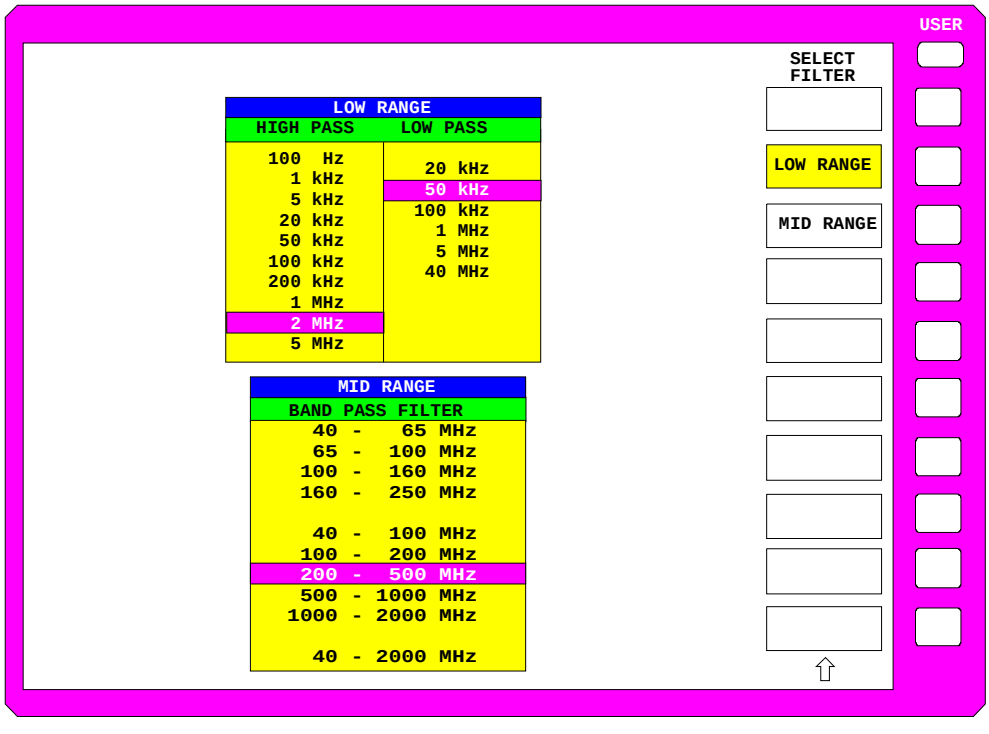
Direct Selection of Preselector Filters

CONFIGURATION MODE - PRESELECT CONFIG menu



The *SELECT FILTER* softkey opens the submenu for directly selecting preselector filters.
In tables *LOW RANGE* and *MID RANGE* the highpass and lowpass filters can be selected for the low and medium preselector range.

For each subrange it is possible to select a highpass, lowpass or bandpass filter (columns HIGH PASS, LOW PASS and BAND PASS FILTER).



LOW RANGE

MID RANGE

The *LOW RANGE* and *MID RANGE* softkeys activate the associated table used for editing. *LOW RANGE* covers the lower frequency range from 100 Hz to 40 MHz, *MID RANGE* the medium frequency range from 40 MHz to 2 GHz.

IEC/IEEE- bus command

```
:INPut<1|2>:PRESelection::FILTer:LPASs[:FREQuency] <num>
:INPut<1|2>:PRESelection::FILTer:HPASs[:FREQuency]  <num
:INPut<1|2>:PRESelection::FILTer:BPASs[:FREQuency] <num>
```

The following tables can be selected in the columns HIGH PASS FILTER, LOW PASS FILTER of the table LOW RANGE and BAND PASS FILTER of the table MID RANGE:

Range 100 Hz to 40 MHz:

HIGH PASS	LOW PASS
100 Hz	20 kHz
1 kHz	50 kHz
√ 5 kHz	100 kHz
20 kHz	1 MHz
50 kHz	√ 5 MHz
100 kHz	40 MHz
200 kHz	
1 MHz	
2 MHz	
5 MHz	

Range 40 MHz to 2 GHz:

BAND PASS
40 - 65 MHz
√ 65 - 100 MHz
100 - 160 MHz
160 - 250 MHz
40 - 100 MHz
100 - 200 MHz
200 - 500 MHz
500 - 1000 MHz
1000 - 2000 MHz
40 - 2000 MHz

Range 2 GHz to 22 GHz (22-GHz model):
In the range above 2 GHz, the preselector cannot be configured.

Error Messages During Consistency Check for Preselector Sets

Preselector sets can only be saved if the data sets are consistent. To be independent of the order of editing a preselector, a consistency check is performed when the changed data set is saved. This allows fast editing of the sets since intermediate checks are omitted.

The following list comprises the rules for editing preselector sets.

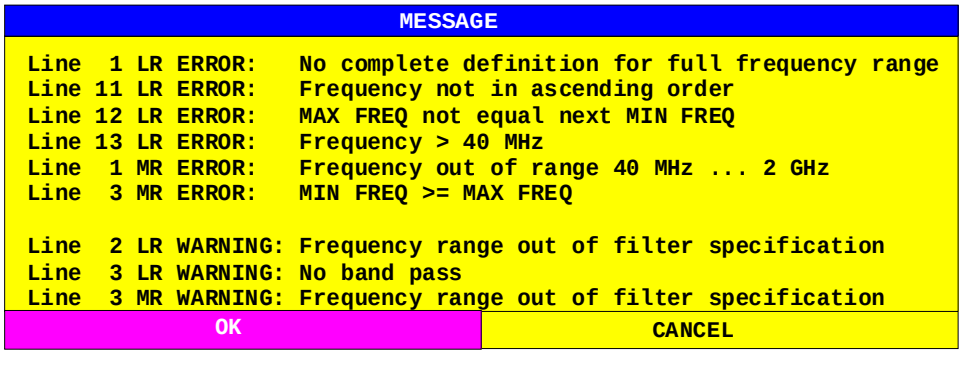
Error conditions:

- The frequency range from 100 Hz to 2/22 GHz has to be defined completely.
  Message: '**Error: No complete definition for full frequency range**'
- The subranges have to be defined in ascending order.
  Message: '**Error: Frequency not in ascending order**'
- The maximum frequency of a subrange (*MAX FREQ*) has to correspond to the minimum frequency of the following subrange (*MIN FREQ*).
  Message: '**Error: MAX FREQ not equal next MIN FREQ**'
- In the frequency range *LOW RANGE* only frequencies in the range
  0 ≤ MIN FREQ, MAX FREQ ≤ 40 MHz are allowed.
  Message: '**Error: Frequency > 40 MHz**'
- In the frequency range *MED RANGE* only frequencies in the range
  40 MHz ≤ MIN FREQ, MAX FREQ ≤ 2 GHz are allowed.
  Message: '**Error: Frequency out of range 40 MHz ... 2 GHz**'
- *MIN FREQ* always < *MAX FREQ*
  Message: '**Error: MIN FREQ >= MAX FREQ**'

Warnings:

- Filters are used outside the specified frequency range:
  MIN FREQ < Cutoff frequency of highpass filter and < lower cutoff frequency of bandpass filter and/or
  MAX FREQ > Cutoff frequency of lowpass filter and > lower cutoff frequency of bandpass filter
  Message: '**Warning: Frequency range out of filter specification**'
- In the frequency range LOW RANGE the cutoff frequency of the highpass filter should be less than the cutoff frequency of the lowpass filter (otherwise no bandpass filter)
  Message: '**Warning: No band pass**'

Errors and warnings are displayed in a table with errors being output first. The errors have to be eliminated prior to saving the preselector set. Warnings only serve for information and can be ignored.



The table indicates for any line:
Line number
Range: Low Range LR, Mid Range MR
Result type ERROR or WARNING
Description of error or warning

The displayed errors have to be eliminated. After confirmation with *OK* the preselector set is saved provided that no errors have occurred. In this case, the warnings are ignored. *CANCEL* returns to the edit mode irrespective of whether errors or only warnings were displayed. With *CANCEL* selected, no storage will take place.

Standard Preselector Sets

The standard preselector sets are suitable for a large number of applications. They can also be used as a sample for newly created sets. The sets NARROW, NORMAL, WIDE, which are sorted according to increasing bandwidths, are available. They have the characteristics listed in the table:

NARROW: Narrowband filters
B / f_m = 0.45 in the medium suboctave filter or f_{min} =0.65 x f_{max}

LOW RANGE			
Min Freq	Max Freq	High Pass	Low Pass
0.000 Hz	1.000 kHz	100 Hz	20 kHz
1.000 kHz	5.000 kHz	1 kHz	20 kHz
5.000 kHz	20.000 kHz	5 kHz	20 kHz
20.000 kHz	50.000 kHz	20 kHz	50 kHz
50.000 kHz	100.000 kHz	50 kHz	100 kHz
100.000 kHz	200.000 kHz	100 kHz	500 kHz
200.000 kHz	1.000 MHz	200 kHz	1 MHz
1.000 MHz	2.000 MHz	1 MHz	5 MHz
2.000 MHz	5.000 MHz	2 MHz	5 MHz
5.000 MHz	40.000 MHz	5 MHz	40 MHz

MID RANGE		
Min Freq	Max Freq	Band Pass Filter
40.000 MHz	65.000 MHz	40 MHz - 65 MHz
65.000 MHz	100.000 MHz	65 MHz - 100 MHz
100.000 MHz	160.000 MHz	100 MHz - 160 MHz
160.000 MHz	250.000 MHz	160 MHz - 250 MHz
250.000 MHz	500.000 MHz	200 MHz - 500 MHz
500.000 MHz	1.000 GHz	500 MHz - 1 GHz
1.000 GHz	2.000 GHz	1 GHz - 2 GHz

NORMAL: Broadband Filter; B / f_m = 0.75 in the medium range

Low Range			
Min Freq	Max Freq	High Pass	Low Pass
0.000 Hz	10.000 kHz	100 Hz	20 kHz
10.000 kHz	400.000 kHz	5 kHz	500 kHz
400.000 kHz	4.000 MHz	200 kHz	5 MHz
4.000 MHz	40.000 MHz	2 MHz	40 MHz

Mid Range		
Min Freq	Max Freq	Band Pass Filter
40.000 MHz	100.000 MHz	40 MHz - 100 MHz
100.000 MHz	200.000 MHz	100 MHz - 200 MHz
200.000 MHz	500.000 MHz	200 MHz - 500 MHz
500.000 MHz	1.000 GHz	500 MHz - 1 GHz
1.000 GHz	2.000 GHz	1 GHz - 2 GHz

WIDE: Full ranges

Low Range			
Min Freq	Max Freq	High Pass	Low Pass
0.000 Hz	40.000 MHz	100 Hz	40 MHz

Mid Range		
Min Freq	Max Freq	Band Pass Filter
40.000 MHz	2.000 GHz	40 MHz - 2 GHz

User-Specific Preselector Sets

User-specific sets can be generated in a similar way as standard preselector sets. In this case, some requirements have to be met which are checked by the software. Basically, any setup is accepted, even if it is nonsensical.

SET1NARR for RBW <= 2 MHz

LOW RANGE			
Min Freq	Max Freq	High Pass	Low Pass
0.000 Hz	1.000 kHz	100 Hz	20 kHz
5.000 MHz	40.000 MHz	5 MHz	40 MHz

MID RANGE		
Min Freq	Max Freq	Band Pass Filter
40.000 MHz	65.000 MHz	40 MHz - 65 MHz
65.000 MHz	100.000 MHz	65 MHz - 100 MHz
100.000 MHz	160.000 MHz	100 MHz - 160 MHz
160.000 MHz	250.000 MHz	160 MHz - 250 MHz
250.000 MHz	500.000 MHz	200 MHz - 500 MHz
500.000 MHz	1.000 GHz	500 MHz - 1 GHz
1.000 GHz	2.000 GHz	1 GHz - 2 GHz

SET1NORM for RBW 5 to 20 MHz

Low Range			
Min Freq	Max Freq	High Pass	Low Pass
0.000 Hz	40.000 MHz	100 Hz	40 MHz

Mid Range		
Min Freq	Max Freq	Band Pass Filter
40.000 MHz	100.000 MHz	40 MHz - 100 MHz
100.000 MHz	200.000 MHz	100 MHz - 200 MHz
200.000 MHz	500.000 MHz	200 MHz - 500 MHz
500.000 MHz	1.000 GHz	500 MHz - 1 GHz
1.000 GHz	2.000 GHz	1 GHz - 2 GHz

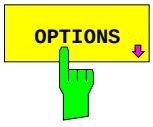
SET1WIDE = WIDE for RBW > 20 MHz

Low Range			
Min Freq	Max Freq	High Pass	Low Pass
0.000 Hz	40.000 MHz	100 Hz	40 MHz

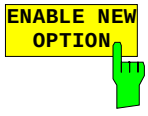
Mid Range		
Min Freq	Max Freq	Band Pass Filter
40.000 MHz	2.000 GHz	40 MHz - 2 GHz

Enabling Firmware Options

CONFIGURATION SETUP menu:



The *OPTIONS* softkey opens a submenu for entering keywords for new firmware options (Application Firmware Modules). Options which are already available are indicated in a table that is opened when the menu is called.



The *ENABLE OPTION* softkey activates the entry of a keyword for a firmware option.

One or several keywords may be specified in the entry field. When a valid keyword is entered, the message *OPTION KEY OK* appears in the info line and the option is written into the *FIRMWARE OPTIONS* table.

The *FIRMWARE OPTIONS* table can also be displayed using the *FIRMWARE OPTIONS* softkey in the *INFO* menu.

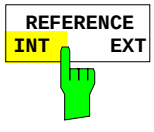
If a keyword is invalid the message *OPTION KEY INVALID* is displayed in the info line.

IEC/IEEE-bus command - -

External Reference Oscillator

In general, the FSET can generate all internal oscillators from either the internal or an external reference oscillator. A 10 MHz crystal oscillator is used as the internal reference source. A reference oscillator output is also available at the rear panel via the EXT REF IN/OUT connector.
This output can be used, e.g., to synchronize other instruments to the FSET. This connector can also be used as an input connector for application of an external frequency standard. The FSET requires that the frequency of the external standard be entered so that the internal oscillators can be synchronized to it.

CONFIGURATION SETUP Menu:



The *REFERENCE INT EXT* softkey toggles between the internal and external references.

IEC/IEEE-bus command `:[SENSe<1|2>:]ROSC:SOURce INT | EXT`



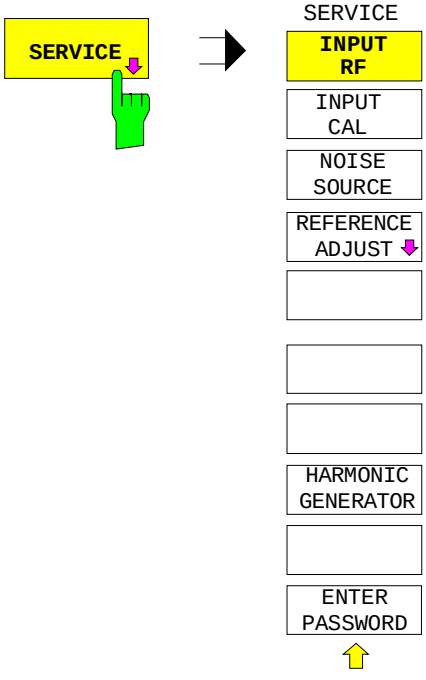
The *EXT REF FREQUENCY* softkey activates the entry of the frequency of the external source.
Range of input values is 1 MHz to 16 MHz in 1 MHz steps.

IEC/IEEE-bus command `:[SENSe<1|2>:]ROSC:EXT:FREQ 13 MHz`

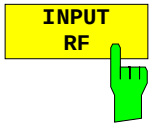
Service Functions

The service menu offers a variety of additional functions which are used for maintenance and/or trouble shooting. The service functions are not necessary for normal measurements, however, incorrect use can impair the functionality and/or data integrity of the FSET. Therefore, many of the functions can only be used after entering a password.

CONFIGURATION SETUP menu:

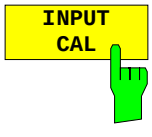


The *SERVICE* softkey calls the service submenu.



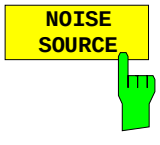
The *INPUT RF* and *INPUT CAL* softkeys are mutually exclusive selection switches. Only one switch can be activated at any one time. They switch the input to the FSET between the *INPUT RF* connector (default) and the internal calibration source (120 MHz, -40 dBm).

After *PRESET*, *RECALL* or FSET power on, the *INPUT RF* is always selected.



IEC/IEEE-bus command

```
:DIAGnostic:SERVice:INPut[:SELect] RF| CAL
```

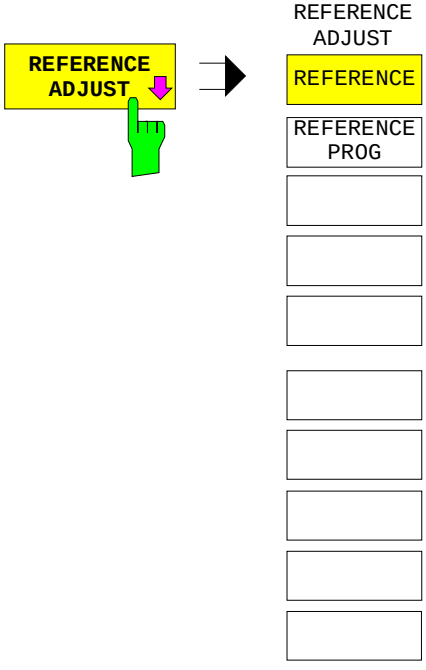


The *NOISE SOURCE* softkey switches the supply voltage for an external noise source on or off. The source is connected to the NOISE SOURCE connector on the instrument's rear panel.

The dc voltages on the connector are described in Chapter 8.

IEC/IEEE-bus command `:DIAGnostic:SERVice:NSOurce ON | OFF`

CONFIGURATION SETUP SERVICE menu:



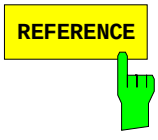
The *REFERENCE ADJUST* softkey opens a submenu used to adjust the frequency precision of the reference oscillator.
The value should be modified only after the frequency precision was checked and found to be erroneous (setting range 0 to 4095).

For more information about how to perform the adjustment of the frequency precision refer to service manual instrument (delivered with the FSET).
The modified reference value is preserved when the menu is closed.

The current adjustment value can be permanently stored in an EEPROM in the instrument.

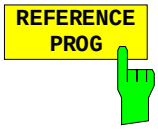
Caution: *As the specifications of the whole instrument depend directly on the setting of the reference oscillator (frequency precision), storing incorrect adjustment values should be avoided.*

Note: *If no adjustment value has been stored (REFERENCE PROG softkey) before the analyzer is switched off and on again, the factory-set value of the reference frequency or the value that has been programmed last will be used.*



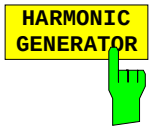
The *REFERENCE* softkey adjusts the frequency precision of the reference oscillator.

IEC/IEEE-bus command
`:[SENSe<1|2>:]ROSC:[INT:]TUNe <num_value>`

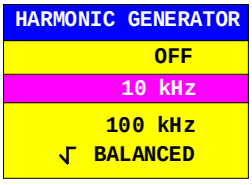


The *REFERENCE PROG* softkey stores the current adjustment value in an EEPROM in the instrument.

IEC/IEEE-bus command
`:[SENSe<1|2>:]ROSC:[INT:]TUNe:SAVe`



The *HARMONIC GENERATOR* softkey opens a selection window with the settable harmonic generators in FSET-Z...



OFF	Default setting which is always active after *PRESET*, *RECALL* or switch-on of FSET.
10 kHz	The harmonic generator generates harmonics in the frequency range from 10 kHz to 40 MHz at intervals of 10 kHz.
100 kHz	The harmonic generator generates harmonics in the frequency range from 100 kHz to 2000 MHz at intervals of 100 kHz.
BALANCED	The harmonic generator generates harmonics in the frequency range from 10 kHz to 50 kHz at intervals of 10 kHz on the BALANCED INPUT. The harmonic generator is internally switched to BALANCED-INPUT.

The harmonic generators are not level-calibrated and are only used to check the signal paths. The provide the following output levels:

Harmonic generator:	Frequency:	Level:
10 kHz (0 to 40 MHz)	10 MHz	40 dBuV
100 kHz (0 to 2 GHz)	120 MHz	30 dBuV
BALANCED (0 to 50 kHz, 10 kΩ)	30 kHz	40 dBuV

IEC/IEEE command `:DIAGnostic:SERVice:HGENerator OFF | 10KHZ | 100KHZ | BALanced`



The *ENTER PASSWORD* softkey allows the entry of a password.

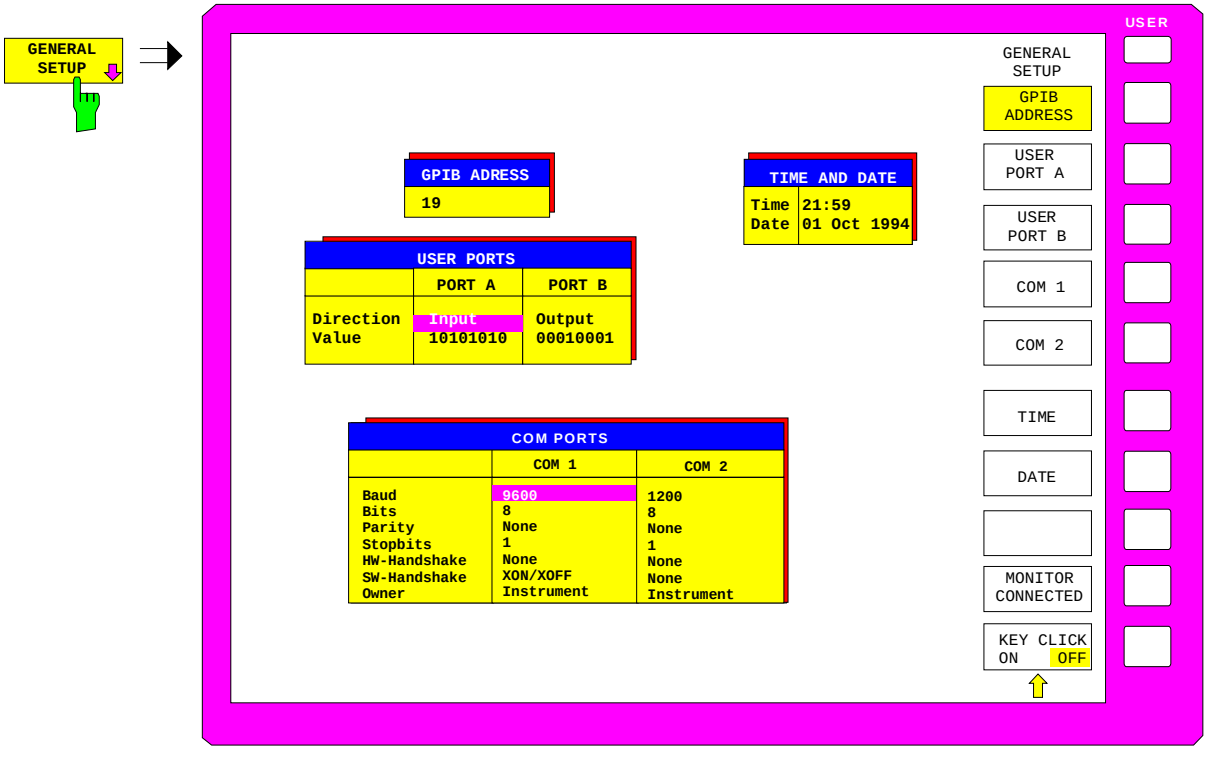
The FSET has a variety of service functions which, if incorrectly used, can impair the functionality of the instrument. These functions can only be accessed with a password (*ENTER PASSWORD).*

IEC/IEEE-bus command `:SYSTem:PASSword[:CENable] <string>`

Setting the Interface Configuration and Time

The *GENERAL SETUP* softkey opens a submenu in which the general instrument setup can be entered. The current settings are displayed as tables on the screen where they may be edited.

CONFIGURATION SETUP menu:



IEC/IEEE-Bus Address Selection

CONFIGURATION SETUP-GENERAL SETUP submenu:

GPIB ADDRESS

The *GPIB ADDRESS* softkey activates the entry of the IEC/IEEE-bus address.

The range is 0 to 31. The default setting is 20.

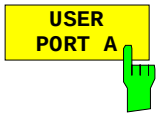
IEC/IEEE-bus command

```
:SYSTem:COMMunicate:GPIB[:SELF]:ADDRess 20
```

User Port Configuration

The instrument provides two parallel interfaces, each of which is 8 bits wide. Over these ports, arbitrary bit patterns can be output or input. The interfaces are designated *USER PORT A* and *USER PORT B*.

CONFIGURATION SETUP-GENERAL SETUP submenu:



The USER PORT A and *USER PORT B* softkeys activate the columns PORT A and PORT B, respectively, in the USERPORTS table for entry of the parameters for both of the parallel interfaces in the instrument. Because the two interfaces are configured in the same manner, how to configure an interface is described in the following using *USER PORT A*.

The following parameters need to be configured in the table:

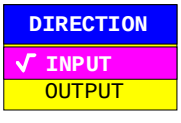
Direction	Direction of data transmission
Value	Indication/entry of current value

USERPORTS		
	PORT A	PORT B
Direction	INPUT	OUTPUT
Value	10101010	

Direction – Direction of data transmission

The *DIRECTION* parameter determines in which direction the interface transmits data.

INPUT	read operation
OUTPUT	write operation

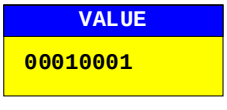


IEC/IEEE-bus command
```
:INPut<1|2>:UPORt<1|2>:STATe ON|OFF
:OUTPut<1|2>:UPORt<1|2>:STATe ON|OFF
```

Value – Indication/Entry of current value

The *VALUE* parameter shows the current value of the data at the port for data input as well as for data output. The displayed data is in binary format with the least significant bit (LSB) on the right.

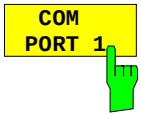
If the port is configured as an *OUTPUT* then, the displayed value can be edited. Data entry must also be in binary format (i.e., only the digits 0 and 1 are accepted).

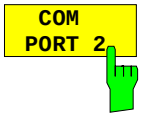


IEC/IEEE-bus command
```
:INPut<1|2>:UPORt<1|2>[:VALue]?
:OUTPut<1|2>:UPORt<1|2>[:VALue] <Binary>
```

Serial Interface Configuration

CONFIGURATION SETUP-GENERAL SETUP submenu:





The *COM PORT 1* and *COM PORT 2* softkeys activate the columns COM1 and COM2, respectively, for entry of the serial interface parameters Since the two interfaces are configured in the same manner, how to configure an interface is described in the following using *COM PORT 1*.

The following parameters must be in the table:

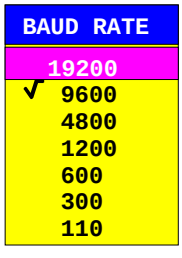
Baud rate	data transmission rate
Bits	number of data bits
Parity	bit parity check
Stop bits	number of stop bits
HW-Handshake	hardware handshake protocol
SW-Handshake	software handshake protocol
Owner	assignment of the serial port to the FSET or computer

COM PORTS		
	COM 1	COM 2
Baud	9600	1200
Bits	8	8
Parity	None	None
Stopbits	1	1
HW-Handshake	None	None
SW-Handshake	XON/XOFF	None
Owner	Instrument	Instrument

Note: *A serial interface (COM1 or COM2) cannot be used for another purpose if a mouse is connected to it.*

Baud – Data transmission rate

Allowed are the indicated values between 110 and 19200 baud. The default setting is 9600 baud.

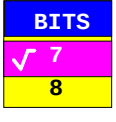


IEC/IEEE-bus command

```
:SYSTem:COMMunicate:SERial<1|2>[:RECeive]:BAUD 9600
```

Bits – Number of data bits per word

For the text transmission without special characters, 7 bits are adequate. For binary data as well as text with special characters, 8 bits must be selected (default setting).



IEC/IEEE-bus command

```
:SYSTem:COMMunicate:SERial<1|2>[:RECeive]:BITS 7 | 8
```

***Parity* – Bit parity check**

NONE no parity check (default setting)

EVEN even parity check

ODD odd parity check

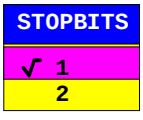


IEC/IEEE-bus command

```
:SYSTem:COMM:SERial<1|2>[:RECeive]:PARity[:TYPE]
                                        EVEN| ODD| NONE
```

***Stop bits* – Number of stop bits**

Available are 1 and 2. The default setting is 1 stop bit.



IEC/IEEE-bus command

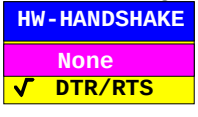
```
:SYSTem:COMMunicate:SERial<1|2>[:RECeive]:SBITs 1|2
```

***HW-Handshake* – Hardware handshake protocol**

The integrity of data transmission can be improved through the use of a hardware handshake protocol which prevents uncontrolled transmission of data and the resulting possible loss of data bytes. With the hardware handshaking procedure, 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 handshaking is, however, that the interface lines (DTR and RTS) are provided between the sender and receiver. For a simple, 3-wire connection, this is not the case and a hardware handshake cannot be realized.

Default setting is *NONE*.



IEC/IEEE-bus command

```
:SYSTem:COMM:SERial<1|2>:CONTrol:DTR IBFull|OFF
:SYSTem:COMM:SERial<1|2>:CONTrol:RTS IBFull|OFF
```

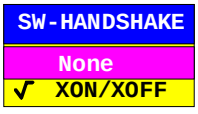
***SW-Handshake* – Software handshake protocol**

Besides the hardware handshake procedure using interface lines, it is also possible to achieve the same effect by using a software handshake protocol. In this case, 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.

Software handshaking, however, does have one limitation. 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*.



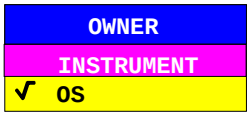
IEC/IEEE-bus command

```
:SYSTem:COMM:SERial<1|2>[:RECeive]:PACE XON|NONE
```

***Owner* – Assignment of the interface**

The serial interface can be assigned either to the instrument or the computer (operating system, OS).

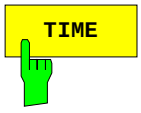
INSTRUMENT	Assignment to the instrument means that outputs to the port by the OS are not possible as any output would be lost.
OS	Assignment to the operating system means that the instrument cannot use the port, i.e. it is not possible to remote control the instrument via this port.



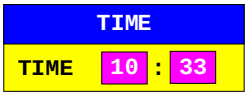
IEC/IEEE-bus command - -

Setting the Date and Time

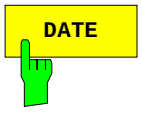
CONFIGURATION SETUP-GENERAL SETUP submenu:



The *TIME* softkey activates the entry of time for the internal real time clock. 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 `:SYSTem:TIME 0...23, 0...59, 0...59`



The *DATE* softkey activates the entry of the date of the internal real-time clock. 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 units key opens a list of abbreviations for the months.





IEC/IEEE-bus command `:SYSTem:DATE <num>,<num>,<num>`

Connecting the External Monitor

Submenu *CONFIGURATION SETUP-GENERAL SETUP*:

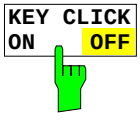


The *MONITOR CONNECTED* softkey informs the unit that an external monitor is available at PC MONITOR connector
The external monitor displays the Windows NT mask.

IEC/IEEE-bus command - -

Switching the Beeper ON/OFF

CONFIGURATION SETUP-GENERAL SETUP submenu:



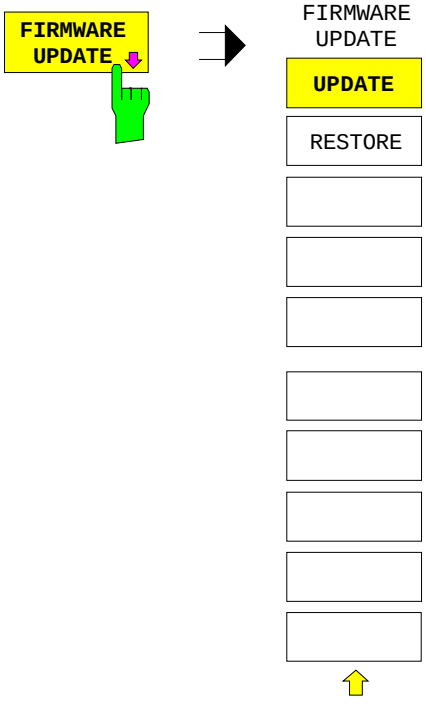
The *KEY CLICK ON/OFF* softkey switches the beeper on or off. The beeper acknowledges each key stroke with a beep.

IEC/IEEE-bus command - -

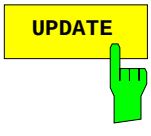
Firmware Update

New firmware versions can be installed from the integral disk drive. The firmware update kit contains several disks.
The installation program is called in the *SETUP* menu.

CONFIGURATION SETUP sidemenu:



The *FIRMWARE UPDATE* softkey opens the submenu for the installion of a new firmware version.

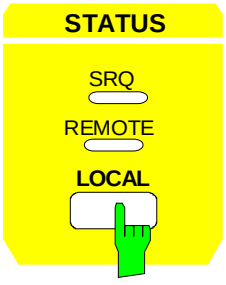


The *UPDATE* softkey starts the installation program and guides the user through the remaining steps of the update procedure.



The *RESTORE* softkey restores the previous firmware version

Status Display-Remote/Manual Control – *STATUS Key Group*



The *SRQ* LED, the *REMOTE* LED and the *LOCAL*. key are contained in the *STATUS* key group.

- The *SRQ* LED indicates that a service request from the instrument has been asserted on the IEC Bus.
- The *REMOTE* LED indicates that the instrument is under remote control.
- 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 comprises:

- **Enabling the Front Panel Keys**
  Under remote control, the softkey menu is turned off and all keys, with the exception of *PRESET* and *LOCAL*, are disabled. Returning to manual mode enables all disabled keys. The main menu of the current mode is selected as the softkey menu..
- **Turning off the *REMOTE* LED**
- **Generating the message OPERATION COMPLETE**
  If the synchronization via *OPC, *OPC? or *WAI is active when the *LOCAL* softkey is pressed, any measurement procedure that is running is aborted and synchronization 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**
  If the status reporting system is configured appropriately, setting this bit immediately elicits a service request (*SRQ*) which is used to inform the controller 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 the necessary manual corrections to instrument settings. This bit is set each time the *LOCAL* key is pressed.

- The *LOCAL* key aborts a running macro. The continuation of the macro is not possible.

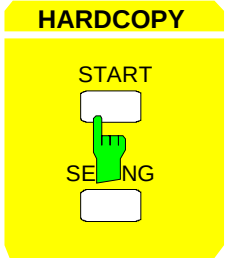
IEC/IEEE-bus command `CALL IBLOC(analyzer%)`

Measurement Documentation – *HARDCOPY* Key Group

Note: *The installation of additional printer drives is described in chapter 1, section "Installation and Configuration of Printers".*

Printing Data – *START* Key

The instrument uses the printer function of Windows NT to output hardcopies. Any printer supported by Windows NT can be used. In addition, the instrument permits data output in the usual data formats WMF, EWMF and BMP which enable hardcopies to be directly inserted into other documents. Network printers can be used if the instrument is connected to a network.



The *START* key initiates the printing of measurement/ instrument status data. The instrument can distinguish between two different printers, each of which may be individually configured, e.g., a laser printer and a ink jet printer. All documents are printed on the printer which is currently active.

IEC/IEEE-bus command `:HCOPy[:IMMediate<1|2>]`

Pressing the *HARDCOPY START* key starts the print job. The settings under Windows NT and in the *HARDCOPY SETTINGS* menu determine the printer configuration. All of the display items to be printed out are written to the printer buffer of Windows NT. Since the printer runs in the background, the instrument may be operated immediately after pressing the *START* key.

When *COPY SCREEN* is selected in menu *HARDCOPY SETTINGS*, all the measurememt diagrams with traces and status displays are printed as they appear on the screen. Softkeys, open tables and data entry fields are not printed out. Specific traces can be printed out with the *COPY TRACE* function. With *COPY TABLE,* tables can be printed out.

If *CLIPBOARD* is active in the *HARDCOPY DEVICE* submenu the clipboard can be used to directly transfer hardcopies to Windows applications. The copy is written in the clipboard by pressing *HARDCOPY START*. The user can then change to another Word document and insert the clipboard content into the document with EDIT - PASTE by using the key combination CTRL+V.

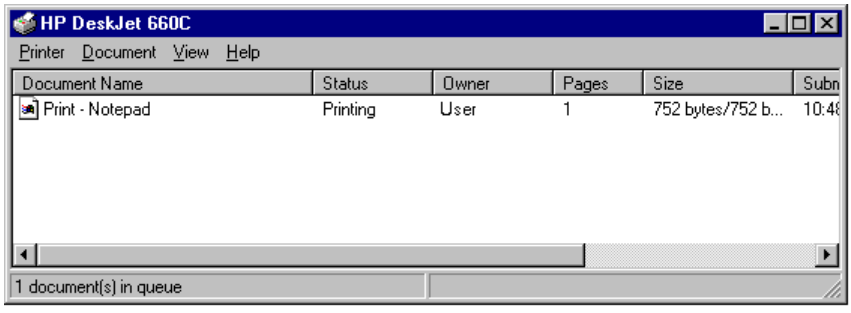
If the *PRINT TO FILE* option in the *HARDCOPY DEVICE* submenu is selected, the printout is directed to a file. When the *HARDCOPY START* is pressed , the file name to which the output data are to be written is requested.

If the *START* key is pressed while printing is in progress, a second output can be released which can also be joined to the printer queue. Any number of print jobs can be released consecutively.

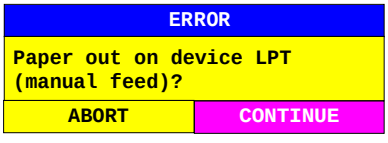
Current print jobs can be aborted only by cancelling the entries in the Windows NT printer queue. After starting the print a printer symbol is displayed in the task bar near the time indication.



A double-click on this symbol opens a window containing the entries of the printer queue. The relevant print order can be cancelled by marking it with the mouse and pressing the DEL key.



While a print job is in progress, problems may occur in the printer. If, while printing, the printer issues a PAPER OUT message, i.e., no more paper is available, the user will be prompted by the following message



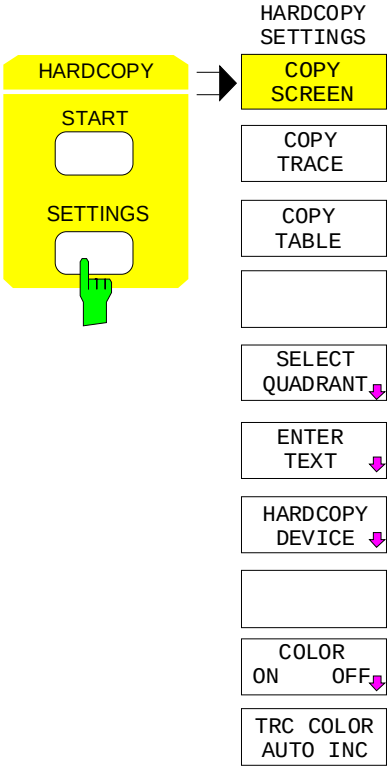
to load paper into the printer. The print job will then be either continued (CONTINUE) or aborted (ABORT).

Switchover between b/w and colored printouts is possible with the *COLOR ON/OFF* softkey provided that an appropriate printer is connected. The colors of the printout correspond exactly to those on the screen, ie a red trace will be output in red.
To change the colors of the objects on the printout, the screen colors have to be changed in *DISPLAY-CONFIG DISPLAY* menu. One exception is the color of the background and the color of the diagrams. The output background is always white irrespective of the screen color and the diagrams are always black.
If several traces are to be output one after the other on the same sheet different colors can be chosen for each trace with the *TRC COLOR AUTO INC* softkey (Trace Color Auto Increment).

On most b/w printers, a better printout of the color screen is obtained on hardcopies if the color information is converted into gray shades. For this, the color output in menu *HARDCOPY SETTINGS* is to be activated (COLOR ON).

Printing Configuration – *SETTINGS* Key

HARDCOPY SETTINGS menu:



The *SETTINGS* key opens the menu to configure the printout.

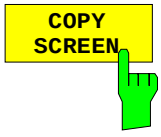
The recommended procedure for configuring the printout is as follows:

- Configure the desired printer and select the interface over which the output is to take place by using Windows NT and the *HARDCOPY DEVICE* softkey.
- Select the display items to be printed with the *COPY SCREEN*, *COPY TRACE softkeys*.
- Select between coloured and b/w printouts with the *COLOR ON/ OFF* and *TRC COLOR AUTO INC* softkeys.
- Enter comment applicable to the diagram or add a title for the overall printout by using the *ENTER TEXT* softkey.
- Select the page format (*QUADRANT, FULL PAGE*) through use of the *SELECT QUADRANT* softkey.

The *COPY SCREEN, COPY TRACE* and *COPY TABLE* softkeys are selection switches, i.e., only one function can be enabled at any one time. The push buttons are used for selection only and do not initiate a print job. The actual printing is initiated by the *HARDCOPY START* key.

Selection of Displayed Elements and Colour Settings

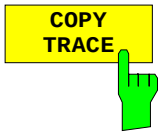
HARDCOPY SETTINGS menu:



The *COPY SCREEN* softkey selects the output of test results.

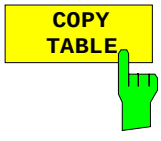
All the diagrams, traces, markers, marker lists, display lines, limit lines etc. are printed out as long as they are displayed on the screen. Softkeys, tables and open data entry fields are not printed out. However, comments, title, date, and time entered are printed out at the bottom of the printout. The logo appears at the top left of the printout.

IEC/IEEE-bus command `:HCOPy:ITEM:ALL`



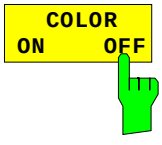
The *COPY TRACE* softkey selects the output of all traces displayed on the screen without any auxiliary information. Specifically, no markers or display lines are printed.

IEC/IEEE-bus command
`:HCOPy:ITEM:WINDow<1|2>:TRACe:STATe ON|OFF`



The *COPY TABLE* softkey selects the output of all tables visible displayed on the screen.

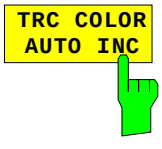
IEC/IEEE-bus command
`:HCOPy:ITEM:WINDow<1|2>:TABle:STATe ON|OFF`



The *COLOR ON/ OFF* softkey selects a coloured or b/w printout.

After having changed the printer driver or the hardcopy device (in submenu, *HARDCOPY SETTINGS*) the softkey is automatically switched to *ON*.
One exception is printer driver HP PCL4 which only supports b/w printouts. In this case, the softkey cannot be operated.

IEC/IEEE-bus command `:HCOPy:DEVice:COLor ON | OFF`



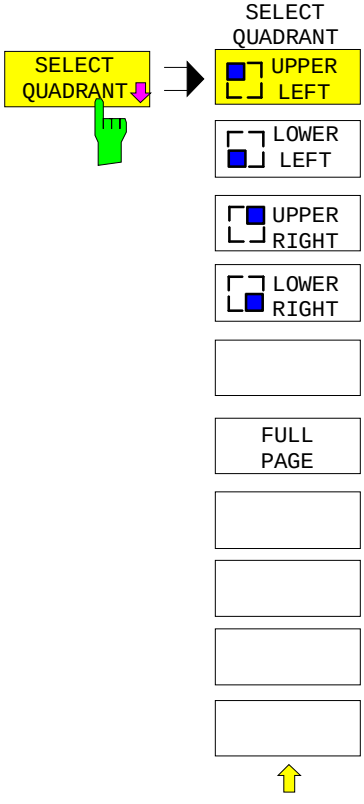
The *TRC COLOR AUTO INC* softkey automatically switches the colours of the traces on to the next printout. On the second printout, trace 1 has the colour of trace 2, trace 2 the colour of trace 3 etc. The fourth printout starts with the first colour. With the softkey switched off, the colours of the traces are reset to their original state.

When changing the printer driver or the hardcopy device (both in submenu *HARDCOPY SETTINGS*) as well as the selection b/w printout (softkey *COLOR ON/ OFF* in position *OFF*), softkey *TRC COLOR AUTO INC* is switched off.

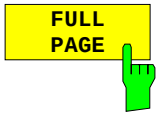
IEC/IEEE-bus command
`:HCOPy:ITEM:WINDow<1|2>:TRACe:CAINcrement ON | OFF`

Selection of Hardcopy Format

HARDCOPY SETTINGS-SELECT QUADRANT submenu:

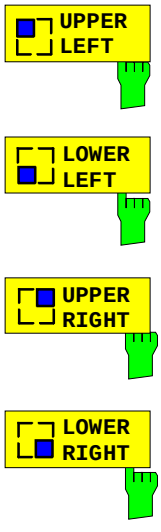


The *SELECT QUADRANT* softkey calls the the submenu for selection of *QUADRANT*the location of the display screen graphics on the printed page.



The *FULL PAGE* softkey switches quadrant printing off, i.e., printing now takes place at full size. The information as to which quadrant was last selected is also lost. *FULL PAGE* is the default setting.

IEC/IEEE-bus command `:HCOPy:PAGE:DIMensions:FULL`



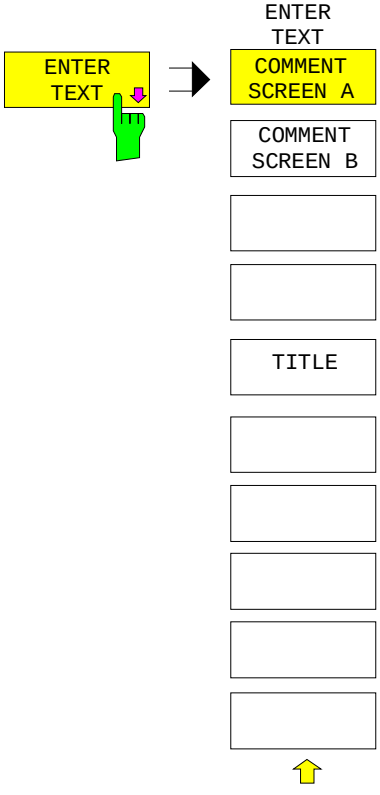
The *UPPER LEFT, LOWER LEFT* as well as *UPPER RIGHT, LOWER RIGHT* softkeys select the page quadrants where the printed data will be positioned. In this case, the actual size of the data printed on the page is reduced to 25% of normal size. This reduction is independent of how the graphics are distributed on the display screen. Thus, for two measurement windows (*SPLIT SCREEN*), both measurement diagrams shown on the display are placed in the chosen quadrant. Thus, up to a maximum of 8 measurement windows can be printed on one page. (4 print commands for a *SPLIT SCREEN* display, each to a different quadrant)

IEC/IEEE-bus command

`:HCOPy:PAGE:DIMensions:QUADrant 1|2|3|4`

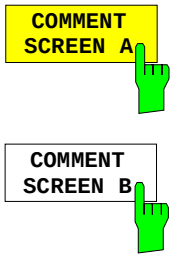
Entry of Comment Text

HARDCOPY SETTINGS-ENTER TEXT submenu:



The *ENTER TEXT* softkey calls the submenu for editing the commentary for the individual windows. The comment text appears in the print-out, but does not appear on the display screen.

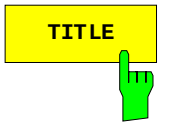
If a comment is not to appear on the printout, it has to be deleted. By pressing *PRESET,* all comments will be deleted.



The *COMMENT SCREEN A* softkey opens an entry field in which a comment of at most two lines (60 characters per line) can be entered for screen A or screen B. If the user enters more than 60 characters, the overflow 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 screen.

IEC/IEEE-bus command

```
:HCOPy:ITEM:WINDow<1|2>:TEXT    <string>
```



The *TITLE* softkey activates a single line entry box for entering a title for the complete print-out with a maximum of 60 characters.

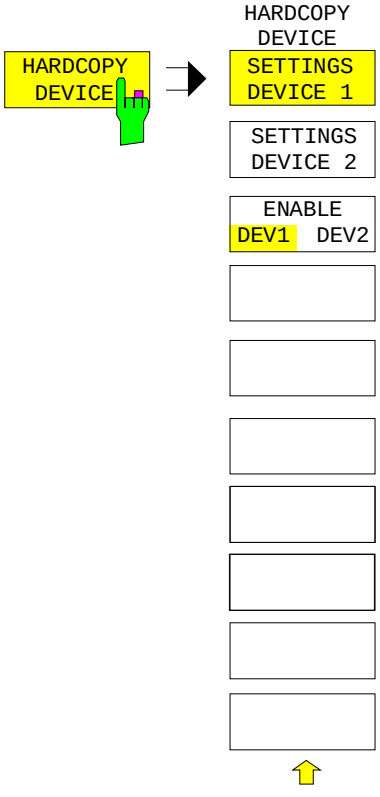
IEC/IEEE-bus command

```
:HCOPy:ITEM:LABel:TEXT    <string>
```

Selection and Configuration of the Printer

The instrument permits two different printers to be configured. One of the devices is defined as the active device and can be used for hardcopies.
The printers are mainly installed and configured under Windows NT and and the settings are valid for all Windows applications (see Chapter 1, section "Connecting an Printer"). The active device and the settings which concern only the output of hardcopies are selected in menu *HARDCOPY DEVICE.*.

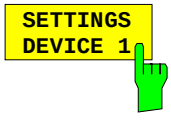
HARDCOPY SETTINGS submenu:



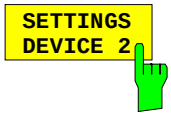
The *HARDCOPY DEVICE* softkey switches to the submenu which is used for the selection/configuration of the two printers.

When the sub-menu is called, the corresponding table is displayed. The *SETTINGS DEVICE 1* softkey is active and the selection bar is located at the *DEVICE1* line in the corresponding column of the table.

HARDCOPY DEVICE SETTINGS	
Device1	WINDOWS METAFILE
Print to File	YES
Orientation	---
Device2	CLIPBOARD
Print to File	---
Orientation	---



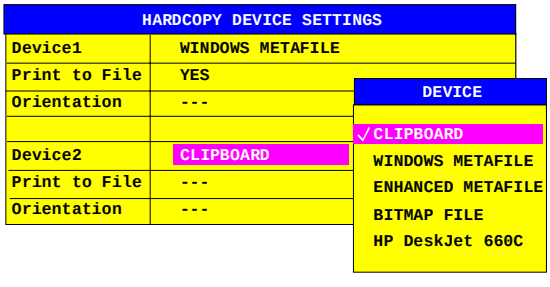
The *SETTINGS DEVICE 1* softkey permits the selection and configuration of the printer DEVICE 1. The *SETTINGS DEVICE 2* softkey is used to configure DEVICE 2.



The actual selection of the active printer takes place with the *ENABLE DEV1 DEV2* softkey in the *HARDCOPY DEVICE* sub-menu.

Device

The selection of the printer/language for DEVICE 1 and DEVICE 2 is made in this line.



Three file formats and the Windows NT clipboard are always available, even if a printer has not yet been installed under Windows NT. All installed printers are listed below in alphabetic order.
The printer installation is described in Chapter 1, Section "Installation and Configuration of Printers".

CLIPBOARD The hardcopies are copied to the Windows NT clipboard. This permits to obtain a printout of high quality which can be directly inserted into other Windows applications (menu EDIT | PASTE or key combination CTRL+V). The lines 'Print to File', 'Orientation' and 'GPIB Address' are deactivated.

WINDOWS METAFILE and ENHANCED METAFILE

WMF and EWMF are vector graphics formats which can be imported by most graphics and editing programs. EMF is recommended for recent Windows32 applications.

BITMAP FILE BMP is a bitmap format which can also be imported by most programs.

When WMF, EWMF and BMP are selected, the line "Print to File" is automatically set to ON and line "Orientation" deactivated.

IEC/IEEE-bus commands

```
:HCOPy:DEVice:LANGuage WMF|EWMF |BMP |GDI
:HCOPy:DESTination<1|2>
  "MMEM"|"SYST:COMM:PRIN"|"SYST:COMM:CLIP"
:HCOPy:ITEM:FFEed<1|2>:STATe   ON | OFF
```

Print to File

With "Print to File" ON, the printout is directed to a file. In this case the user is prompted to enter a file name on starting the printout.

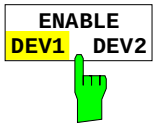
Note: *This setting is coupled to the corresponding setting under Windows NT.*

IEC/IEEE-bus commands

```
:HCOPy:DESTination<1|2> "MMEM"
:MMEMory:NAME <file_name>
```

Orientation

In this line, the print format of the output page is set to either vertical (= PORTRAIT) or horizontal (= LANDSCAPE).



The *ENABLE DEV1 / DEV2* softkey determines the active printer. The default printer is DEVICE 1, i.e., all output takes place on DEVICE 1.

IEC/IEEE-bus command `--` (The numeric suffix after `HCOPy:IMMediate` denotes the first or second device.)

Saving and Recalling Data Sets – *MEMORY* Key Group

The keys in the *MEMORY* group call the following functions:

- Functions for managing storage media (*CONFIG*). This includes among others functions listing files, formatting storage media, copying, and deleting/renaming files.
- Save/recall functions for saving (*SAVE*) settings such as instrument configurations (measurement/display settings, etc.) and saving measurement results from working memory to permanent storage media, or for recalling (*RECALL*) stored data.

The FSET can internally store complete instrument settings with instrument configurations and measurement data in the form of data-sets. The data are stored on the internal hard disk or, if if required, on an external disk. The hard-disk drive and the floppy-disk drive are assigned logical names as usual in PC applications:

Disk drive	A:
hard disk	C:

In addition to saving and recalling 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 have a different extension. A data set therefore comprises several files which have the same name but different extensions (see Table 4-2).

When saving or recallong a data set, the subsets which are to be saved or recallong can be selected in the corresponding menus. This makes it easy to recall specific instrument settings.

When saving and recalling data via the *SAVE* and *RECALL* menus, data subsets are selected in a table in the sub-menu *SEL ITEMS TO SAVE/RECALL.* The relationship between the designations in the table and the contents of the data subsets is shown in Table 4-2

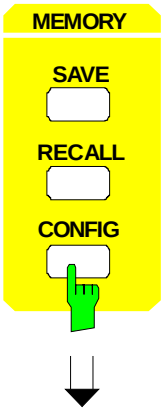
The saved data set files can be copied from one storage medium (e.g. drive C:) to another (e.g. drive A:) or to another directory using the functions found in the *MEMORY CONFIG* menu. However, do not change the file names and extensions when copying. Table 4-2 hows how extensions are assigned to data subsets..

Table 4-2 Assignment of extensions to data subsets

	Extension	**Contents**	**Designation in the table SEL ITEMS TO SAVE/RECALL**
Configuration data:	.SET	current settings of the measurement hardware and designation, if present	HARDWARE SETTINGS
	.LIN	data-point tables for the active limit lines	LINES
	.LIA	all defined limit lines	ALL LINES
	.CFG	current configuration of general instrument parameters	GENERAL SETUP
	.HCS	configuration for hardcopy output	HARDCOPY
	.TS	activated transducer set	TRANSDUCER
	.TSA	all transducer sets	ALL TRANSDUCER
	.TF	transducer factor	TRANSDUCER
	.TFA	all transducer factors	ALL TRANSDUCER
	.COL	user-defined color settings	COLOR SETUP
Measurement results:	.TR1....4	measurement data trace 1 to trace 4	TRACE1...4

Configuration of Memory – *CONFIG* Key

MEMORY CONFIG menu:



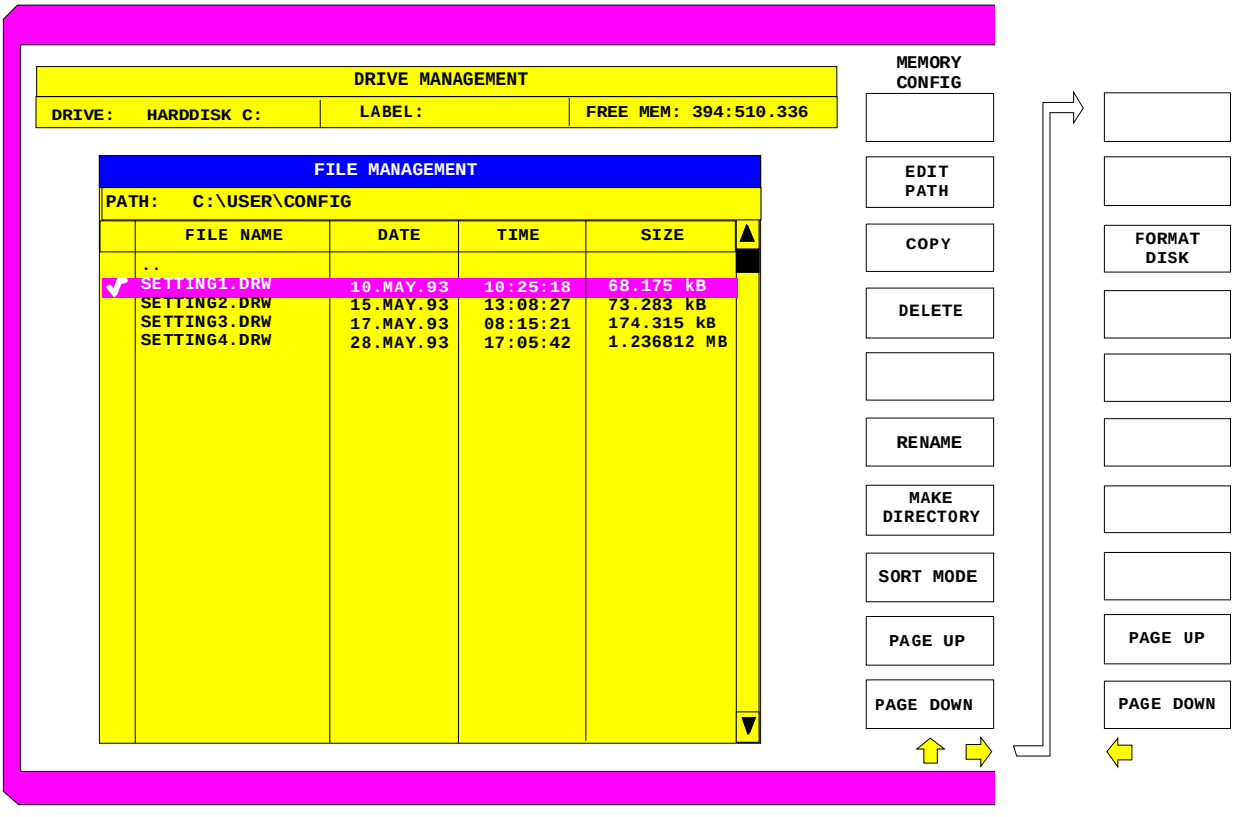
The *CONFIG* key opens a menu for managing storage media and files.

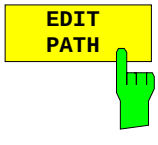
The *Drive Management* table displays the name and label of the storage medium as well as the free memory.

The *File Management* table displays the files in the current directory and indicates if any subdirectories are present.

If a directory name is selected, the FSET automatically changes to this directory. Selection of the entry '..' moves the FSET to the next highest directory level.

Note: *It is not possible to change menus as long as a file operation is running.*

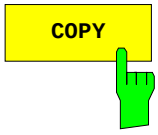




The *EDIT PATH* softkey activates the entry of the directory which will be used for subsequent file operations.

The new path is included in the *FILE MANAGEMENT* table.

IEC/IEEE-bus commands `:MMEMory:MSIS 'C:\'`
`:MMEMory:CDIRectory 'C:\user\data'`

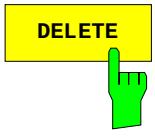


The *COPY* softkey activates the entry of the destination for the copy operation.

By prefixing a disk drive letter (e.g. C:), a file can also be copied to another storage medium. When the *ENTER* key is pressed, the selected files/directories are copied.

IEC/IEEE-bus command

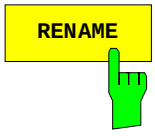
```
:MMEMory:COPY 'C:\user\data\setup.cfg','A:'
```



The *DELETE* softkey deletes the selected files.
To prevent accidental deletion of data, confirmation by the user is requested.

IEC/IEEE-bus command

```
:MMEMory:DELete 'TEST01.HCP'
:MMEMory:RDIRectory 'C:\test'
```



The *RENAME* softkey activates the entry of a new name for the selected file or directory.

IEC/IEEE-bus command

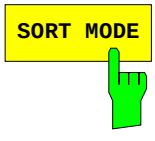
```
:MMEMory:MOVE 'TEST.CFG', 'SETUP.CFG'
```



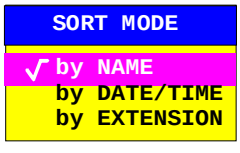
The *MAKE DIRECTORY* softkey creates directories/sub-directories. The use of sub-directories is recommended as a way of structuring the storage medium to make it easier to navigate.

When entering a subdirectory, 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-bus command `:MMEMory:MDIRectory 'C:\user\data'`

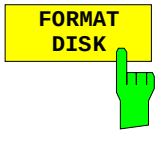


The *SORT MODE* softkey activates the selection of the sort criteria for the files listed in the *FILE MANAGEMENT* table.



Directory names are at the top of the list after the entry for the next highest directory level ("..").

IEC/IEEE-bus command `--`



The *FORMAT DISK* softkey formats disks located in drive A:.
To prevent accidental destruction of disks data, confirmation by the user is requested.

IEC/IEEE-bus command `:MMEMory:INITialize <msus>`

Saving Data Sets – *SAVE* Key

The *SAVE* key activates a menu which contains all functions necessary for saving instrument data.

– Entry of the name of the data set which should be saved. Confirmation of the entry initiates a save operation to store the data set.

  Data set names may contain both alphabetical and numeric characters, in the simplest case only numbers. The simplest example for the input of a data set name is illustrated by the following key strokes:

  <SAVE> <1> <units key>

– Entry of the directory in which the data set should be saved

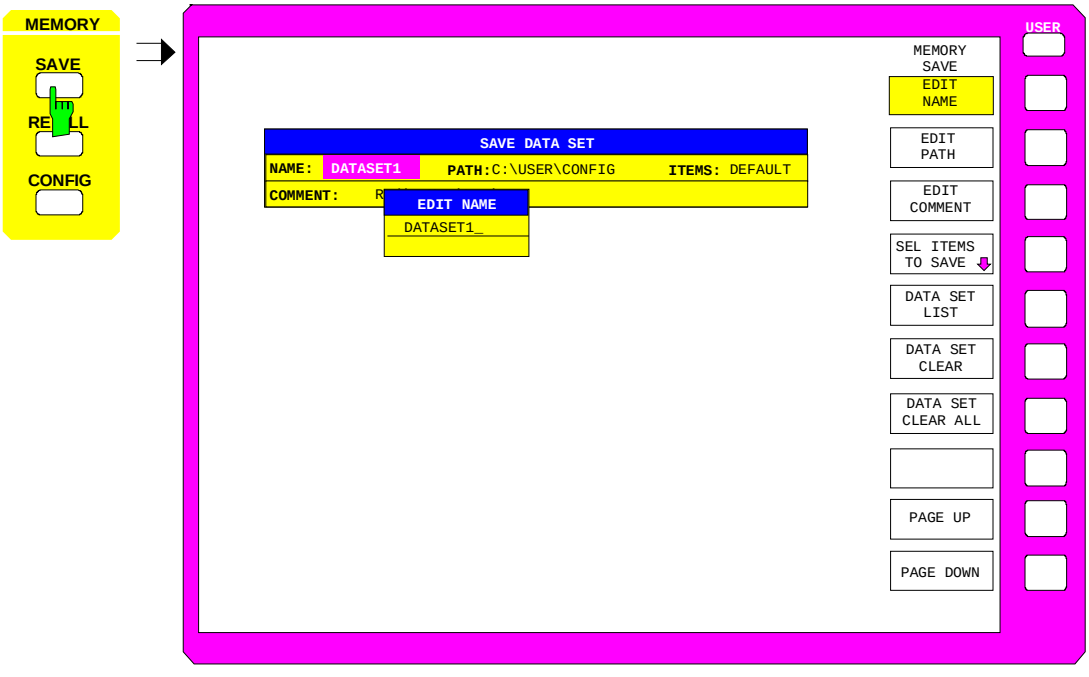
– Input of data set description

– Selection of the data subsets to be saved (sub-menu SEL ITEMS TO SAVE)

– Indication of all available data sets

– Deletion of all available data sets

MEMORY SAVE menu



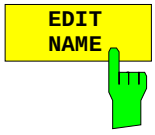
The *SAVE DATA SET* table shows the current settings regarding the data set:

Name	Name of data set
Path	Directory in which the data set will be saved
Items	Indicates whether the default selection of data subsets (DEFAULT) or a user-defined selection (SELECTED) will be saved
Comment	Comments about the data set

The *EDIT NAME* softkey for entering the name of the data set to be saved is activated automatically.

Selecting the Data Set for Saving

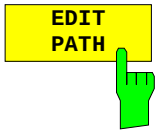
MEMORY SAVE menu:



The *EDIT NAME* softkey activates the entry of the name of the data set to be saved.

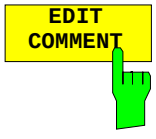
Data entry is concluded by pressing one of the units keys which initiates a save operation to store the data set.

IEC/IEEE-bus command `:MMEMory:STORe:STATe 1,'test'`



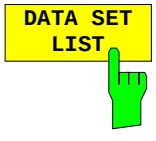
The *EDIT PATH* softkey activates the input of a directory name where the data sets are to be stored. Default path is c:\user\config.

IEC/IEEE-bus command - -

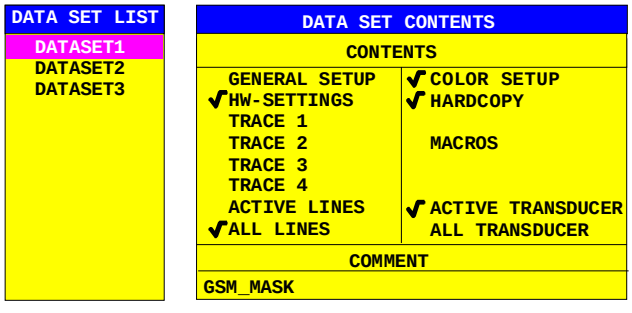


The *EDIT COMMENT* softkey activates the entry of comments for the current data set. A total of 60 characters are available for this purpose.

IEC/IEEE-bus command `:MMEMory:COMMent <string>`



The *DATA SET LIST* softkey opens the *DATA SET LIST/CONTENTS* table. The *DATA SET CLEAR* and *DATA SET CLEAR ALL* softkeys are also displayed.



The *DATA SET LIST* column lists all 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 comments for the currently selected data set.

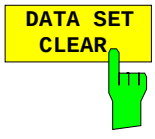
IEC/IEEE-bus command - -

Note: *The current instrument configuration can be easily stored under the name of an existing data set:*

- *Press a units key after selecting a data set*

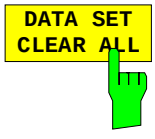
  The name and the selection of the data subsets for the currently selected data set will be placed in the SAVE DATA SET table. The DATA SET LIST table is closed and, instead, the entry field for the EDIT NAME function with the name of the selected data set is opened.

- *Press a units key.*
  The current instrument configuration is saved as a data set under this name.



The *DATA SET CLEAR* softkey clears the marked data set.

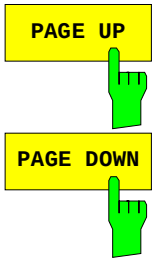
IEC/IEEE-bus command `:MMEMory:CLEar:STATe 1,'test'`



The *DATA SET CLEAR ALL* softkey deletes all data sets in the current directory.

To prevent all the data sets from being accidentally lost, confirmation from the user is required before actual clearing takes place.

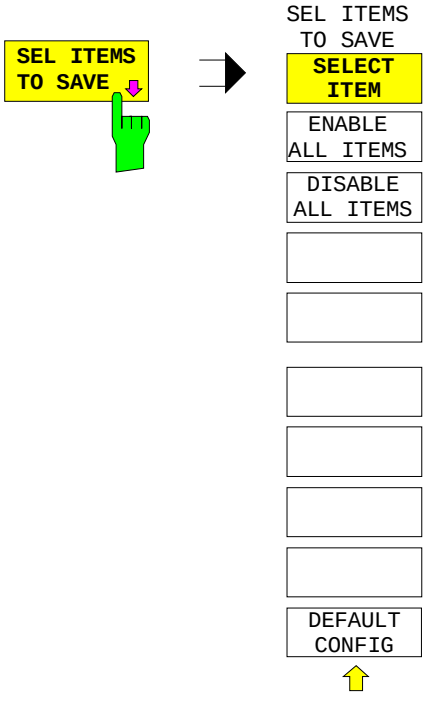
IEC/IEEE-bus command `:MMEMory:CLEar:ALL`



The *PAGE UP* or *PAGE DOWN* softkey sets the *DATA SET LIST* table to the next or previous page.

Selecting the Data subset for Storage

MEMORY SAVE-SELECT ITEMS TO SAVE sub-menu:

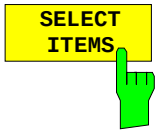


The *SEL ITEMS TO SAVE* softkey opens a sub-menu for selection of the data subsets.

The *ITEMS TO SAVE* table displays the selectable data subsets:

ITEMS	TO SAVE
GENERAL SETUP	√COLOR SETUP
√HW-SETTINGS	√HARDCOPY
TRACE 1	
TRACE 2	MACROS
TRACE 3	
TRACE 4	
√ACTIVE LINES	ACTIVE TRANSDUCER
ALL LINES	ALL TRANSDUCER

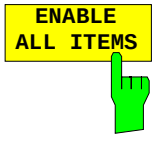
General Setup	current configuration of general instrument parameters
HW-Settings	current measurement hardware settings
Trace1...4	measurement data trace 1 to trace 4
Active Lines	active limit lines
All Lines	all limit lines
Color Setup	user-defined color settings
Hardcopy Setup	configuration for hardcopy output
Macros	macros
Active Transducer	active transducer
All Transducer	all transducer



The *SELECT ITEMS* softkey moves the selection bar to the first line, left column of the table.

IEC/IEEE-bus commands

```
:MMEMory:SELect[:ITEM]:GSETup ON|OFF
:MMEMory:SELect[:ITEM]:HWSettings ON|OFF
:MMEMory:SELect[:ITEM]:TRACe<1...4> ON|OFF
:MMEMory:SELect[:ITEM]:LINes[:ACTive] ON|OFF
:MMEMory:SELect[:ITEM]:LINes:ALL ON|OFF
:MMEMory:SELect[:ITEM]:CSETup ON|OFF
:MMEMory:SELect[:ITEM]:HCOPy ON|OFF
:MMEMory:SELect[:ITEM]:MACRos ON|OFF
:MMEMory:SELect[:ITEM]:TRANsducer ON|OFF
:MMEMory:SELect[:ITEM]:TRANsducer:ALL ON|OFF
```



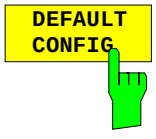
The *ENABLE ALL ITEMS* softkey marks all entries in the *ITEMS TO SAVE*. table.

IEC/IEEE-bus command `:MMEMory:SELect[:ITEM]:ALL`



The *DISABLE ALL ITEMS* softkey unmarks all entries in the *ITEMS TO SAVE* table.

IEC/IEEE-bus command `:MMEMory:SELect[:ITEM]:NONE`



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 DATA SET* table.

IEC/IEEE-bus command `:MMEMory:SELect[:ITEM]:DEFault`

Recalling of Data Sets – *RECALL* Key

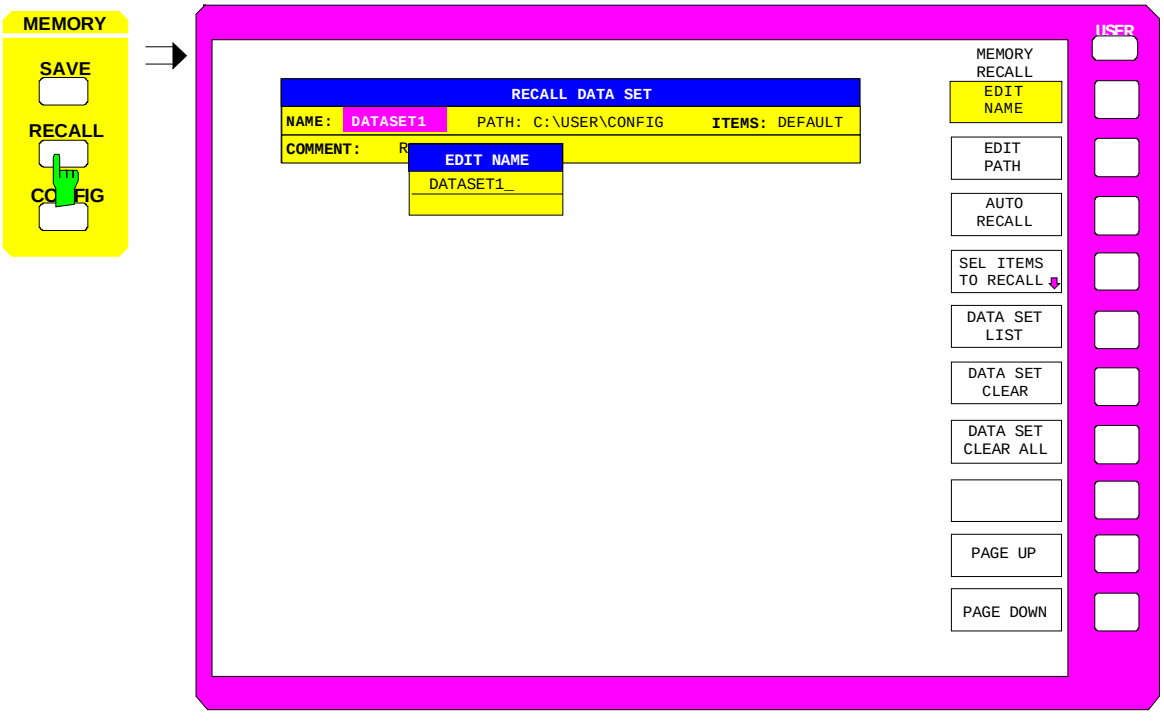
The *RECALL* key activates a menu which contains all functions necessary for recalling data sets.

- Entry of the name of the data set which should be recalled. Confirmation of the entry initiates a load operation to recall the data set.
- Entry of the directory in which the data set is stored
- Display of data set description
- Selection of a data set which will be automatically loaded upon power-up
- Indication of all available data sets
- Deletion of all available data sets
- Selection of the data subsets which should be loaded (configurations, measurement and calibration data, sub-menu SEL ITEMS TO RECALL)

Any settings not restored when data subsets are loaded will remain unchanged in the instrument. During recall operations, the FSET recognises which data subsets are present in the recalled data set and offers only the corresponding settings for selection in the *SELECT ITEM* sub-menu.

A new instrument data set can be easily constructed from several existing data sets: the desired data subsets are selected and recalled out of various data sets in several *RECALL* operations. When the desired configuration is completed, the new data set can be saved under a new name.

MEMORY RECALL menu:



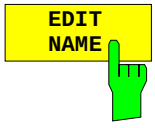
The *RECALL DATA SET* table shows the current settings regarding the data set:

Name	Name of data set
Path	Directory in which the data set is located
Items	Indicates whether the default selection of data subsets (DEFAULT) or a user-defined selection (SELECTED) will be loaded
Comment	Comments about the data set

The *EDIT NAME* softkey for entering the name of the data set to be loaded is activated automatically.

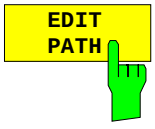
Selecting the Data Set for Recalling

MEMORY RECALL menu:



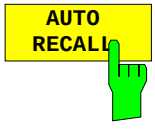
The *EDIT NAME* softkey activates the entry of a data set name.
The data input is terminated by pressing one of the units keys which simultaneously initiates the data set recall operation.

IEC/IEEE-bus command `:MMEMory:LOAD:STATe 1,'A:test'`



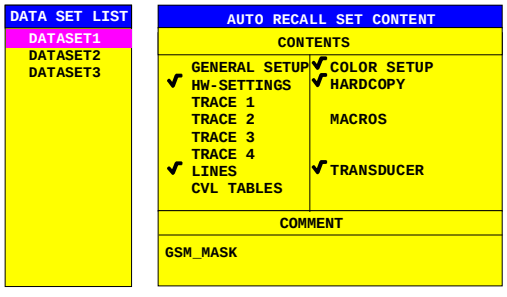
The *EDIT PATH* softkey activates the entry of a directory name in which the data set is located. Default path is c:\user\config.

IEC/IEEE-bus command `--`



The *AUTO RECALL* softkey activates the selection of a data set which will be automatically recalled when the instrument is powered up. The *DATA SET LIST/CONTENT* table is opened to make the selection (analogous to *DATA SET LIST).*

IEC/IEEE-bus command
`:MMEMory:LOAD:AUTO 1,'C:\user\data\auto'`



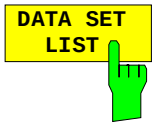
The *DATA SET LIST* column displays all the data sets in the selected directory.

The *CONTENTS* and *COMMENT* lines in the *AUTO RECALL CONTENTS* column indicate the saved data subsets and the comments for the currently selected data set.

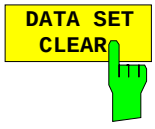
In addition to the data sets saved by the user, the data set *FACTORY*, which contains the settings of the instrument before it was last switched off (Standby), is always included.

If a data set other than *FACTORY* is chosen the data subsets in the selected data set that are available are recalled when the FSET is powered up. The data subsets which are not in this data set are taken from the *FACTORY* data set.

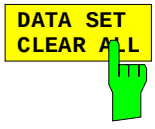
Note: *The selected data set is also loaded on PRESET if AUTO RECALL is active. The preset settings can then be configured as required.*



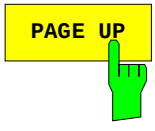
see Chapter "Saving Data Sets"

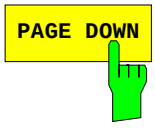


see Chapter "Saving Data Sets"



see Chapter "Saving Data Sets"

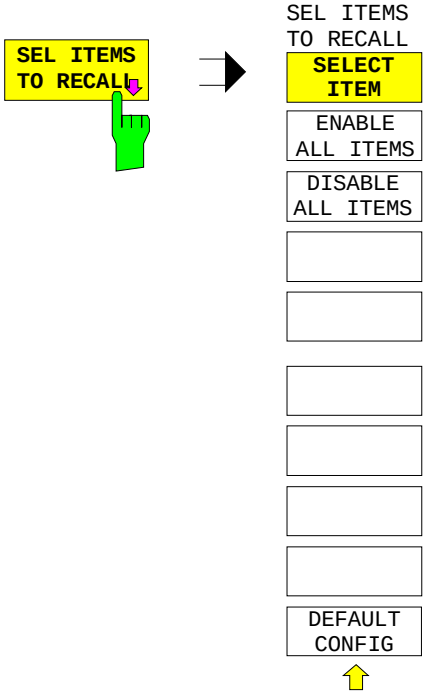




The *PAGE UP* or *PAGE DOWN* softkey sets the *DATA SET LIST* table to the next or previous page.

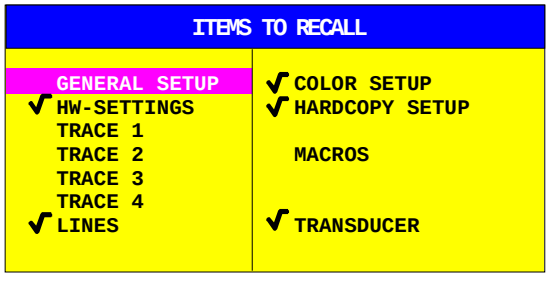
Building a Data Set

MEMORY RECALL-SELECT ITEMS TO RECALL sub-menu:

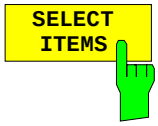


The *SEL ITEMS TO RECALL* softkey opens a sub-menu to select data subsets.

The *ITEMS TO RECALL* table displays the selectable data subsets:

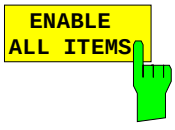


General Setup	current configuration of general instrument parameters
HW-Settings	current measurement hardware settings
Trace1...4	measurement data trace 1 to trace 4
Lines	data point tables for the active limit lines
Color Setup	user-defined color settings
Hardcopy Setup	configuration for hardcopy output
Macros	macros
Transducer	transducer factor, transducer set



The *SELECT ITEMS* softkey activates the *ITEMS TO RECALL* table and sets the selection bar to the first line, left column of the table.

IEC/IEEE-bus command see "Selecting the Data subset for Storage"



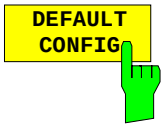
The *ENABLE ALL ITEMS* softkey marks all entries in the *ITEMS TO RECALL* table.

IEC/IEEE-bus command `:MMEMory:SELect[:ITEM]:ALL`



The *DISABLE ALL ITEMS* softkey unmarks all entries in the *ITEMS TO RECALL* table.

IEC/IEEE-bus command `:MMEMory:SELect[:ITEM]:NONE`



The *DEFAULT CONFIG* softkey establishes the default selection of the data subset to be recalled and outputs *DEFAULT* in the *ITEMS* field of the *RECALL DATA SET* table.

IEC/IEEE-bus command `:MMEMory:SELect[:ITEM]:DEFault`

Macros – *USER Key*

The FSET menus are so designed that the receiver can be easily applied to most of the usual measurement tasks with a minimum number of key operations. However, the *USER* menu also permits a tailored adaptation of any necessary setup and measurement functions needed for special applications. Here, a sequence of key operations, which may occur repeatedly, can be listed in the *USER* menu as a key macro, then stored in memory and recalled as required by the application.

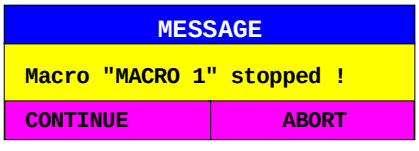
Fundamentals

Macros are defined as arbitrary key sequences which need to be defined only once and then can be recalled as often as desired. Through the use of macros, often-needed measurement functions or instrument setups, which may require a large number of key operations, can be easily performed. The writing of macros is possible only under manual control. Macro generation is not possible under remote control (e.g. via the IEC Bus interface) and when using a mouse.

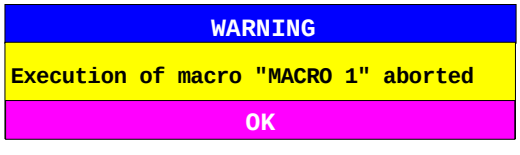
A total of 7 different macros can be programmed and assigned to the individual softkeys of the *USER* menu. Each macro has a title (arbitrarily defined by the user) which is also used as a label for the corresponding softkey. To indicate that a macro has not yet been programmed, the softkey label appears in parenthesis (e.g. (MACRO 1)). After a key-sequence macro has been defined, the parenthesis are removed and the softkey is replaced by the titel specified by the user.

A macro is executed by pressing the corresponding softkey.

During execution of macros, the key actions are repeated in exactly the **same sequence** as they were programmed. The sequential execution of a macro may be interrupted by using the PAUSE instruction. As soon as a macro is interrupted, adjustments on the Unit Under Test (UUT) may be made, etc. The interrupted macro is allowed to continue by pressing *CONTINUE i*n the message window and is aborted by pressing ABORT.



A running macro can be aborted by pressing the *LOCAL* key. At this time, the following message is displayed:



During the time a macro is executing, manual operations on the instrument are not possible, and the softkey panel is disabled. After interruption or conclusion of a macro, the applicable softkey panel is enabled (i.e., menu state at the conclusion of the macro).

Starting Macros

USER menu



The USER key opens a menu for selection and starting of macros.

The *MACRO 1* to *7* softkeys start the execution of the macros.

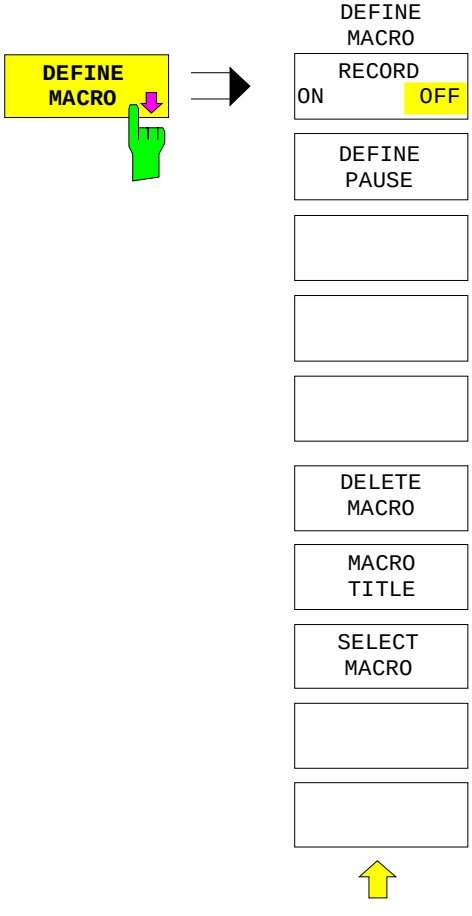
IEC/IEEE-bus command - -

The macros can be defined in the *DEFINE MACRO* submenu.

Defining Macros

In the *DEFINE MACRO* menu, all necessary softkeys needed for macro management are available. Included are functions for starting and ending macro programming, editing of a macro title, etc.

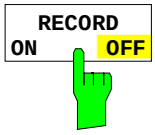
USER DEFINE MACRO menu



The *DEFINE MACRO* softkey calls the sub-menu to define the macros.

The *SELECT MACRO* softkey is active and opens the box to select the macro to be edited. In case no selection is made, *MACRO 1* is automatically selected.

IEC/IEEE-bus command - -



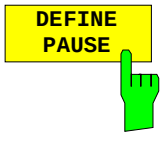
The *RECORD ON/OFF* starts or stops the recording of the macro.

ON All key actions are recorded until the softkey is changed to *OFF* . To indicate that macro record is enabled, the enhancement label MAC is displayed.

The number of actions which can be stored in a macro is limited. If the limit is exceeded, the error message "Macro too long. Recording aborted" is output and the recording operation is aborted, however, the actions already recorded do remain stored.

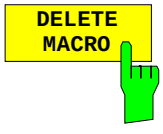
OFF The recording is stopped. The key actions are stored under the macro chosen by the *SELECT MACRO* softkey.

IEC/IEEE-bus command - -



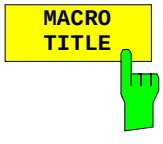
The *DEFINE PAUSE* softkey inserts a pause instruction into the macro sequence which is being recorded. A running macro will pause when it reaches this instruction, at which point settings on the unit under test could for example be made. *CONTINUE* in the message window is used to continue the macro execution.

IEC/IEEE-bus command - -



The *DELETE MACRO* softkey deletes the macro which was previously selected by the *SELECT MACRO* softkey. The softkey of the deleted title now carries its default label (*MACRO X*, X = macro number)

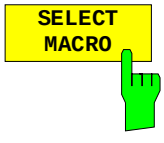
IEC/IEEE-bus command - -



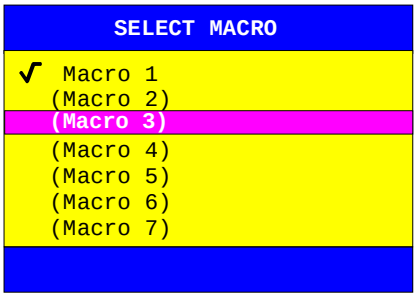
The *MACRO TITLE* softkey activates the entry of the title for the selected macro.

Because the macro title is used for labelling the corresponding softkey, a maximum of only 20 characters is allowed. All text after the 10 th character is written to the second line. However, entering the character @ forces a new line at any point in the softkey title.

IEC/IEEE-bus command - -



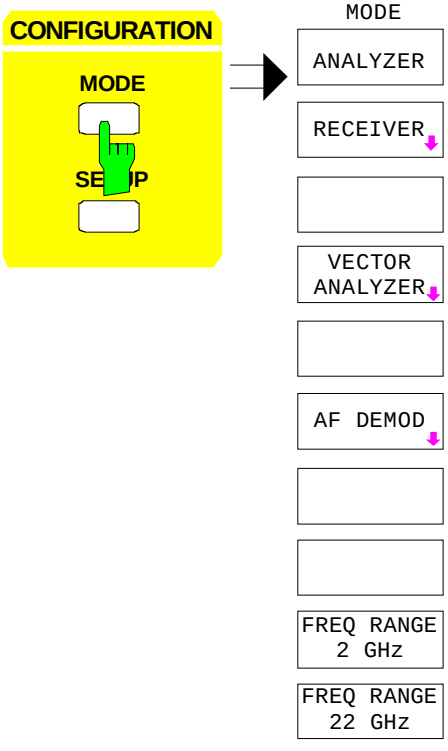
The *SELECT MACRO* softkey open the selection box with a list of all 7 macros. All softkey functions of this menu are related to this macro.



IEC/IEEE-bus command - -

Analyzer Mode

The analyzer mode is activated in the *CONFIGURATION MODE* menu (see also Section 'Mode Selection - *MODE* Key')



The *ANALYZER* softkey selects the *ANALYZER* mode.

This mode is the default setting of the FSET.

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

IEC/IEEE-bus command

```
:INSTrument<1|2>[:SELect] SANalyzer
```

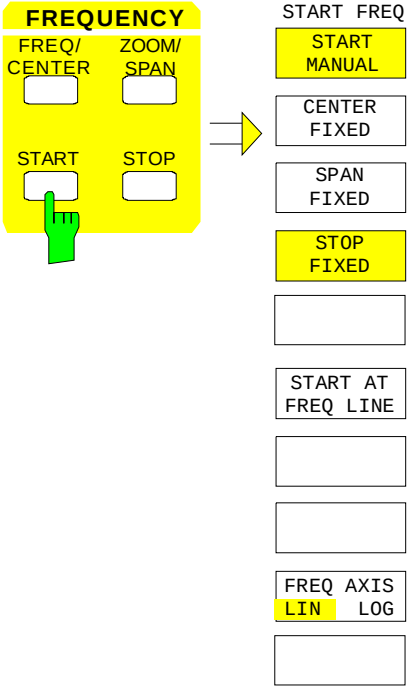
Note: *If two displays (screen A and screen B) are opened after switch-on of signal analysis, the analyzer mode is only set for the display activated for entry (marked at the top right corner of the screen). For the other display, the previous settings remain valid.*
Storage and display of measured values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

Frequency and Span Selection – *FREQUENCY* Key Group

The *FREQUENCY* key group is used to specify the frequency axis of the active measurement window. The frequency axis can be defined either by the start and stop frequency or by the center frequency and span. For the case when two measurement windows (*SPLIT-SCREEN)* are displayed simultaneously, data entered are always related to the window selected in the *SYSTEM-DISPLAY* menu.
When one of the keys *CENTER*, *SPAN*, *START* or *STOP* is pressed, its value can be specified in an entry window. At the same time, a softkey menu appears, which allows selecting the optional parameters.

Start Frequency – *START* Key

FREQUENCY – START menu:

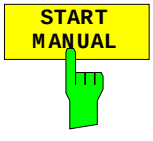


The *START* key opens a menu which displays the various options for setting the start frequency of the sweep. The *START MANUAL* softkey is automatically active and opens the entry window for manual input of the start frequency. At the same time, the coupling of the parameters is set to *STOP FIXED*

The *STOP FIXED, SPAN FIXED* and *CENTER FIXED* softkeys are mutually exclusive selection switches. Only one of these switches may be active at any one time. The frequency coupling selected by the softkeys defines which of the dependent parameters stop frequency, center frequency and span is to remain constant when a change in the start frequency is made.

The *FREQ AXIS LIN/LOG* softkey switches between linear and logarithmic scaling of the frequency axis.

A special case is the possibility to start the sweep at the frequency of the frequency line using *START AT FREQ LINE*. In this case, the frequency span is not changed.



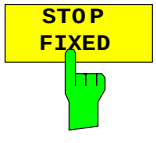
The *START MANUAL* softkey activates manual entry of the start frequency.

The allowed range of values for the start frequency is:

0 Hz <= f_{start} <= f_{max} - minspan/2

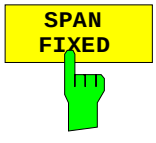
f_{start} start frequency
minspan smallest selectable span)
f_{max} max. frequency

IEC/IEEE-bus command `:[SENSe<1|2>:]FREQuency:STARt 20 MHz`



If the *STOP FIXED* key is active, the stop frequency remains constant when the start frequency is changed. The center frequency is adjusted to the new frequency range. *STOP FIXED* coupling is the default setting.

IEC/IEEE-bus command `:[SENSe<1|2>:]FREQ:STARt:LINK STOP`



If the *SPAN FIXED* softkey is active, the span remains constant when the start frequency is changed. The stop frequency is adjusted to the new frequency range.

IEC/IEEE-bus command `:[SENSe<1|2>:]FREQ:STARt:LINK SPAN`



If the *CENTER FIXED* softkey is active, the center frequency remains constant when the start frequency is changed. The stop frequency is adjusted to the new frequency range.

IEC/IEEE-bus command `:[SENSe<1|2>:]FREQ:STARt:LINK CENTer`



The *START AT FREQ LINE* softkey starts the sweep at the frequency line. The span is not changed.

IEC/IEEE-bus command `:[SENSe<1|2>:]FREQ:STARt:FLINe ON|OFF`



The *FREQ AXIS LIN/LOG* softkey switches between linear and logarithmic scales on the frequency axis.

When the log scale is used, the following restrictions apply:

- For the start/stop frequency ratio the following holds:

$$\frac{Stopfrequency}{Startfrequency} \geq 1.4$$

  At ratios below 1.4, a linear frequency scale is automatically selected.

- Up to five decades can be set.

$$\frac{Stopfrequency}{Startfrequency} \leq 10^5$$

  When the start or stop frequency is changed, the stop or start frequency is adapted to the settable range, as required.

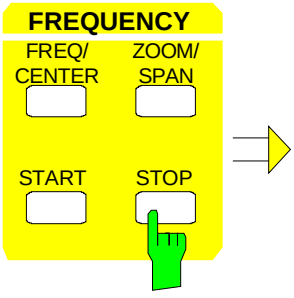
- A frequency offset is not allowed.
- The *CHANNEL POWER*, *C/N, C/N0*, *ADJACENT CHAN POWER* and *OCCUPIED PWR BANDW* measurements are disabled.

Note: *The function of a limit line is influenced by the FREQ AXIS LIN/LOG setting at the time of the definition.*
Limit lines are entered as tabulated values (level and frequency). Most regulations and standards prescribe the linking of values by straight lines both for the linear and logarithmic display. When the limit line is defined with the desired frequency scale selected, this is automatically taken into account (linear interpolation).
To be able to use the correct limit values among the tabulated values after a scale switchover, the limit line is recalculated after the switchover.

IEC/IEEE-bus command `:[SENSe<1|2>:]SWEep:SPACing LIN | LOG`

Stop Frequency – *STOP* Key

FREQUENCY – STOP menu:





The *STOP* key opens a menu which displays the various options for setting the stop frequency of the sweep.

The *STOP MANUAL* softkey is automatically active and opens the entry window for manual input of the stop frequency. At the same time, parameter coupling is set to *START FIXED*.

The *START FIXED, CENTER FIXED* and *SPAN FIXED* softkeys are mutually exclusive selection switches. Only one switch can be active at any one time. The softkeys are used to select the frequency coupling. The frequency coupling defines which of the dependent parameters start frequency, center frequency or span is to remain constant when the stop frequency is changed.

A special case is the possibility to stop the sweep at the frequency of frequency line 2 instead of stopping it at the stop frequency using *STOP AT FREQ LINE*. In this case, the frequency span is not changed.



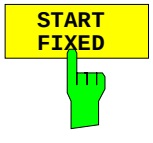
The *STOP MANUAL* softkey activates the manual entry window for the stop frequency.

The allowed range of values for the stop frequency is:

$minspan \leq f_{stop} \leq f_{max}$

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

IEC/IEEE-bus command `:[SENSe<1|2>:]FREQuency:STOP 13 GHz`



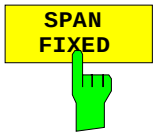
If the *START FIXED* softkey is active, the start frequency remains constant when the stop frequency is changed. The center frequency is adjusted to the new frequency range. The *START FIXED* coupling is the default setting.

IEC/IEEE-bus command `:[SENSe<1|2>:]FREQ:STOP:LINK STARt`



If the *CENTER FIXED* softkey is active, the center frequency remains constant when the stop frequency is changed. The start frequency is adjusted to the new frequency range.

IEC/IEEE-bus command `:[SENSe<1|2>:]FREQ:STOP:LINK CENTer`



If the *SPAN FIXED* softkey is active, the span remains constant when the stop frequency is changed. The start frequency is adjusted to the new frequency range.

IEC/IEEE-bus command `:[SENSe<1|2>:]FREQ:STOP:LINK SPAN`



The *STOP AT FREQ LINE* softkey stops the sweep at frequency line 2. The span is not changed.

IEC/IEEE-bus command `:[SENSe<1|2>:]FREQ:STOP:FLINe ON|OFF`



The *FREQ AXIS LIN/LOG* softkey switches between linear and logarithmic scales on the frequency axis (see START key).

IEC/IEEE-bus command `:[SENSe<1|2>:]SWEep:SPACing LIN | LOG`

The following example shows the operating steps required to sweep between the two frequency lines:

Fixing position of start frequency

➢ Declare frequency line 1 for start frequency [FREQUENCY START: *START AT FREQ LINE*].

Frequency line 1 is automatically positioned to the left margin of the diagram.

➢ Move frequency line 1 to the desired frequency position using the rotary knob.

FSET now sweeps from the position of frequency line 1 to the set stop frequency.

Fixing position of stop frequency

➢ Declare frequency line 2 for stop frequency [FREQUENCY STOP: *STOP AT MARKER*].

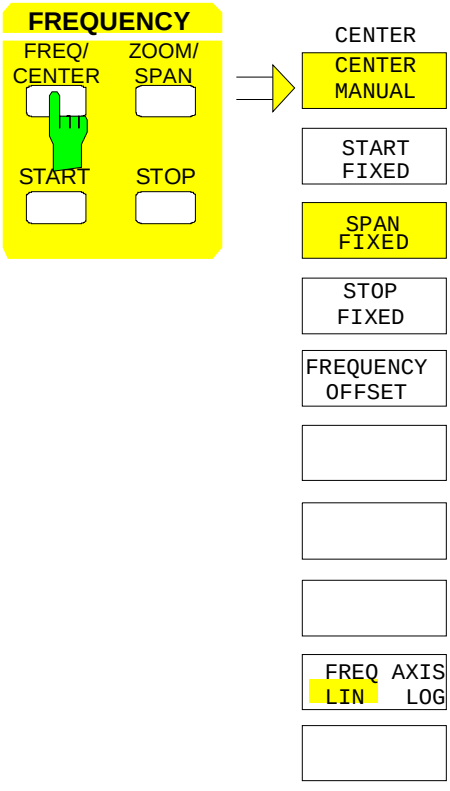
Frequency line 2 is automatically positioned to the right margin of the diagram

➢ Move frequency line 2 to the desired frequency position.

FSET now sweeps from the position of frequency line 1 to the position of frequency line 2.

Center Frequency – *CENTER* Key

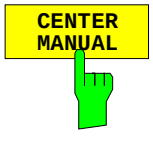
FREQUENCY – CENTER menu:



The *CENTER* softkey opens a menu which displays the various options for setting the center frequency of the sweep.

The *CENTER MANUAL* softkey is automatically active and opens the entry window for manual input of the center frequency. At the same time, the coupling of the parameters is set to *SPAN FIXED*.

The *START FIXED, STOP FIXED* and *SPAN FIXED* softkeys are mutually exclusive selection switches. Only one switch can be active at any one time. The softkeys are used to select the frequency coupling. The frequency coupling defines which of the dependent parameters start frequency, stop frequency or span remains constant when the center frequency is changed.



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

The entry range for the center frequency is:

for the frequency domain (span > 0):

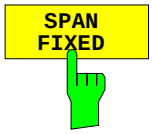
$0\ Hz <= f_{center} <= f_{max} - minspan/2$

and for the time domain (span = 0)

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

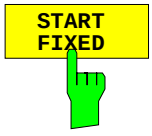
f_{center}	center frequency
minspan	smallest selectable span (10Hz)
f_{max}	max. frequency

IEC/IEEE-bus command `:[SENSe<1|2>:]FREQuency:CENTer 1.3 GHz`



If the *SPAN FIXED* softkey is active, the span remains constant when the center frequency is changed. The start and stop frequency are adjusted to the new frequency range. *SPAN FIXED* coupling is the default setting.

IEC/IEEE-bus command `:[SENSe<1|2>:]FREQ:CENTer:LINK SPAN`



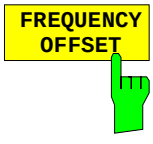
If the *START FIXED* softkey is active, the start frequency remains constant when the center frequency is changed. The span is adjusted to the new frequency range.

IEC/IEEE-bus command `:[SENSe<1|2>:]FREQ:CENTer:LINK STARt`



If the *STOP FIXED* softkey is active, the stop frequency remains constant when the center frequency is changed. The span is adjusted to the new frequency range.

IEC/IEEE-bus command `:[SENSe<1|2>:]FREQ:CENTer:LINK STOP`



The *FREQUENCY OFFSET* softkey activates the entry of a straight frequency offset which is added to the frequency axis. The offset range is -100 GHz to 100 GHz. The default setting is 0 Hz.

IEC/IEEE-bus command `:[SENSe<1|2>:]FREQ:OFFSet 10 GHz`



The *FREQ AXIS LIN/LOG* softkey switches between linear and logarithmic scales on the frequency axis (see START key).

IEC/IEEE-bus command `:[SENSe<1|2>:]SWEep:SPACing LIN | LOG`

Center Frequency Step Size

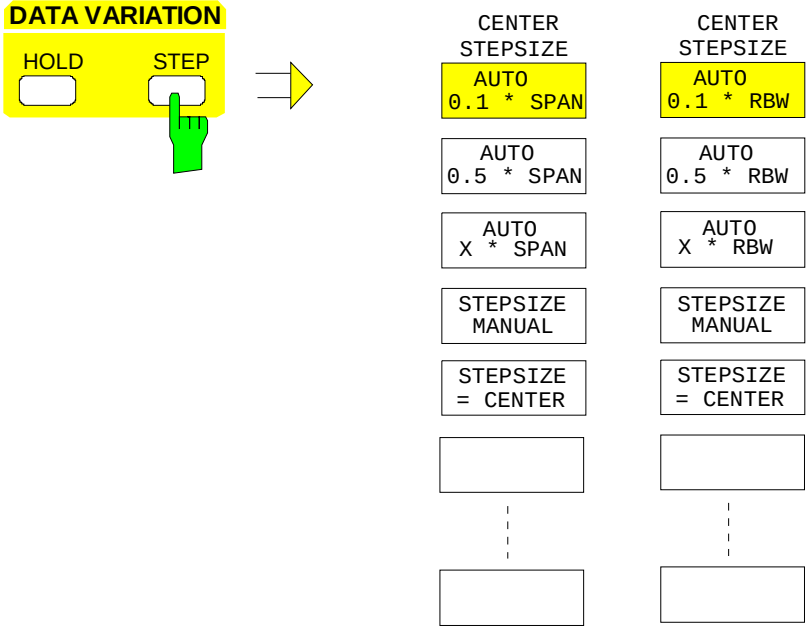
The *STEP* key in the *DATA VARIATION* key group opens a menu for setting the step size of the center frequency. The step size can be coupled to the span (frequency domain) or the resolution bandwidth (time domain) or it can be manually set to a fixed value.

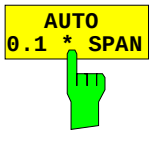
In order to change the step size, the entry window for the center frequency must already be active. After pressing the *STEP* key, the *CENTER STEP* menu appears. The softkeys are presented according to the selected domain (frequency or time).

Only one of the menu softkeys can be activated at any one time.

Control is returned to the *FREQUENCY CENTER* menu via the menu key .

DATA VARIATION - STEP menu for span ≠ 0 for span = 0

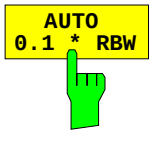




Frequency domain: The *AUTO 0.1 * SPAN* softkey sets the step size for center frequency entry to 10% of the span.

IEC/IEEE-bus command

```
:[SENSe<1|2>:]FREQuency:CENTer:STEP:LINK SPAN;
:[SENSe<1|2>:]FREQuency:CENTer:STEP:LINK:FACTor 10PCT
```

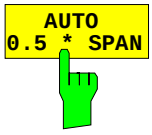


Time domain: The *AUTO 0.1 * RBW* softkey sets the step size of the center frequency entry to 10% of the resolution bandwidth

IEC/IEEE-bus command

```
:[SENSe<1|2>:]FREQuency:CENTer:STEP:LINK RBW;
:[SENSe<1|2>:]FREQuency:CENTer:STEP:LINK:FACTor 10PCT
```

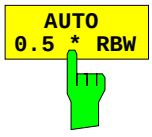
*AUTO 0.1 * RBW* is the default setting.



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

IEC/IEEE-bus command

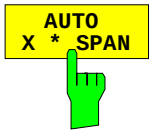
```
:[SENSe<1|2>:]FREQuency:CENTer:STEP:LINK SPAN;
:[SENSe<1|2>:]FREQuency:CENTer:STEP:LINK:FACTor 50PCT
```



Time domain: The *AUTO 0.5 * RBW* softkey sets the step size of the center frequency entry to 50% of the resolution bandwidth

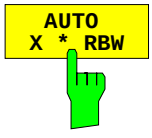
IEC/IEEE-bus command

```
:[SENSe<1|2>:]FREQuency:CENTer:STEP:LINK RBW;
:[SENSe<1|2>:]FREQuency:CENTer:STEP:LINK:FACTor 50PCT
```



Frequency domain: The *AUTO X * SPAN* softkey activates the entry of the factor defining the center frequency step size as a % of span.

IEC/IEEE-bus command see *AUTO 0.5 * SPAN*



Time domain: The *AUTO X * RBW* softkey activates the entry of the factor defining the center frequency step size as a % of the resolution bandwidth.

IEC/IEEE-bus command see *AUTO 0.5 * RBW*

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



The *STEPSIZE MANUAL* softkey activates the entry window for the input of a fixed step size.

IEC/IEEE-bus command

```
:[SENSe<1|2>:]FREQuency:CENTer:STEP 1.3 GHz
```

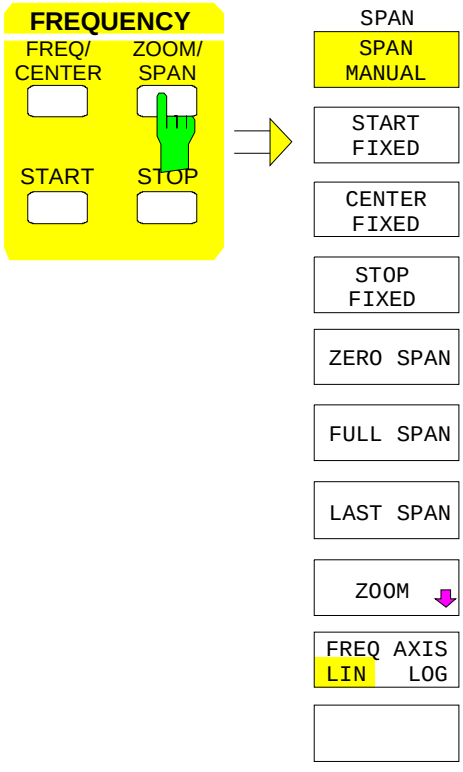


The *STEPSIZE = CENTER* softkey sets the step size coupling to *MANUAL* and the step size to the center frequency. This function is especially useful when measuring harmonics, because, when the center frequency is entered, each *STEP* key stroke slects the center frequency of the next harmonic.

IEC/IEEE-bus command - -

Frequency Span – *SPAN* Key

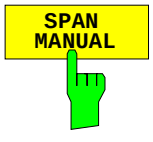
FREQUENCY – SPAN menu:



The *SPAN* key opens a menu for setting the sweep span.

The *SPAN MANUAL* softkey is automatically active and opens the entry window for manual input of the span. At the same time, the parameter coupling is set to *CENTER FIXED*.

The *START FIXED, CENTER FIXED* and *STOP FIXED* softkeys are mutually exclusive selection switches. Only one switch can be active at any one time. The frequency coupling is selected with these softkeys. The frequency coupling defines which of the dependent parameters start frequency, center frequency or stop frequency is to remain constant when the span is changed



The *SPAN MANUAL* softkey activates the manual entry of the span.

The span entry range is for:
time domain (span = 0):

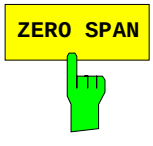
0 Hz

frequency domain (span > 0):

$minspan \leq f_{span} \leq f_{max}$

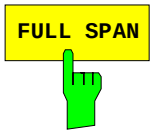
f_{span}	frequency span
minspan	smallest selectable span (10Hz)
f_{max}	max. frequency

IEC/IEEE-bus command `:[SENSe<1|2>:]FREQuency:SPAN 10MHZ`



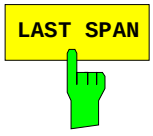
The *ZERO SPAN* softkey sets the span value to 0 Hz. The x axis becomes the time axis. The axis labelling corresponds to the sweep time (on the left, 0 ms, on the right, the current sweep time (SWT)).

IEC/IEEE-bus command `:[SENSe<1|2>:]FREQuency:SPAN 0HZ`



The *FULL SPAN* softkey sets the span value to the maximum span of the FSET.

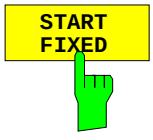
IEC/IEEE-bus command `:[SENSe<1|2>:]FREQuency:SPAN:FULL`



The *LAST SPAN* softkey restores the previous setting if the span has been changed. This makes it possible to switch over between an overview measurement (*FULL SPAN*) and a detailed measurement (manually set center frequency and span).

The *FULL SPAN* softkey modifies the center frequency as well as the selected span. The *LAST SPAN* softkey cancels this change.

IEC/IEEE-bus command `--`



If the *START FIXED* softkey is activated, the start frequency remains constant when the span is changed. The center and stop frequency are adjusted to the new span.

IEC/IEEE-bus command `:[SENSe<1|2>:]FREQ:SPAN:LINK START`



If the *CENTER FIXED* softkey is activated, the center frequency remains constant when the span is changed. The center and stop frequency are adjusted to the new span. The *CENTER FIXED* coupling is the default setting.

IEC/IEEE-bus command `:[SENSe<1|2>:]FREQ:SPAN:LINK CENTer`



If the *STOP FIXED* softkey is activated, the stop frequency remains constant when the span is changed. The center and start frequency are adjusted to the new span.

IEC/IEEE-bus command `:[SENSe<1|2>:]FREQ:SPAN:LINK STOP`

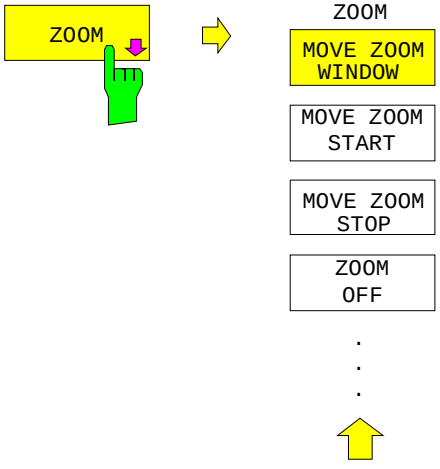


The *FREQ AXIS LIN/LOG* softkey switches between linear and logarithmic scales on the frequency axis (see START key).

IEC/IEEE-bus command `:[SENSe<1|2>:]SWEep:SPACing LIN | LOG`

Display Zoom

FREQUENCY SPAN- ZOOM submenu:



The *ZOOM* softkey activates the zoom mode and opens a sub-menu to define the zoom span.

Two frequency lines, which show and define the frequency range to be zoomed, appear in the active measurement window when the zoom mode is switched on. The default setting is a zoom span of 10% to the left and 10% to the right of the center frequency. The zoomed display is shown in the second measurement window.
The settings for the second measurement window are taken from the original window. The second measurement window thus becomes the active measurement window and its settings can now be changed.

If only one window is active when the zoom function is selected, *SPLIT SCREEN* mode is automatically switched on.

The zoom span can be edited by using the softkeys of the sub-menu to change the position of the frequency lines.

The softkey ZOOM OFF switches off the zoom.

With *Capture Memory* switched on (the *CAPT MEM ON/OFF* softkey in *TRACE-DETECTOR* menu), the *ZOOM* softkey activates the *Capture Frequency Zoom* or the *Capture Time Zoom*.
Preconditions:

- screen A is the active screen
- the frequency or time axis is scaled linearly
- trace 1 is set to VIEW
- measured values are recorded.

During the *Capture Zoom* the unit no longer sweeps and the measured values are taken from the expanded capture memory. The device settings with which the trace was recorded cannot be changed.
The zoomed display is in measurement window B. The defined zoom range of 10% starts at the left margin of the display range. It can be changed by moving the two lines as described under *Frequency Zoom*.

Capture Zoom is also deactivated by leaving the analyzer mode or by switching off *Capture Memory*.



The *MOVE ZOOM WINDOW* softkey shifts the whole zoom window. The window can be shifted until the upper line reaches the right diagram side or the lower line reaches the left diagram side of the original window.

IEC/IEEE-bus commands

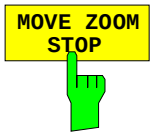
```
:DISPlay[:WINDow<1|2>]:TRACe<1..4>:X[:SCALe]:ZOOM ON
:DISPlay[:WINDow<1|2>]:TRACe<1..4>:X:ZOOM:CENTer 1GHz
```



The *MOVE ZOOM START* softkey shifts the lower line of the zoom window . The start frequency of the zoomed display can then be modified. The frequency line can be maximally shifted to the left diagram side of the original window.

IEC/IEEE-bus commands

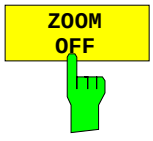
```
:DISPlay[:WINDow<1|2>]:TRACe<1..4>:X[:SCALe]:ZOOM ON
:DISPlay[:WINDow<1|2>]:TRACe<1..4>:X:ZOOM:STARt 100MHz
```



The *MOVE ZOOM STOP* softkey shifts the upper line. The stop frequency of the zoomed display can then be modified. It can be maximally shifted up to the right diagram side of the original window.

IEC/IEEE-bus commands

```
:DISPlay[:WINDow<1|2>]:TRACe<1..4>:X[:SCALe]:ZOOM ON
:DISPlay[:WINDow<1|2>]:TRACe<1..4>:X:ZOOM:STOP 200MHz
```



The *ZOOM OFF* softkey switches the zoom function off and then returns control to the main menu.
The lines indicating the zoom span are deleted and trace 1 is displayed in FULL SCREEN mode.

IEC/IEEE-bus command

```
:DISPlay[:WINDow<1|2>]:TRACe<1..4>:X[:SCALe]:ZOOM OFF
```

Level Display and RF Input Configuration – *LEVEL Key Group*

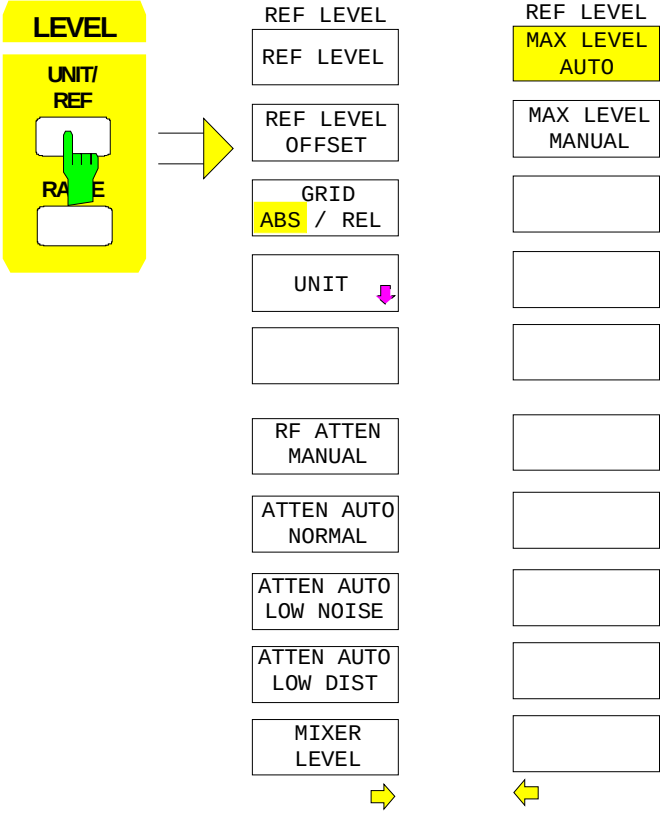
The *REF* and *RANGE* keys are used to set the reference level (= maximum RF input level, = overload limit), the maximum level (= upper grid level) , and the display range of the active window. The *INPUT* key sets the characteristics of the RF input (AC-/DC- coupling of the preselector,input impedance and input attenuation).

Reference Level – *REF* key

In addition to the reference level (maximum RF input level), the FSET provides a function to define a maximum level (uppermost grid line on the display):
For a spectrum analyzer, the upper boundary of the measurement diagram (maximum level) is also the limit of its dynamic range (reference level). This means, that a signal which goes beyond the upper grid line also overdrives the analyzer.

For compensation of frequency or antenna characteristics, transducer factors can be applied to increase the signal level. In this case, the calculated values can be above the reference level without actually being physically applied to the instrument. In order to display these signals on the grid, an upper grid level which is different from the reference level of the analyzer can be entered.

LEVEL REF menu:



The *REF* key opens a menu to set the reference level and the input attenuation for the active measurement window .

The *REF LEVEL* softkey is automatically active with the menu called up and opens the entry window for manual input of the reference level.

At the same time various settings concerning the level and the attenuation display can be made.

The functions for setting the attenuation are identical to those under the *INPUT* key and are described in Section "Configuration of the RF Input - INPUT Key".



The *REF LEVEL* softkey activates the entry of the reference level. The unit of the entry will be the currently active unit (dBm, dBµV, etc.).

If the *MAX LEVEL MANUAL* softkey is active, a change of the reference level causes an equal amount of change in maximum level Thus, the separation between the overload limit of the analyzer to the upper grid edge remains the same. Thus, with only one entry, it is possible to make a change to the display and simultaneously to perform an adjustment to the amplifier.

IEC/IEEE-bus command

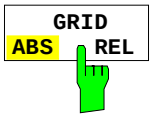
```
:DISPlay[:WINDow<1|2>]:TRACe<1..4>:Y:RLEVel -60DBM
```



The *REF LEVEL OFFSET* softkey activates the entry of a straight level offset (±200 dB in 0,1 dB steps). The offset is added to the measured level irrespective of the selected unit. The scaling of the y axis is changed accordingly. The input can be used to take into account an external attenuation.
The setting range is ±200 dB in 0,1-dB steps.

IEC/IEEE-bus command

```
:DISPlay[:WINDow<1|2>]:TRACe<1..4>:Y:RLEVel:OFFSet -1dB
```



The *GRID ABS/REL* softkey toggles between absolute and relative scaling of the level axis. *GRID ABS* is the default setting.

For absolute scaling the labeling of the level lines is referenced to the absolute value of the reference level.

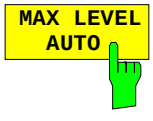
For relative scaling, the upper line of the grid is always at 0 dB and the scale units are in dB. In contrast, the reference level is always displayed in the set units (dBm, dBµV,..).

The softkey is not displayed for setting *LIN / %* (linear scaling, labelling in %) in the *LEVEL-RANGE* menu since the % unit itself implies a relative scale.

IEC/IEEE-bus command

```
:DISPlay[:WINDow<1|2>]:TRACe<1..4>:Y:MODE  ABS | REL
```

The *MAX LEVEL MANUAL* and *MAX LEVEL AUTO* softkeys are mutually exclusive selection switches. Only one switch can be active at one time. The softkeys are used to select whether reference level and maximum level are identical or not:



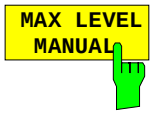
When *MAX LEVEL AUTO* softkey is active, the reference level and maximum level are identical.
In this case, the reference level is displayed above the upper left corner of the grid in the corresponding function field.

MAX LEVEL AUTO is the default setting.

If the *MAX LEVEL MANUAL* softkey was active prior to pressing the *MAX LEVEL AUTO* softkey, the upper boundary of the grid is set to the reference level.

IEC/IEEE-bus command

```
:DISPlay[:WINDow<1|2>]:TRACe<1..4>:Y:RVALue:AUTO ON
```



The *MAX LEVEL MANUAL* softkey activates the entry of the maximum level. The range of input values is ± 200dBm with 0.1 dB resolution.

If the *MAX LEVEL MANUAL* softkey is activated, the maximum level is displayed in addition to the reference level to the right above the grid.

IEC/IEEE-bus commands

```
:DISPlay[:WINDow<1|2>]:TRACe<1..4>:Y:RVALue:AUTO OFF
:DISPlay[:WINDow<1|2>]:TRACe<1..4>:Y:RVALue -20DBM
```

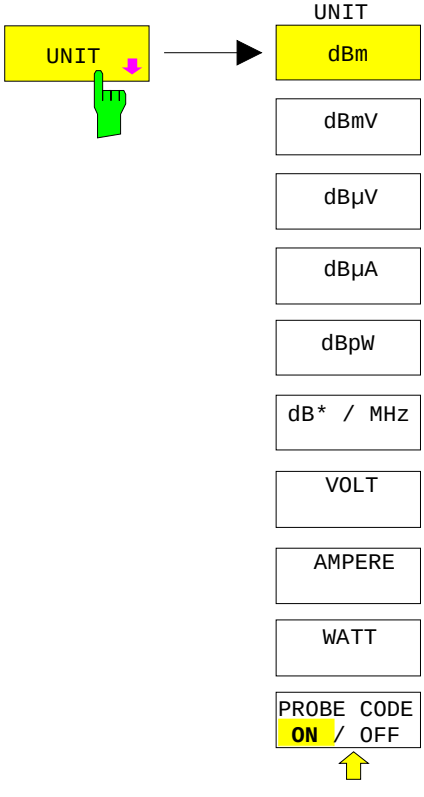
Display Units

Generally, a spectrum analyzer measures the signal voltage at the RF input. The level display is calibrated in terms of therms values of an unmodulated sine wave. In the initial state, the level is displayed at a power of 1 milliwatt (= dBm). As the input impedance is known to be 50Ω or 75Ω, conversion to other units is possible. The units dBm, dBµV, dBµA, dBpW, V, A and W are directly convertible and can be selected in the *REF UNIT* menu.
Units dB../MHz have a special status. They are applicable for broadband pulse signals. The measured pulse voltage or the pulse current is referred to 1 MHz bandwidth. This conversion is not useful for narrowband or sinewave signals.
If the antenna coded connector on the front panel is used, the coded unit there determines the possible display units. Connecting to the coded connector deactivates the settings of the *UNIT* menu.
By certain codings it is nevertheless possible to select a conversion of the unit in the menu. The dependencies between the unit of the antenna coded connector or the unit of the transducer and the unit which is to be selected for the display are given in the softkey description.

The default coding defined by the connector can be switched off using the *PROBE CODE ON/OFF* softkey. In this case, the unit can be set with the corresponding unit softkeys (dBm, dBµV, ...) even if a coded connector is plugged in. The coded entries in the connector are then ignored.

Note: *The units dBµV/m and dBµA/m can only be set via the unit of a transducer or via the unit of the coded connector.*

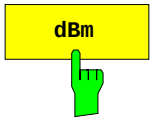
LEVEL REF UNIT submenu:

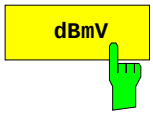


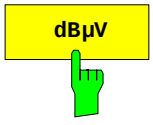
The *UNIT* softkey opens a sub-menu in which the desired units for the level axis can be selected and the coding of the antenna coded connector can be switched on and off.

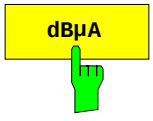
The selected units are valid for both displays when two measurement windows are displayed.

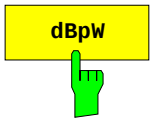
The unit softkeys are mutually exclusive selection switches. Only one of these switches may be active at any one time.











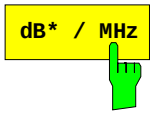
The *dBm, dBµV, dBmV, dBµA, dBpW* softkeys set the display units to the corresponding logarithmic units. The dBm unit is the default unit in analyzer mode.

The units *dBm, dBµV, dBmV, dBµA* cannot be selected when the coded antenna connector or the used transducer defines a unit.

Only for coding dB, the conversion to the desired units is permitted.

IEC/IEEE-bus command

```
:CALCulate<1|2>:UNIT:POWer DBM |DBMV |DBUV |DBUA |DBPW
```



The *dB*/MHz* softkey activates/disactivates the display of results in units relative to the bandwidth. Those units can be derived from the logarithmic units *dBµV, dBµV/m, dBµA* and *dBµA/m.*

This leads to the following relative units:

dBmV	⇒	*dBmV/MHz*
dBµV	⇒	*dBµV/MHz*
dBµV/m	⇒	*dBµV/mMHz*
dBµA	⇒	*dBµA/MHz*
dBµA/m	⇒	*dBµA/mMHz*

Switching over is possible also if a coded antenna connector or a transducer fixes the unit to be used.

Conversion to 1 MHz is via the pulse bandwidth of the selected resolution bandwidth B_{imp} according to the following equation (example for *dBµV)* :

$$P\ /\ (\mathrm{dB}\mu V\ /\ \mathrm{MHz}) = 20 \cdot \log \frac{B_{imp}\ /\ \mathrm{MHz}}{1\mathrm{MHz}} + P\ /\ (\mathrm{dB}\mu V),$$

where P = display level

The dBµV/MHz unit can be combined with the following coded connector or transducer units

dB (the unit dBµV/MHz remains)

µV/m (yields the display unit dBµV/mMHz)

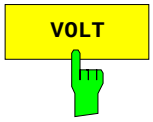
analogous for dBµA/MHz:

dB and µA (the unit dBµA/MHz remains)

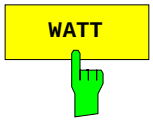
Other combinations are not allowed.

IEC/IEEE-bus command

```
:CALCulate<1|2>:UNIT:POWer DBUV_MHZ|DBUA_MHZ|DBMV_MHZ
```





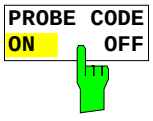


The *VOLT, AMPERE, WATT* softkeys set the display units to the corresponding linear units.

The units *VOLT, AMPERE, WATT* cannot be selected when the coded antenna connector or the transducer table defines one of the following as units:

µV/m
µA

For coding dB, the conversion to the desired units is permitted.

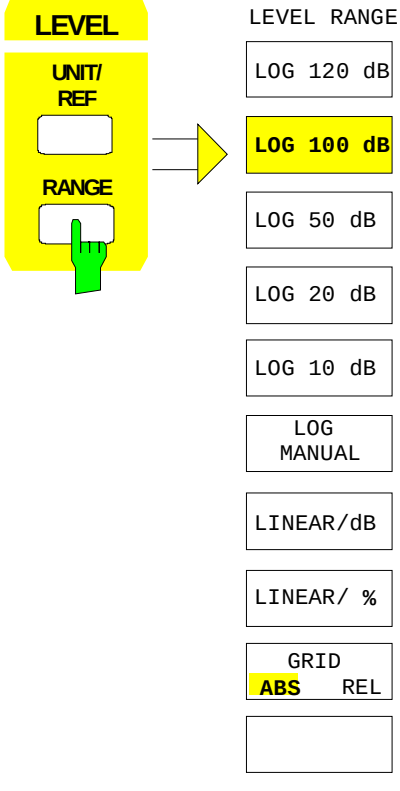


The *PROBE CODE ON/OFF* softkey enables or disables the units defined by the coded connector.

IEC/IEEE-bus command `:UNIT<1|2>:PROBe ON | OFF`

Level Range – *RANGE* Key

LEVEL RANGE menu:



The *RANGE* key calls a menu in which the range, linear or logarithmic the display scale, absolute or relative and the level units for the active window can be selected.

The display range for the level range is 1, 2, 5 dB and 10 to 200 dB in 10-dB steps, ie the maximum level resolution is 0.1 dB/Div, the minimum resolution 20 dB/Div.
The default setting is 100 dB.

The most often used settings (120 dB, 100 dB, 50 dB, 20 dB and 10 dB) are each directly selectable by a softkey.
All other ranges are chosen with the *LOG MANUAL* softkey.

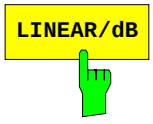
After pressing the *RANGE* key, the *LOG MANUAL* entry window is enabled if the display range is not set to *LIN.*



The *LOG MANUAL* softkey activates the entry of the level display range. Display ranges 1, 2, 5 dB and 10 to 200 dB are allowed in 10-dB steps. Values which are not permissible are rounded to the next valid number.

IEC/IEEE-bus commands

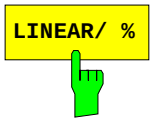
```
:DISPlay[:WINDow<1|2>]:TRACe<1..4>:Y:SPACing LOG
:DISPlay[:WINDow<1|2>]:TRACe<1...4>:Y 110DB
```



The *LINEAR/dB* softkey switches the display range of the analyzer to linear scaling. The horizontal lines are labelled according to the selection *GRID ABS/REL* in dB* or *.

IEC/IEEE-bus command

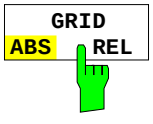
```
:DISPlay[:WINDow<1|2>]:TRACe<1..4>:Y:SPACing LINear
```



The *LINEAR/%* softkey switches the display range of the analyzer to linear scaling. The horizontal lines are labelled in %. The grid is divided into decades.

IEC/IEEE-bus command

```
:DISPlay[:WINDow<1|2>]:TRACe<1..4>:Y:SPACing PERCent
```



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 is referenced to the absolute value of the reference level.

REL The upper line of the grid is always at 0 dB and the scale units are in dB. In contrast, the reference level is always displayed in the set units (dBm, dBµV,..).

The softkey is not displayed for setting *LIN / %* (linear scaling, labelling in %) since the % unit itself implies a relative scale.

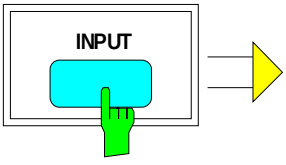
IEC/IEEE-bus command

```
:DISPlay[:WINDow<1|2>]:TRACe<1..4>:Y:MODE  ABS | REL
```

RF Input Configuration – *INPUT* Key

In addition to manual entry of the input attenuation, the FSET provides an option which allows the RF attenuation, dependent on the selected reference level, to be automatically set. Thus, it is guaranteed that an optimum combination of RF attenuation, preamplification, and IF amplification is always used. For the automatic selection process, three modes are provided. The *AUTO LOW NOISE* mode selects the amplification/attenuation combination so that the display of noise on the FSET is at a minimum. The signal/noise ratio is maximised. The *AUTO LOW DISTORTION* mode is tuned for minimisation of the internally generated interference products. This causes, however, a lower signal/noise ratio. The *ATTEN AUTO NORMAL* mode is a compromise between low noise and low distortion.

INPUT menu:

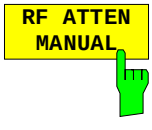




The *INPUT* key opens the menu for configuring the RF input. It contains the input attenuator and mixer level for matching the RF input to the input signal.

The *RF ATTEN MANUAL*, *ATTEN AUTO NORMAL*, *ATTEN AUTO LOW NOISE* and *ATTEN AUTO LOW* softkeys are mutually exclusive selection switches. only one can be active at any one time.

The *INPUT SELECT* softkey calls a submenu for configuration of the RF input



The *RF ATTEN MANUAL* softkey activates the entry of an attenuation factor independent of the reference level.

The following attenuation settings are possible depending on the frequency:

FSET7:
- 100 Hz to 2 GHz : 0 to 80 dB in 1-dB steps

FSET22:
- 100 Hz to 2 GHz : 0 to 80 dB in 1-dB steps,
- 2 GHz to 22 GHz: 0 to 70 dB in 10-dB steps

FSET7 and **FSET22** without Preselector FSET-Z..:

- 100 Hz to f_{max} 0 to 70 dB in 10-dB steps

Other inputs will be rounded to the next higher 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 `:INPut<1|2>:ATTenuation 40DB`

The following tables give an example of the combination of RF attenuation, RF preamplification and IF gain for the different attenuation modes:

Auto Low Noise

Ref Level	RF ATT	Preamp	Mixer Level	IF Gain
20 dBm	30 dB	0 dB	-10 dBm	0 dB
10 dBm	20 dB	0 dB	-10 dBm	0 dB
0 dBm	10 dB	0 dB	-10 dBm	0 dB
-10 dBm	10 dB [0 dB]*	10 dB [0 dB]	-10 dBm	0 dB
-20 dBm	10 dB [0 dB]*	20 dB [10 dB]	-10 dBm	0 dB
-30 dBm	10 dB [0 dB]*	30 dB [20 dB]	-10 dBm	0 dB
-40 dBm	10 dB [0 dB]*	30 dB	-20 [-10] dBm	10 dB [0 dB]
-50 dBm	10 dB [0 dB]*	30 dB	-30 [-20] dBm	20 dB [10 dB]
..	..	..	..	..

* The 0-dB setting is only allowed if it was admitted by the user (0 dB used ON)

Normal

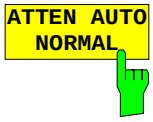
Ref Level	RF ATT	Preamp	Mixer level	IF Gain
20 dBm	40 dB	0 dB	-20 dBm	10 dB
10 dBm	30 dB	0 dB	-20 dBm	10 dB
0 dBm	20 dB	0 dB	-20 dBm	10 dB
-10 dBm	10 dB	0 dB	-20 dBm	10 dB
-20 dBm	10 dB [0 dB]*	10 dB [0 dB]	-20 dBm	10 dB
-30 dBm	10 dB [0 dB]*	20 dB [10 dB]	-20 dBm	10 dB
-40 dBm	10 dB [0 dB]*	30 dB [20 dB]	-20 dBm	20 dB
-50 dBm	10 dB [0 dB]*	30 dB	-30 [-20] dBm	30 dB [20 dB]
..	..	..	..	..

* * The 0-dB setting is only allowed if it was admitted by the user (0 dB used ON)
)

Low Distortion

Ref Level	RF ATT	Preamp	Mixer level	IF Gain
20 dBm	50 dB	0 dB	-30 dBm	20 dB
10 dBm	40 dB	0 dB	-30 dBm	20 dB
0 dBm	30 dB	0 dB	-30 dBm	20 dB
-10 dBm	20 dB	0 dB	-30 dBm	20 dB
-20 dBm	10 dB	0 dB	-30 dBm	20 dB
-30 dBm	10 dB [0 dB]*	10 dB [0 dB]	-30 dBm	20 dB
-40 dBm	10 dB [0 dB]*	20 dB [10 dB]	-30 dBm	20 dB
-50 dBm	10 dB [0 dB]*	30 dB [20 dB]	-30 dBm	20 dB
-60 dBm	10 dB [0 dB]*	30 dB	-40 [-30] dBm	30 dB [20 dB]
..	..	..	..	..

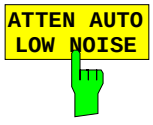
* * The 0-dB setting is only allowed if it was admitted by the user (0 dB used ON)



The *ATTEN AUTO NORMAL* softkey sets the RF attenuation automatically as a function of the selected reference level.

IEC/IEEE-bus commands

```
:INPut<1|2>:ATTenuation:AUTO:MODE NORMal
:INPut<1|2>:ATTenuation:AUTO ON
```



The *ATTEN AUTO LOW NOISE* softkey sets the RF attenuation always 10dB lower than in the *RF ATTEN AUTO* mode. Therefore, for 10 dB RF attenuation, the maximum reference level is -10 dBm. For reference levels which are lower, at least 10 dB is always set (see above).

Setting Low Noise means that the indicated inherent noise level is low. This setting is recommended if signals with a low level have to be measured as the highest S/N ratio is then obtained.

IEC/IEEE-bus commands

```
:INPut<1|2>:ATTenuation:AUTO:MODE LNOise
:INPut<1|2>:ATTenuation:AUTO ON
```



The *ATTEN AUTO LOW DIST* softkey sets the RF attenuation 10 dB higher than in *RF ATT AUTO* mode. This means that for 10 dB RF attenuation, the maximum reference level is -30 dBm (-40 dBm at the mixer).

This setting is recommended whenever a small signal is to be measured in the presence of larger signals. Here, the intermodulation-free range of the FSET is large and the internal distortion products are minimised.

IEC/IEEE-bus commands

```
:INPut<1|2>:ATTenuation:AUTO:MODE LDIStortion
:INPut<1|2>:ATTenuation:AUTO ON
```

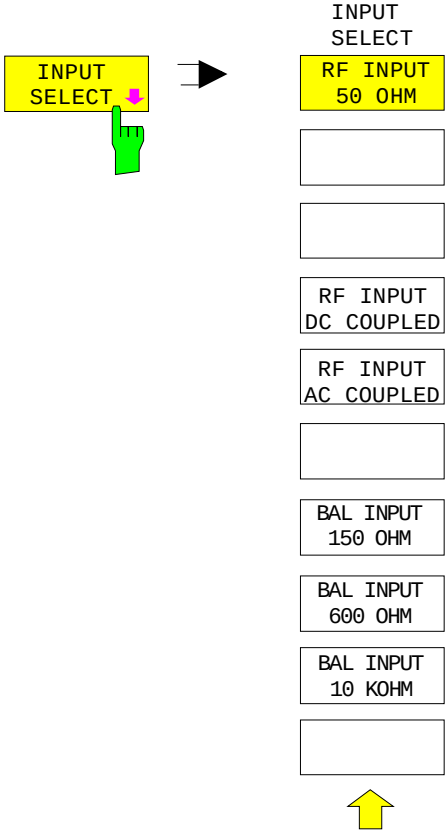


The *MIXER LEVEL* softkey activates the entry of the maximum mixer level attainable for a given reference level. At the same time it enables softkeys *ATTEN AUTO LOW NOISE* and *ATTEN AUTO LOW DIST* .

Range of input values is -10 to -100 dBm

IEC/IEEE-bus command `:INPut<1|2>:MIXer -30DBM`

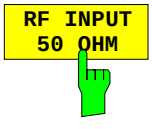
INPUT INPUT SELECT submenu:



The *INPUT SELECT* softkey opens a submenu for configuration of the RF input. If FSET is operated without Preselector FSET-Z.., the 50-Ohm RF input of the FSET basic unit is always selected (softkey in inverse video). There are no other choices.
During operation with the preselector its input can be *DC COUPLED* or *AC COUPLED*. The default setting is DC coupling.

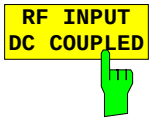
Attention: *AC coupling is only possible up to 2 GHz. For frequencies >2 GHz the RF input of FSET-Z.. is always DC coupled. For DC coupling do not exceed the permissible DC voltage at the RF input as the attenuator or the input mixer might otherwise be damaged.*

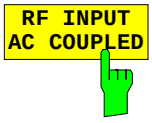
During operation with Preselector FSET-*Z..* it is also possible to use the balanced input. Its frequency range has an upper frequency limit of 50 kHz. The impedance of the balanced input can be switched between 150 Ohm, 600 Ohm and 10 kOhm.



The *RF INPUT 50 OHM* softkey sets the input impedance to 50 Ohm (= default setting). All level indications are referenced to 50 Ohm.
If a different input was selected for FSET previously, the RF input will automatically be switched to.

IEC/IEEE-bus command `:INPut<1|2>:IMPedance 50`





The softkeys *RF INPUT DC COUPLED* and *RF INPUT AC COUPLED* chose DC or AC coupling for the RF input.

The unbalanced input of FSET-*Z..* can be operated with DC or AC coupling. The two softkeys are selector switches. If one function is switched on the other is automatically switched off.

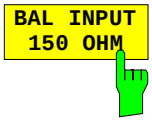
The default setting is *DC COUPLED*. For AC coupling, an isolating capacitor is switched on at the RF input. The bottom frequency limit is 100 Hz.

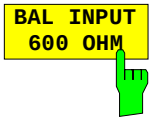
The type of coupling is displayed by enhancement lables next to the measurement value diagram:

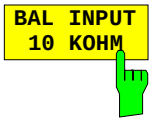
AC: RF input is AC coupled
DC: RF input is DC coupled.

When using the unbalanced input or if FSET is operated without Preselector FSET-*Z..*, only DC coupling is possible. The two softkeys are then not offered for selection.

IEC/IEEE-bus command `:INPut<1|2>:COUPling DC | AC`
`:INPut<1|2>:TYPE RF`







The *BAL INPUT* softkeys select the balanced input and one of the input impedances 150 Ohm, 600 Ohm or 10 kOhm for Preselector FSET-*Z...* The input impedances are alternative, ie if one is selected the others are switched off. If the RF input has been selected, FSET switches over to the balanced input.

With the balanced input used, the frequency range of FSET is limited to 50 kHz. Higher frequencies cannot be set.
The enhancement label BAL on the right of the measurement value window indicates that the balanced input is being used.

If FSET is operated without Preselector FSET-*Z..* the softkeys are not provided.

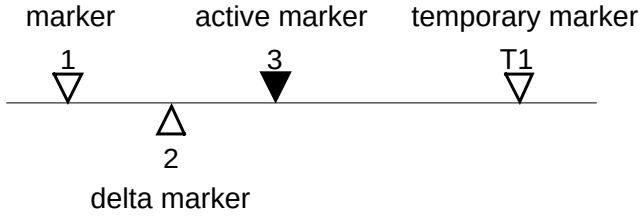
IEC/IEEE-bus command
`:INPut<1|2>:BIMPedance 150 | 600 | 10000`
`:INPut<1|2>:TYPE BALanced`

Marker Functions – *MARKER Key Group*

The markers are used for marking points on measurement curves, reading out measurement values and for quickly selecting a display screen segment. Preselected measurement routines can be called by pressing a key in the marker menu. The FSET provides four markers and four delta markers per measurement window. The currently activated marker can be shifted with the cursor keys, the roll-key or the softkeys. The softkeys are defined according to the type of display representation selected (frequency or time domain).

The marker which can be moved by the user is defined as the **active marker**.

Examples:



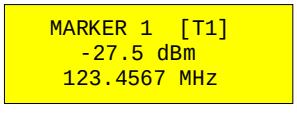
The measurement values of the active marker (also called **marker values**) are displayed in the marker field. In the **marker info list**, the measurement values from all enabled markers are sorted in ascending order. The marker info list can be switched off with the *MARKER INFO* softkey so that only the values for the active marker are shown.

The summary markers have a special function. They read out the rms or average value of the current trace or the trace averaged over several sweeps in the marker info list. These markers are not displayed.

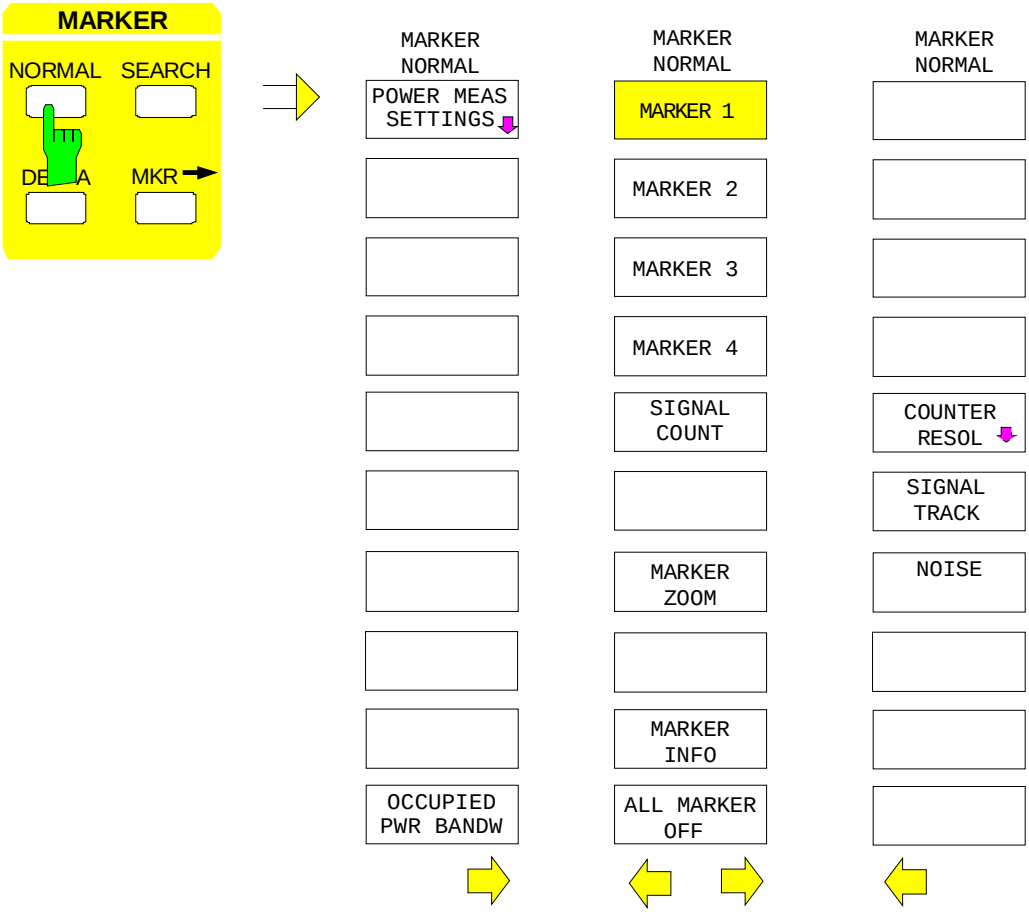
Main Markers – *NORMAL Key*

The *NORMAL* key calls a menu which contains all standard functions. The current state of the markers is indicated by a colored illumination of the softkeys. If no marker is enabled prior to pressing the *NORMAL* key, *MARKER 1* will be enabled as the reference marker and a peak search on the measurement curve is carried out (assumption: at least one measurement curve is active). Otherwise, the peak search is omitted and the entry window for the reference marker is activated.

The marker field at the upper left of the display screen shows the marker location (here, frequency), the level and the currently selected measurement curve.



MARKER NORMAL menu:

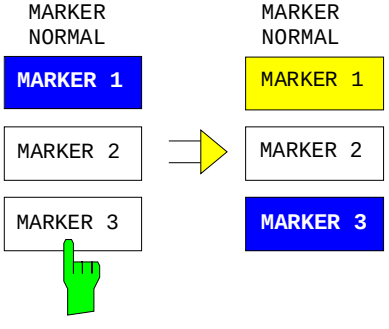




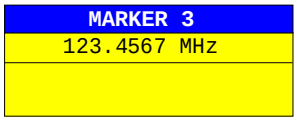
The *MARKER 1* to *MARKER 4* softkeys switch the corresponding marker on/off or activate it as the reference marker. If the marker is activated as a reference marker, an entry field for manually setting the position of the reference marker is opened simultaneously. If the marker is disabled, the softkey is not illuminated. Enabled markers and the reference marker are indicated by illuminating the corresponding softkeys in different colors.(In the instrument default state, the active reference marker is displayed in red and enabled markers are displayed in green.)

Operating example:

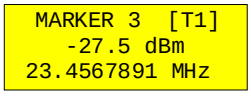
MARKER 1 is shown as the reference marker by the colored background illumination. *MARKER 2* through *MARKER 4* are turned off.

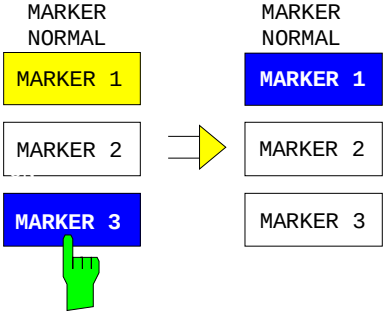


Pressing the *MARKER 3* softkey switches *MARKER 3* on and it becomes the reference maker. The previous reference marker remains enabled and the softkey remains illuminated. However, the entry mode for this marker is not now active. Instead, the entry window for *MARKER 3* is opened and the position of *MARKER 3* can be shifted.



The information in the marker field also changes to describe the new reference marker.





Pressing the current reference marker (*MARKER 3)* softkey again switches *MARKER 3* off. If at least one marker is enabled, the marker with the smallest number will be selected as the new reference marker (in the example, *MARKER 1*). Switching off the last active marker also deletes are delta markers.

IEC/IEEE-bus commands

```
:CALCulate<1|2>:MARKer<1..4>[:STATe]  ON | OFF;
:CALCulate<1|2>:MARKer<1..4>:X  10.7MHz;
:CALCulate<1|2>:MARKer<1..4>:Y?
```

When several measurement curves (traces) are being displayed, the marker is set to the maximum value (peak) of the active curve which has the lowest number (1 to 4). In case a marker is already located there, it will be set to the frequency of the next highest level (next peak).

When the split screen display mode is active, the marker will be placed in the active window (for *SCREEN A*: trace 1 or 3, for *SCREEN B*: trace 2 or 4). Since markers are attached to a measurement curve, the marker can only be enabled when at least one curve in the corresponding window is visible .

If a measurement curve is turned off, the corresponding markers and marker functions are also erased. If the curve is switched on again (*VIEW*, *CLR/WRITE*;..), these markers along with coupled functions will be restored to their original positions. A prerequisite for the restoration of the marker positions is that individual markers have not been used on another measurement curve or that the sweep data (start/stop frequency for span > 0 or sweep time for span = 0) have not been changed.

If a marker (or, delta marker) necessary for a marker function is not available, it will be automatically checked whether or not the enabling of the corresponding marker is possible (see above). If this is not the case, a warning is issued.

The activation of the desired marker function is then not possible.

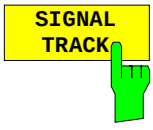
On the other hand, if the marker can be enabled, a peak search is automatically performed. Thereafter, the desired marker function can be executed.

MARKER NORMAL menu:



The *ALL MARKER OFF* softkey switches off all markers (reference and delta markers). Similarly, it switches off all functions and displays correlated with the markers/delta markers (signal count, signal track, marker zoom, N dB down, shape factor, marker list and marker info).

IEC/IEEE-bus command `:CALCulate<1|2>:MARKer<1...4>:AOFF`



After each sweep, the *SIGNAL TRACK* softkey starts a search for the maximum signal level on the display screen (*PEAK SEARCH)* and then sets the center frequency to this signal (*MARKER ->CENTER)*.

If a threshold line is enabled, only signals above the threshold level are considered. If no signal is over the threshold, the center frequency remains constant until a signal is available which is over the threshold.

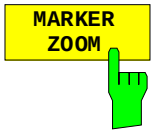
If no marker is switched to the active trace, the next unused marker is automatically activated and positioned by the peak search routine.

In order to reduce the search range, it is possible to apply the *SEARCH LIMIT ON/OFF* function (see section: "Search Functions"). Bei einer Änderung der Mittenfrequenz bleibt die Position der Frequenzlinie relativ zur Mittenfrequenz erhalten, d.h., die absolute Position wird entsprechend angepaßt.

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

IEC/IEEE-bus commands

```
:CALCulate<1|2>:MARKer<1..4>:COUNt ON |OFF;
:CALCulate<1|2>:MARKer<1..4>:COUNt:FREQuency?
```



The *MARKER ZOOM* softkey expands the area around the active marker. 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 is then configured and the new settings are used by the FSET 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.

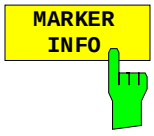
If no marker is activated when the softkey is pressed, then *MARKER 1* is automatically activated and set to the highest peak in the measurement window.

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

```
:CALCulate<1|2>:MARKer<1..4>:FUNCtion:ZOOM  1KHZ
```



The *MARKER INFO* softkey opens the display of several markers within the grid. In the upper right corner of the grid, a maximum of 4 markers/delta markers with the marker symbols Δ/∇, marker number (1 to 4), position and measurement value are listed. For the output of the marker position, the number or displayed characters will be limited as required.

If the number of lines available is not enough for all the enabled markers and delta markers, first the markers and then the delta markers are entered into the info list

In the *SPLIT SCREEN* display, the info list is partitioned into 2 partial lists and assigned to the corresponding measurement window (*SCREEN A* and *SCREEN B*). The info list for *SCREEN A* contains the markers which are assigned to trace 1 or trace 3. The info list for *SCREEN B* contains the markers which are assigned to trace 2 and trace 4.

For the two measurement windows, it is not possible to turn the *MARKER INFO* function selectively on/off .

IEC/IEEE-bus command `:DISPlay:WINDow<1|2>:MINFo ON | OFF`

Frequency Measurement

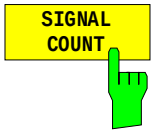
In order to perform an exact determination of the frequency of a signal, the FSET is equipped with an internal frequency counter. The frequency counter measures the frequency of the RF signal at the intermediate frequency. Using the value found at the intermediate frequency, the FSET calculates the frequency of the RF signal by applying the known frequency conversion relationships.

The frequency measurement error depends only upon the accuracy of the frequency standard used (external or internal reference). Although the FSETalways operates with a synchronous sweep, independent from the set span, the frequency counter delivers a more exact frequency measurement than a measurement performed with a marker. This is explained by the following:

- The marker measures only the position of the pixel on the measurement curve (trace) and infers therefrom the frequency of the signal. The trace, however, contains only a limited number of pixels. Each pixel, depending upon the selected span, may contain many measurement values which, as a consequence, causes a limitation in the frequency resolution.
- The resolution with which the frequency can be measured is proportional to the measurement time. For measurement time reasons, the bandwidth is normally held as wide as possible and the sweep time is set a 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 (see also Chapter 2).

MARKER NORMAL menu:



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

The frequency is counted at the position of the reference marker. 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 *COUNTER RESOL* sub-menu.

If no marker is enabled when the *SIGNAL COUNT* softkey is pressed, *MARKER 1* is switched on and set at the largest signal.

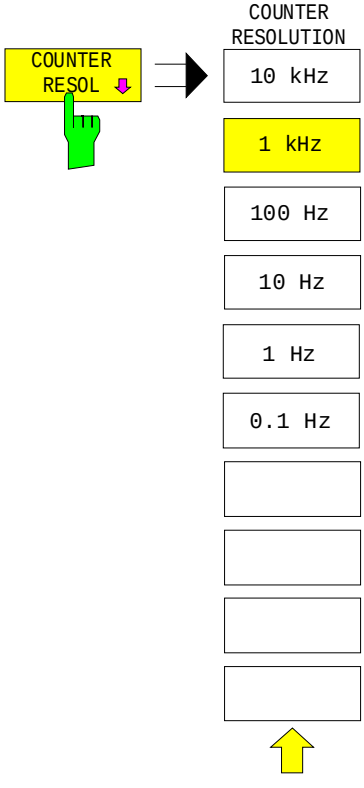
In addition, the *SIGNAL COUNT* function is displayed in the marker field on the display screen with [T x CNT].

```
MARKER 2 [T1 CNT]
   -27.5 dBm
 23.4567891 MHz
```

Switching the *SIGNAL COUNT* function off is accomplished by pressing the softkey once again.

IEC/IEEE-bus command

```
:CALCulate<1|2>:MARKer<1..4>:COUNt  ON | OFF;
:CALCulate<1|2>:MARKer<1..4>:COUNt:FREQuency?
```



The *COUNTER RESOL* softkey in the right-hand supplementary menu opens a sub-menu in which the resolution of the frequency counter can be defined.
The value can be selected between 0.1 Hz and 10 kHz.

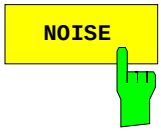
The time which the frequency counter requires for a measurement is proportional to the selected resolution. For example, a 1 Hz resolution will require approximately one second measurement time. In order to prevent slowing the sweep time unnecessarily, it is recommended that the frequency resolution be set as low as possible.

IEC/IEEE-bus command

```
:CALCulate<1|2>:MARKer<1..4>:COUNt:RES 1KHZ
```

Noise Power Density Measurement

MARKER NORMAL menu:



The *NOISE* softkey located in the right-hand supplementary menu switches the noise measurement on/off.

During a noise measurement, the noise power density is measured at the position of the reference marker. The display takes place in the marker field dependent upon the vertical units in dBx/Hz (for logarithmic scale) or in V/Hz, A/Hz or W/Hz for linear scales. The correction factors for the selected bandwidth and the conversion of the IF logarithmic converter are automatically taken into consideration.

The measurement should be performed by the sampling detector which allows displaying the effective value of the noise power.

In order to produce a smoother noise display, neighboring points (symmetrical to measurement frequency) on the measurement curve are averaged.

In the time domain display, an average of the measurement values takes place in time (after each sweep).

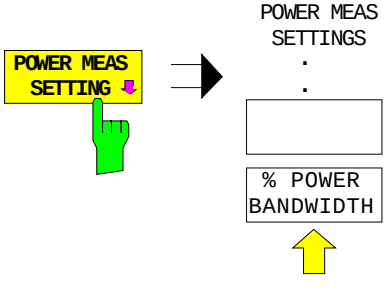
IEC/IEEE-bus command

```
:CALCulate<1|2>:MARKer<1..4>:FUNCtion:NOISe ON | OFF;
:CALCulate<1|2>:MARKer<1..4>:FUNCtion:NOISe:RESult?
```

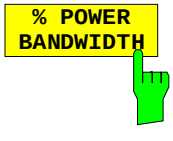
Occupied Bandwidth Measurement

An important characteristic of a modulated signal is the bandwidth which it occupies. The occupied bandwidth must be limited in a radio communications system so that disturbance-free transmission in adjacent channels is possible. The occupied bandwidth is defined as the bandwidth in which a defined percentage of the total transmitter power is contained. The percentage of the power can be set between 10% and 99% in the FSET.

MARKER NORMAL - POWER MEAS SETTINGS submenu:



The *POWER MEAS SETTINGS* softkey calls the sub-menu for the entry of the percentage of power.

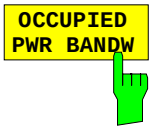


The *% POWER BANDWIDTH* softkey opens an entry window for defining the percentage of the power with respect to the total power in the displayed frequency range. This defines the occupied bandwidth (percent of the total power).

The permitted range is 10 % - 99 %.

IEC/IEEE-bus command `:[SENSe<1|2>:]POWer:BANDwidth 99PCT`

MARKER NORMAL menu:



The *OCCUPIED PWR BANDW* (occupied power bandwidth) softkey starts the measurement for determining the occupied bandwidth.
In the spectrum display mode, the bandwidth is determined in which a predefined percentage of the power in the displayed bandwidth is contained. (selectable in the *POWER MEAS SETTINGS* sub-menu with the : *% POWER BANDWIDTH* softkey*)*. The occupied bandwidth is output to the marker display field and marked on the measurement curve with temporary markers.

IEC/IEEE-bus command

```
:CALCulate<1|2>:MARKer<1...4>:FUNCtion:POW:SELect OBW
:CALCulate<1|2>:MARKer<1...4>:FUNCtion:POW:RESult? OBW
:CALCulate<1|2>:MARKer<1...4>:FUNCtion:POW[:STATe] OFF
```

Measurement principle:

For example, the bandwidth is to be found in which 99% of the signal power is contained. The routine calculates first the total power of all displayed points (pixels) of the measurement curve. In the next step, the measurement points from the right edge of the measurement curve are integrated until 0.5% of the total power is reached. Then the FSET integrates, in an analog fashion, from the left edge of the measurement curve until 0.5% of the power is reached. The delta marker is positioned at this point. Thus, 99% of the power is located between the two markers. The difference between the two frequency markers is the occupied bandwidth which is displayed in the marker info field.

A prerequisite for the correct operation of the measurement is that **only** the signal to be measured is visible on the display screen of the FSET. An additional signal would falsify the measurement.

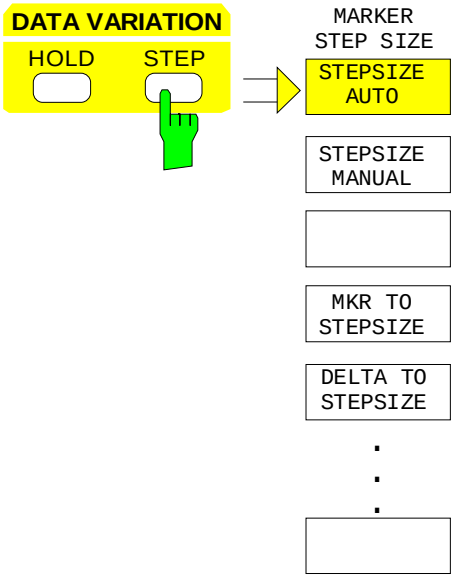
In order to be able to perform correct power measurements, especially for noisy signals, and thus to achieve the correct occupied bandwidth, the selection of the following parameters should be observed:

RBW	<< occupied bandwidth (≤ approx. 1/20 of the occupied bandwidth, for voice communications, typ. 300 Hz or 1 kHz)
VBW	≥ 3 x RBW
detector	sampling
span	≥ 2 to 3 x occupied bandwidth

According to the application or other measurement guidelines, it may be necessary or reasonable to average a definite number of sweeps in order to achieve a usable value for the occupied bandwidth.
This is provided by the *TRACE* (1....4) key group and the averaging function. With the *SWEEP COUNT* softkey, the number of averages is defined.
Some measurement instructions (e.g. PDC, RCR, STD-27B) require the occupied bandwidth to be measured by means of a peak detector. In this case, the detector of the FSET must be corrected appropriately.

Marker Step Size

DATA VARIATION – STEP menu:



The *STEP* key in the *DATA VARIATION* key group opens a menu to match the marker step size to each individual application. In order to change the step size, the marker entry mode must already be active.

Control is returned to the *MARKER NORMAL* menu via the menu key .

STEPSIZE AUTO

The *STEPSIZE AUTO* softkey sets the marker step size to *AUTO*. In this case, the step size is exactly 10% of the grid. A one-raster movement of the roll-key corresponds to one pixel.

STEPSIZE AUTO is the default setting.

IEC/IEEE-bus command

```
:CALCulate<1|2>:MARKer<1..4>:STEP:AUTO  ON|OFF
```

STEPSIZE MANUAL

The *STEPSIZE MANUAL* softkey activates the entry window for defining a fixed value for the marker step size.

Pressing the step key shifts the marker position by the selected step size. The resolution of the roll-key is always one pixel per raster.

IEC/IEEE-bus command

```
:CALCulate<1|2>:MARKer<1..4>:STEP 10KHZ
```

MKR TO STEPSIZE

The *MKR TO STEPSIZE* or *DELTA TO STEPSIZE* softkeys set the marker step size to the current (delta) marker frequency or (delta) marker time, respectively

In the frequency domain, this function is well suited to harmonic measurements. The marker is set to the largest signal using the peak search function. After activation of the *MKR TO STEPSIZE* function, the marker is set to the corresponding harmonic of the signal each time the cursor key or is pressed when entering the marker position (see also Chapter 2).

IEC/IEEE-bus command

```
:CALCulate<1|2>:MARKer<1..4>:FUNCtion:MSTep
```

DELTA TO STEPSIZE

The *DELTA TO STEPSIZE* softkey sets the marker step size to the difference between the reference marker and the last active delta marker.

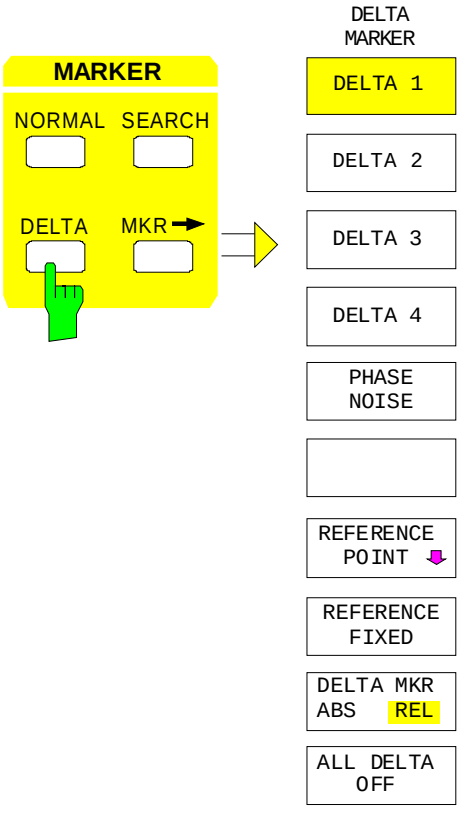
The softkey is only available when at least one delta marker is enabled.

IEC/IEEE-bus command --

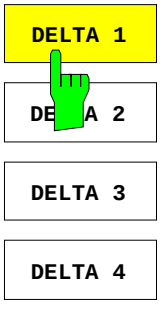
Delta Markers – *DELTA Key*

The delta markers are used to measure a level or frequency referred to a reference marker. They are always referenced to the marker whose position was last changed. A delta marker is displayed as an empty △ symbol. The reference marker is displayed as a filled ▼ symbol.

MARKER DELTA menu:



The *DELTA* key switches a delta marker on and calls the menu for its control. If no marker is enabled, *MARKER 1* is automatically activated when the delta marker is switched on. The delta marker activated to entry mode is shown on the display screen as a filled ▲ symbol.



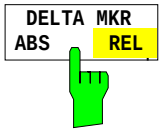
The *DELTA 1 to 4* softkeys are used to enable delta markers 1...4. The control of the delta markers corresponds to that of the markers. After a delta marker has been enabled, all entries are now applicable to this marker. The main marker must be activated anew if its position is to be changed.

The delta marker field on the display screen contains the delta marker number, the difference frequency from the delta marker to reference marker and the level difference between the active delta markers and reference markers.

The indicated differences are, in general, referred to the reference marker. If the *PHASE NOISE* or *REFERENCE FIXED* functions are enabled, the reference values under *REFERENCE POINT* are applicable.

IEC/IEEE-bus commands

```
:CALCulate<1|2>:DELTamarker<1..4>  ON|OFF
:CALCulate<1|2>:DELTamarker<1..4>:X 10.7MHZ
:CALCulate<1|2>:DELTamarker<1..4>:X:REL?
:CALCulate<1|2>:DELTamarker<1..4>:Y
```



The *DELTA ABS REL* softkey switches between relative and absolute entry modes for the delta-marker frequency.

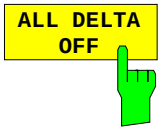
In the *REL* position, the delta marker frequency is entered relative to the reference marker. In this case, the entry mode for the delta-marker frequencies is also relative.

In the *ABS* position, the entry of the delta-marker frequency is in terms of absolute frequency.

The default setting is *REL*.

IEC/IEEE-bus command

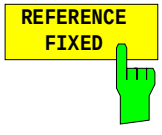
```
:CALCulate<1|2>:DELTamarker<1..4>:MODE  ABS | REL
```



The *ALL DELTA OFF* softkey switches off all active delta markers and any associated functions (e.g. *REFERENCE FIXED*, *PHASE NOISE*).

IEC/IEEE-bus command

```
:CALCulate<1|2>:DELTamarker<1...4>:AOFF
```



The *REFERENCE FIXED* softkey enables/disables relative measurements with respect to a fixed, measurement-curve-independent reference value.

The information in the delta-marker field on the display screen is referenced to this fixed reference value. For the generation of the marker lists using *MARKER INFO* list, the delta markers are also output relative to a fixed reference. In the lists, the *REFERENCE POINT* is tagged by the number of the reference marker (only one enabled)

When *REFERENCE FIXED* is enabled, the current settings of the reference marker become the reference values. If no marker is active, *MARKER 1* (with peak search) is activated. After transferring the reference values, all markers are deleted, and the active delta marker is set to the position of the reference value. Additional delta markers can be switched on.

The reference value can be subsequently changed

1. by shifting it in the *REFERENCE POINT* sub-menu.

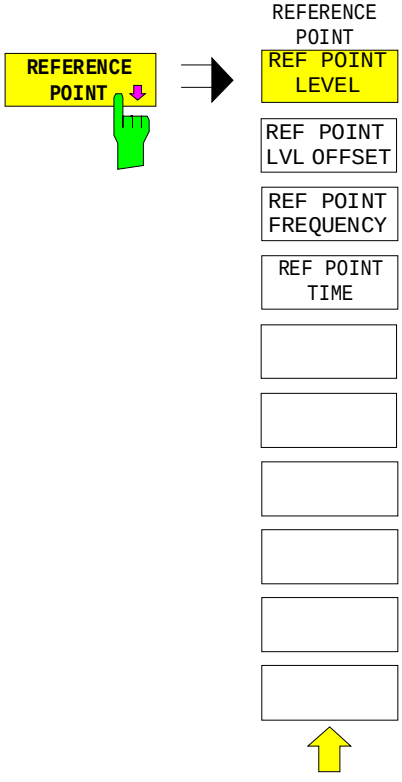
2. by starting a search:
   In the *MARKER NORMAL* menu the *REF POINT* is handled as a reference marker (even though it is not bound to the measurement curve). This means, that it will be shown as enabled and can also be changed in position. The co-ordinates of the *REF POINT* are overwritten by the marker values (they lie, by definition, on the measurement curve). Thus, it is possible, even for an enabled *REFERENCE FIXED*, to define a new reference point function with search functions.

The *REFERENCE FIXED* function is particularly useful for measurements which are performed relative to a reference signal that is not available during the whole measurement time (e.g. harmonics measurements, see Chap. 2).

IEC/IEEE-bus command

```
:CALCulate<1|2>:DELTamarker<1..4>:FUNCtion:FIXed ON|OFF
```

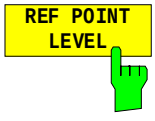
MARKER DELTA- REFERENCE POINT submenu:



The *REFERENCE POINT* softkey opens a sub-menu in which the reference value the *REFERENCE FIXED* and *PHASE NOISE* functions can be modified.

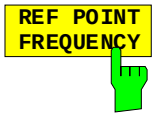
The position of the reference value is indicated by two additional display lines (horizontal and vertical). In addition, an offset level may be defined which is added to each difference during output.

The softkey is only available when the *REFERENCE FIXED* or *PHASE NOISE* function is switched on.



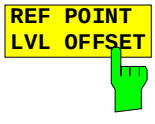
The *REF POINT LEVEL* softkey activates an entry box for setting the reference level relevant to the *REFERENCE FIXED* or *PHASE NOISE.* functions.

IEC/IEEE-bus command
`:CALCulate<1|2>:DELT<1..4>:FUNC:FIXed:RPOint:Y -10DBM`



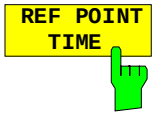
The *REF POINT FREQUENCY* softkey activates the entry box for the input of a reference frequency for the *REFERENCE FIXED* or *PHASE NOISE.* functions.

IEC/IEEE-bus command
`:CALCulate<1|2>:DELT<1..4>:FUNC:FIXed:RPOint:X 10.7MHZ`



The *REF POINT LVL OFFSET* softkey activates the entry box for the entry of an additional offset level during output when the *REFERENCE FIXED* or *PHASE NOISE.* functions are enabled.
The offset level is set to 0 dB when the *REFERENCE FIXED* or *PHASE NOISE.* functions are switched on.

IEC/IEEE-bus command
`:CALCulate<1|2>:DELT<1..4>:FUNC:FIX:RPO:Y:OFFSet 10DB`



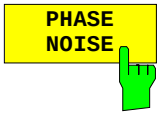
The *REF POINT TIME* softkey activates the entry box for the input of a reference time for the *REFERENCE FIXED* function in the time domain (span = 0).

The entry of a reference time for the *PHASE NOISE* function is not possible.

IEC/IEEE-bus command
`:CALCulate<1|2>:DELT<1..4>:FUNC:FIXed:RPOint:X 100ms`

Phase Noise Measurement

MARKER DELTA menu:



The *PHASE NOISE* softkey switches the *PHASE NOISE* function on/off.

Enabling the *PHASE NOISE* function causes the frequency and level of the reference marker to be transferred as reference values, that means, the REFERENCE FIXED function is activated.

The difference between this reference point and the active delta markers is determined. The correction factors for bandwidth and the logarithmic converter are automatically taken into consideration. The sampling detector is also enabled to allow the effective noise power to be displayed. The measured values are displayed in the delta marker field in units of dBc/Hz.

If several delta markers are enabled, only the measurement value output of the active marker is shown in the marker field. Using *MARKER INFO* and *MARKER LIST* the measurement data of all delta markers can be displayed.

If no marker is present when the *PHASE NOISE* function is enabled, *MARKER* 1 is automatically switched on (peak search), and the marker values are saved as reference values. The reference value can be changed later in the *NORMAL* menu, *SEARCH* menu or *REFERENCE POINT* sub-menu (see *REFERENCE FIXED* softkey).

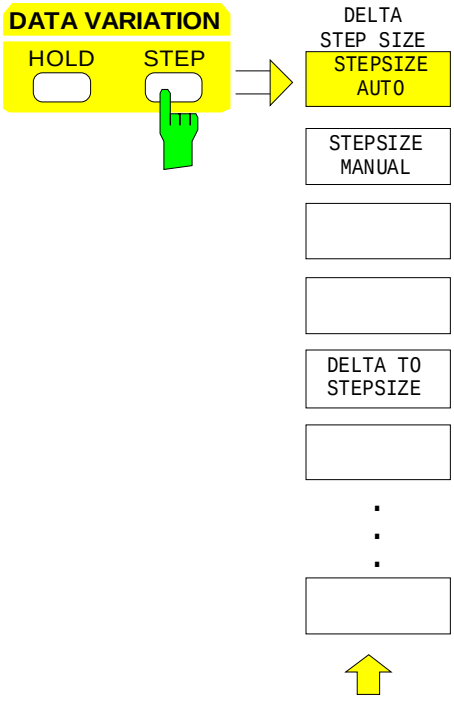
Turning on an additional marker causes the *PHASE NOISE* function to be disabled.

IEC/IEEE-bus commands

```
:CALCulate<1|2>:DELTamarker<1..4>:FUNC:PNOise  ON | OFF
:CALCulate<1|2>:DELTamarker<1..4>:FUNC:PNOise:RESult?
```

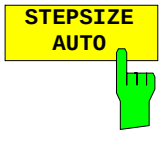
Delta-Marker Step Size - *STEP Key*

STEP-DELTA STEP menu:



The *STEP* key in the *DATA VARIATION* key group opens a menu to match the step size of the individual delta markers to the specific application. In order to change the step size, the entry mode for a delta marker must already be active.

Control is returned to the DELTA MARKER menu via the menu key .



The *STEPSIZE AUTO* softkey sets the delta marker step size to *AUTO*. In this case, the step size of the delta marker is exactly 10% of the grid. The roll-key corresponds to 1/500, i.e., for each rotational pulse, the delta marker is shifted one pixel position.

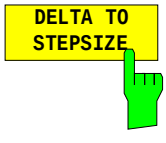
IEC/IEEE-bus command
`:CALCulate<1|2>:DELTamarker<1..4>:STEP:AUTO ON | OFF`



The *STEPSIZE MANUAL* softkey permits the entry of a fixed value for the delta marker step size.

Pressing the step-key shifts the marker position by the selected step size. The roll-key resolution, however, always remains constant at 1 pixel.

IEC/IEEE-bus command
`:CALCulate<1|2>:DELTamarker<1..4>:STEP 10HZ`



The *DELTATO STEPSIZE* softkey sets the delta marker step size to a quantity equal to the difference between the delta and reference markers.

The softkey is only presented when at least one delta marker is switched on.

IEC/IEEE-bus command `--`

Search Functions – SEARCH Key

The FSET offers numerous functions useful for peak/min. peak searching. The search functions can be used for marker as well as delta marker functions.

The setups applicable to the available search functions are performed in the *MARKER-SEARCH* menu.

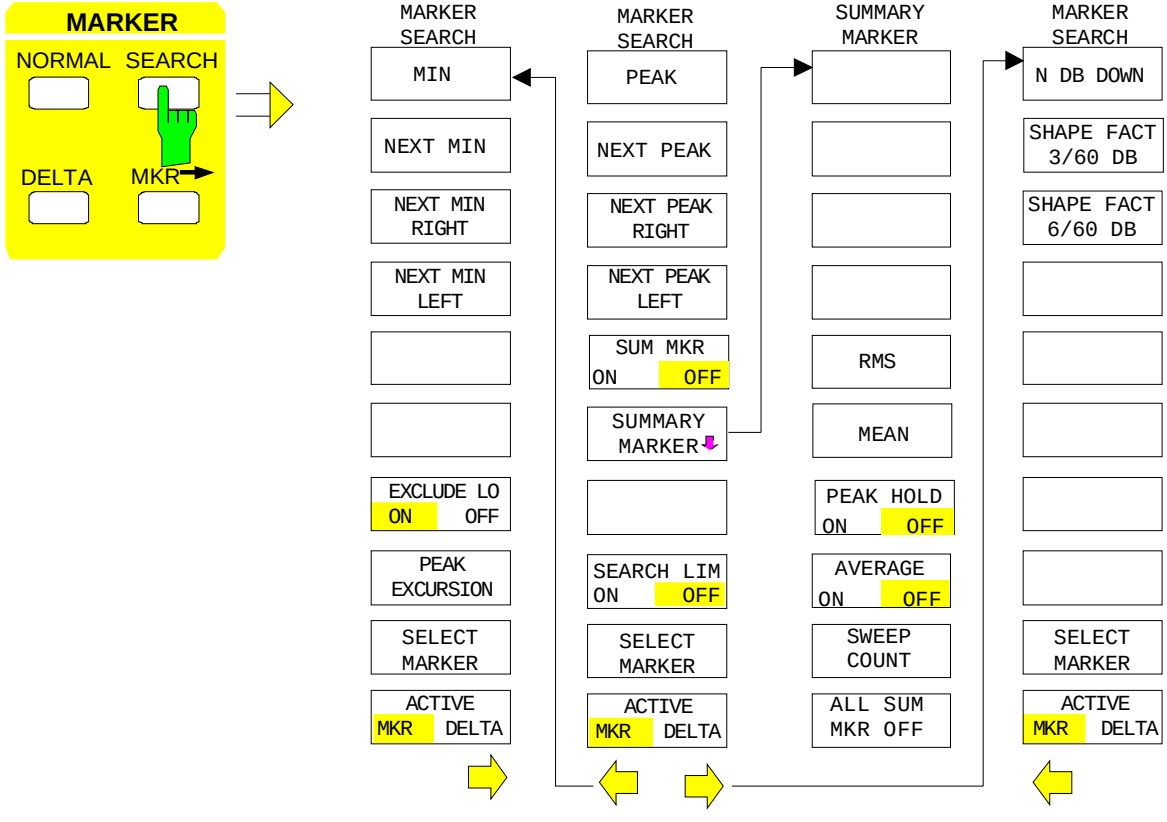
The search functions are always related to the currently active marker. If the *SEARCH* key is pressed while the marker entry mode is active, then all search functions are related to the current reference marker. If the entry mode of a delta marker is active, then the functions will be applied to the corresponding delta marker. For the case where no marker is active, *MARKER* 1 will be automatically enabled (with peak search). The *ACTIVE MKR / DELTA* softkey allows toggling between the active marker and the active delta marker.

If the threshold line is turned on, the peak/min. search functions will only evaluate signals which have a level above/below the selected threshold. In addition, the search range can also be limited (*SEARCH LIM ON/OFF* softkey) by the frequency/time lines (*FREQUENCY LINE 1/2, TIME LINE 1/2*).

For all peak search functions, the first local oscillator is omitted at 0 Hz if it happens to be displayed.

In the time domain display, the summary markers can be activated and set in addition to the search functions in menu *MARKER-SEARCH*.

MARKER SEARCH menu:





The *ACTIVE MKR / DELTA* softkey toggles between the active marker and the active delta marker.

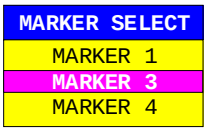
If *DELTA* is illuminated, the following search functions are performed with the active delta marker.

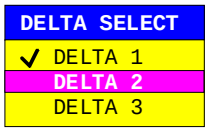
Note: *Switching between marker and delta marker entry modes may also be performed using the NORMAL and DELTA keys.*

IEC/IEEE-bus command - -

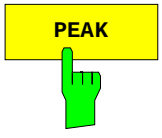


The *SELECT MARKER* softkey activates the selection of the marker/delta markers. The selection box lists the currently enabled markers/delta markers.





IEC/IEEE-bus command - -



The *PEAK* softkey sets the active marker/delta marker to the maximum displayed value on the corresponding trace.

IEC/IEEE-bus commands

```
:CALCulate<1|2>:MARKer<1..4>:MAXimum
:CALCulate<1|2>:DELTamarker<1..4>:MAXimum
```



The *NEXT PEAK* softkey sets the active marker/delta marker to the next lower peak value on the corresponding curve.

IEC/IEEE-bus commands

```
:CALCulate<1|2>:MARKer<1..4>:MAX:NEXT
:CALCulate<1|2>:DELTamarker<1..4>:MAX:NEXT
```



The *NEXT PEAK RIGHT* softkey sets the active marker to the next peak to the right of the current marker position.

IEC/IEEE-bus commands

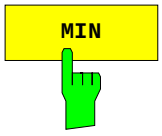
```
:CALCulate<1|2>:MARKer<1..4>:MAX:RIGHt
:CALCulate<1|2>:DELTamarker<1..4>:MAX:RIGHt
```



The *NEXT PEAK LEFT* softkey sets the active marker to the next peak to the left of the current marker position.

IEC/IEEE-bus commands

```
:CALCulate<1|2>:MARKer<1..4>:MAX:LEFT
:CALCulate<1|2>:DELTamarker<1..4>:MAX:LEFT
```



The *MIN* softkey sets the active marker to the lowest displayed peak on the corresponding measurement curve.

IEC/IEEE-bus commands

```
:CALCulate<1|2>:MARKer<1..4>:MIN
:CALCulate<1|2>:DELTamarker<1..4>:MIN
```



The *NEXT MIN* softkey sets the active marker to the next higher of the low peaks on the corresponding measurement curve.

IEC/IEEE-bus commands

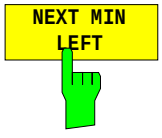
```
:CALCulate<1|2>:MARKer<1..4>:MIN:NEXT
:CALCulate<1|2>:DELTamarker<1..4>:MIN:NEXT
```



The *NEXT MIN RIGHT* softkey set the active marker to the next low peak to the right of the current marker position.

IEC/IEEE-bus commands

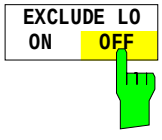
```
:CALCulate<1|2>:MARKer<1..4>:MIN:RIGHt
:CALCulate<1|2>:DELTamarker<1..4>:MIN:RIGHt
```



The *NEXT MIN LEFT* softkey sets the active marker to the next low peak to the left of the current marker position.

IEC/IEEE-bus command

```
:CALCulate<1|2>:MARKer<1...4>:MIN:LEFT
:CALCulate<1|2>:DELTamarker<1...4>:MIN:LEFT
```



The *EXCLUDE LO ON/OFF* softkey switches between a restriced (*ON*) and an unrestricted search range (*OFF*).

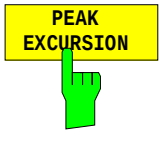
ON Because of non-ideal input mixer, the first LO of any analyzer can be seen at 0 Hz. The search functions can possibly respond to this LO level, in particular in the preset setting (FULL SPAN). To avoid this, the search range is restricted according to the following formula:

$$\text{Search range} \geq 6 \times \text{resolution bandwidth}$$

OFF No restriction to the search range. The search functions find also signals below the frequency limit quoted above.

IEC/IEEE-bus command

```
:CALCulate<1|2>:MARKer<1..4>:LOEXclude ON|OFF
```



The *PEAK EXCURSION* softkey activates the entry box which sets the minimum amount a signal level must decrease/increase before it is recognised by the search functions (except PEAK and MIN) as a maximum or minimum.
Input values from 0 dB to 80 dB are allowed with a resolution of 0.1 dB.

IEC/IEEE-bus command

```
:CALCulate<1|2>:MARKer<1..4>:PEXCursion 10DB
```

The peak excursion is preset to 6 dB. This is completely sufficient for the functions *NEXT PEAK* (or *NEXT MIN*) as always the next smaller (or higher) signal is searched four.

Functions *NEXT PEAK LEFT* and *NEXT PEAK RIGHT* (or *NEXT MIN LEFT and NEXT MIN RIGHT*) search for the next relative maximum (or minimum) independent of the current signal amplitude.
As for wide bandwidths, the set 6-dB level change is already reached by the noise indication of the analyzer, the noise values are also identified as peak. 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.

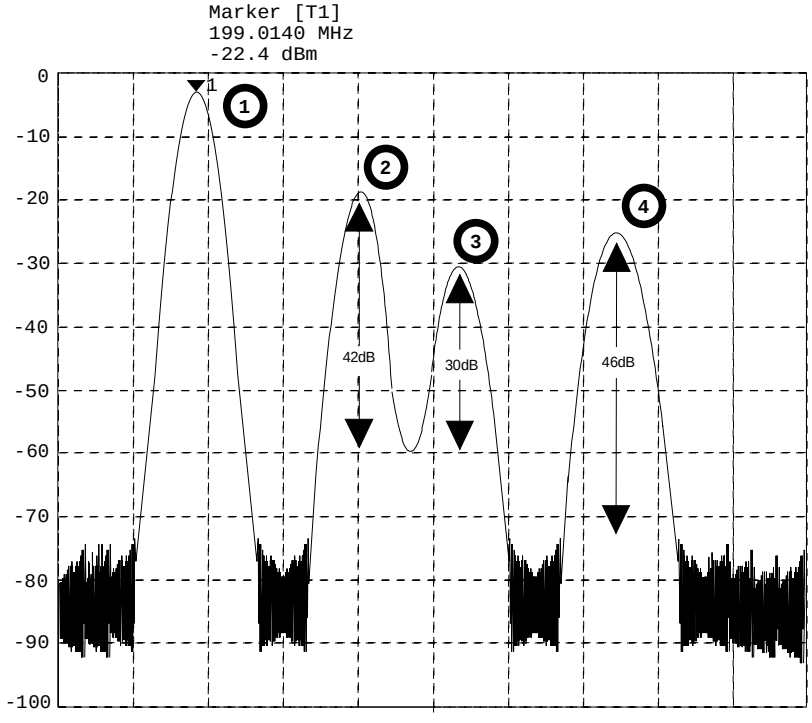


Fig. 4-6 Example for level measurements at different peak excursion settings

Maximum relative level change of the measured signals:

Signal 2:	42dB
Signal 3	30dB
Signal 4:	46dB

Setting **Peak Excursion 40dB** causes signal 2 and 4 to be detected with *NEXT PEAK* or *NEXT PEAK RIGHT*. Signal 3 is not detected since it is only decreased 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

Setting **Peak Excursion 20dB** causes signal 3 to be detected 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

Setting **Peak Excursion 6dB** recognizes 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 *SEARCH LIMIT ON/OFF* softkey switches between a limited (*ON*) and unlimited (*OFF*) search range.

For peak and min. search functions, the search range can also be limited by the frequency and time lines (FREQUENCY LINE 1, 2/TIME LINE 1, 2). If *SEARCH LIMIT = ON,* the appropriate signal level will only be searched for between the specified frequency/time lines.

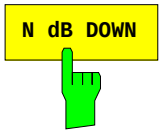
The default setting is *SEARCH LIMIT = OFF*.

When only one line is enabled, frequency/time line 1 is defined as the lower limit and the upper limit is defined by the stop frequency. If frequency/time line 2 turned on, then it determines the upper limit.

For the case in which no line is active the search range is unlimited.

IEC/IEEE-bus command

```
:CALCulate<1|2>:MARKer<1..4>:X:SLIMits ON|OFF
```



The *N dB DOWN* softkey automatically activates the temporary markers T1 and T2 which are located n dB below the active reference marker. The marker T1 is located to the left, the marker T2 is located to the right of the reference marker. The value n can be entered in an entry window. The default value is 6 dB.

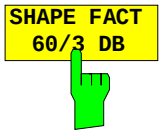
The frequency difference between the two temporary markers is shown in the level output field on the display screen.
If, e.g., due to the noise level, it is not possible to find the frequency difference for the n dB value, a broken line is displayed in the level output field.

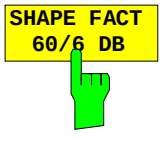
Entry mode is switched to the reference marker for the case in which the delta maker entry mode is to be active. The position of the reference marker can be changed in the usual way (numeric input, step-keys, roll-key, peak search, etc.).

Pressing the *N dB DOWN* softkey again switches the function off, however, the entry function for the reference marker remains turned on.

IEC/IEEE-bus commands

```
:CALCulate<1|2>:MARKer<1..4>:FUNCtion:NDBDown 3DB
:CALCulate<1|2>:MARKer<1..4>:FUNCtion:NDBDown:STATe ON
:CALCulate<1|2>:MARKer<1..4>:FUNCtion:NDBDown:RESult?
:CALCulate<1|2>:MARKer<1..4>:FUNCtion:NDBDown:FREQ?
```





The *SHAPE FACT 60/3dB*.and *SHAPE FACT 60/6dB* softkeys activate the automatic measurement of the form factor for the displayed signals.

For this purpose, four temporary markers are used. The markers T1 to T4 indicate, in increasing order, the 3 dB/6 dB positions below the reference marker level.

In the level output field, the relationship between the two frequency differences Δf_{60dB} / Δf_{3dB} and Δf_{60dB} / Δf_{6dB} are displayed

The display of the measurement value takes place in the marker field. When the level differences cannot be determined, the measurement value is marked as invalid. The update of the shape-factor display takes place at the end of sweep.

The entry mode is switched to the reference marker if the delta marker entry mode is to be active. The position of the reference marker can be changed in the usual way (numeric input, step-keys, roll-key, peak search, etc.).

The *SHAPE FACTOR* function is turned off by pressing *SHAPE FACTOR* softkey once again, or by enabling another marker.

The *SHAPE FACTOR* function is available only in the frequency domain.

IEC/IEEE-bus commands

```
:CALCulate<1|2>:MARKer<1..4>:FUNCtion:SFACtor
                                (60dB/3dB) | (60dB/6dB)
:CALCulate<1|2>:MARKer<1..4>:FUNCtion:SFACtor:STATe ON
:CALCulate<1|2>:MARKer<1..4>:FUNCtion:SFACtor:RESult?
:CALCulate<1|2>:MARKer<1..4>:FUNCtion:SFACtor:FREQ?
```

Summary Marker

The summary markers are available for measurements in the time domain (SPAN = 0).

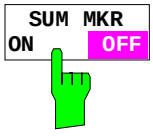
Unlike the markers and delta markers, the *summary markers* are not used to mark the pixels of a trace. They activate a measurement of the rms value (*RMS*) or of the average value (*MEAN*) of the whole trace. The result is displayed in the marker info field.

The measured values are either updated after every sweep or averaged according to a defined number of sweeps (*AVERAGE ON/OFF* and *SWEEP COUNT*). In case of maximum peak evaluation (*PEAK HOLD ON*) the measured values are held until the occurrence of the next higher value.

Example:
Marker info field switched on with summary marker: *MEAN*, *AVERAGE ON* and *PEAK HOLD ON*

```
MEAN HOLD      2.33 Watt
MEAN AV        2.29 Watt
```

MARKER SEARCH menu



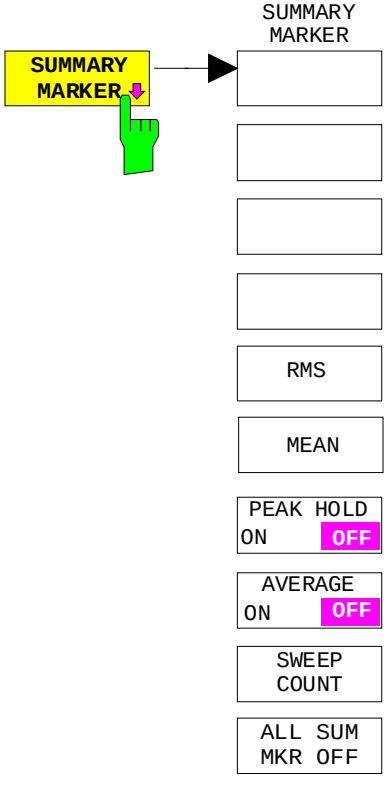
The *SUM MKR* softkey activates the summary marker

The measurement, rms or average value and the settings for maximum peak evaluation and averaging is selected in the submenu *SUMMARY MARKER*.

The softkey is only available in the time domain.

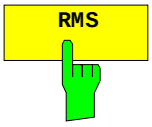
IEC/IEEE-bus command

```
:CALCulate<1|2>:MARKer<1..4>:FUNCtion:SUMMary ON|OFF
```



The *SUMMARY MARKER* softkey calls up the submenu for selecting the summary marker measurements.

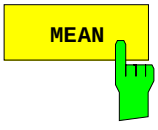
The softkey is only available in the time domain.



The *RMS* softkey selects the measurement of the rms value of the signal per sweep.
In case of maximum peak evaluation the highest rms value since the activation of *PEAK HOLD ON* is displayed.
In case of *AVERAGE ON* the rms values of a trace are averaged and displayed over several sweeps.
The number of sweeps is set with the *SWEEP COUNT* softkey. If *PEAK HOLD = ON* is active at the same time, the display is held until the occurrence of the next higher average value.

IEC/IEEE-bus commands

```
:CALCulate<1|2>:MARKer<1..4>:FUNCtion:SUMM:RMS ON
:CALCulate<1|2>:MARKer<1..4>:FUNCtion:SUMM:RMS:RES?
:CALCulate<1|2>:MARKer<1..4>:FUNCtion:SUMM:RMS:AVER:RES?
:CALCulate<1|2>:MARKer<1..4>:FUNCtion:SUMM:RMS:PHOL:RES?
```

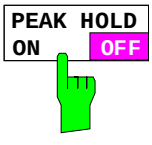


The *MEAN* softkey selects the measurement of the average value of the signal per sweep.

Thus, the mean power can be measured, for example during a GSM burst.
In case of maximum peak evaluation, the highest average value since the activation of *PEAK HOLD ON* is displayed.
In case of *AVERAGE ON*, the average values of a trace are averaged and displayed over several sweeps.
The number of sweeps is set with the *SWEEP COUNT* softkey. If *PEAK HOLD = ON* is active at the same time, the display is held until the occurrence of the next higher average value.

IEC/IEEE-bus commands :

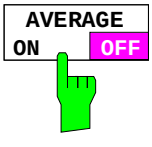
```
:CALCulate<1|2>:MARKer<1..4>:FUNCtion:SUMM:MEAN ON
:CALCulate<1|2>:MARKer<1..4>:FUNCtion:SUMM:MEAN:RES?
:CALCulate<1|2>:MARKer<1..4>:FUNCtion:SUMM:MEAN:AVER:RES?
:CALCulate<1|2>:MARKer<1..4>:FUNCtion:SUMM:MEAN:PHOL:RES?
```



The *PEAK HOLD ON/OFF* softkey switches the maximum peak evaluation on and off.
For all active summary markers, the displays are updated after each sweep only if higher values have occurred.
The measured values can be reset by switching the *PEAK HOLD ON / OFF* softkey on and off again.

IEC/IEEE-bus command

```
:CALCulate<1|2>:MARKer<1..4>:FUNCtion:SUMMary:PHOLd ON
```



The *AVERAGE ON/OFF* softkey switches the averaging of the summary markers on and off.
The measured values can be reset by switching the *AVERAGE HOLD ON / OFF* softkey on and off again.

IEC/IEEE-bus command

```
:CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary:AVERage ON
```



The *SWEEP COUNT* softkey activates the entry of the number of sweeps in the *SINGLE SWEEP* mode.

The permissible range of values is 0 to 32767.

In case of *AVERAGE ON*:

If an averaging has been selected, SW*EEP COUNT* also determines the number of measurements required for averaging.

SWEEP COUNT = 0 10 measured values are required for running averaging.

SWEEP COUNT = 1 No averaging is carried out.

SWEEP COUNT > 1 An averaging is carried out over the set number of measured values.

In the *CONTINUOUS SWEEP* mode averaging is performed until the number of sweeps set under *SWEEP COUNT* is attained and then running averaging is performed.

The maximum peak evaluation is infinite independent of the entry under *SWEEP COUNT.*

Note: *This setting is equivalent to the settings of the number of sweeps of menus TRACE and SWEEP-SWEEP.*

IEC/IEEE-bus command `:[SENSe<1|2>:]SWEep:COUNt 20`

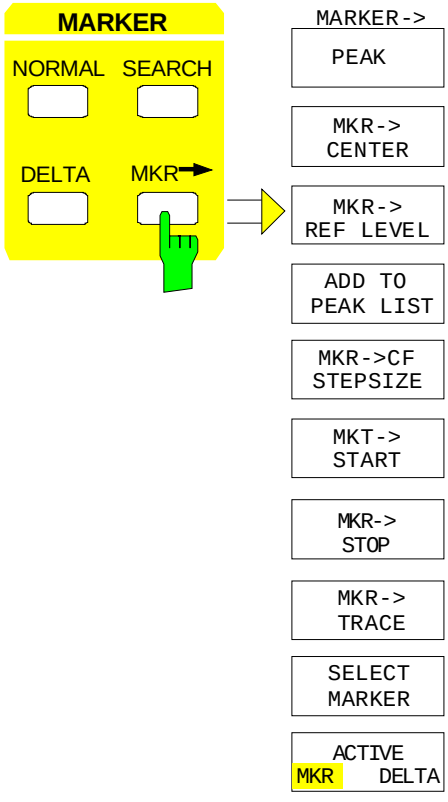


The *ALL SUM MKR OFF* softkey switches all the summary markers off.

IEC/IEEE-bus command
`:CALCulate<1|2>:MARKer<1..4>:FUNCtion:SUMMary:AOFF`

Instrument Parameter Changes via Markers – MKR Key

*MARKER MKR →*menu:



The *MKR →* menu offers functions through which instrument parameters can be changed with the aid of the currently active marker. Exactly as in the *SEARCH* menu, these functions can also be applied to the delta markers.

The choice between marker and delta marker is made according to the currently active frequency entry mode for the marker/delta marker. If no entry mode is active, the marker with the lowest number will be activated as the reference marker.

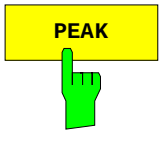


The *ACTIVE MKR /DELTA* softkey toggles between the active marker and the active delta marker.

If *DELTA* is illuminated, the following marker functions are carried out with the active delta marker.

Note: *Switching between marker and delta marker can also be done with the NORMAL and DELTA keys.*

IEC/IEEE-bus command - -



To simplify control, the *PEAK* search function (see section "Search Functions - *SEARCH Key")* is also available in the *MRK→* menu. Thus, the most important functions *MARKER→PEAK*, *MKR→CENTER* and *MKR→REF LEVEL* can be selected in one menu.

IEC/IEEE-bus commands

```
:CALCulate<1|2>:MARKer<1..4>:MAX
:CALCulate<1|2>:DELTamarker<1..4>:MAX
```



The *MKR→CENTER* softkey sets the center frequency for the current marker/delta marker .

The softkey is not available in the time domain.

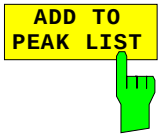
IEC/IEEE-bus command

```
:CALCulate<1|2>:MARKer<1..4>:FUNCtion:CENTer
```



The *MKR→REF LEVEL* softkey sets the reference level to that of the current marker.

IEC/IEEE-bus command
```
:CALCulate<1|2>:MARKer<1..4>:FUNCtion:REFerence
```



The *ADD TO PEAK LIST* softkey adds the receiver frequency of the current marker to the peak list (see also Section "Data Reduction and Peak List").

IEC/IEEE-bus command `--`



The *MKR→CF STEPSIZE* softkey sets the step size for the center frequency entry mode to the current marker frequency, and also sets step-size adaptation to *MANUAL*. The *CF STEP SIZE* 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, helpful in the measurement of harmonics with large dynamic range (narrow bandwidth and narrow span).

The softkey is not available in the time domain.

IEC/IEEE-bus command
```
:CALCulate<1|2>:MARKer<1..4>:FUNCtion:CSTep
```



The *MKR→START* softkey sets the start frequency to the current marker frequency.

The softkey is not available in the time domain.

IEC/IEEE-bus command
```
:CALCulate<1|2>:MARKer<1..4>:FUNCtion:STARt
```



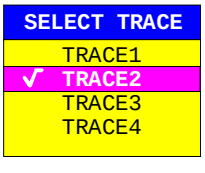
The *MKR→STOP* softkey sets the stop frequency to the current marker frequency.

The softkey is not available in the time domain.

IEC/IEEE-bus command
```
:CALCulate<1|2>:MARKer<1..4>:FUNCtion:STOP
```



The *MKR→TRACE* softkey opens a selection window through which the marker can be set to a new measurement curve. The traces available for selection appear in the window.



IEC/IEEE-bus commands
```
:CALCulate<1|2>:MARKer<1..4>:TRACe 2
:CALCulate<1|2>:DELTamarker<1..4>:TRACe 2
```

Setup of Display and Limit Lines – *LINES* Key Field

Display Lines – *D LINES Key*

Display lines are aids which, similar to markers, make the evaluation of trace data more convenient. The function of display lines is similar to that of a movable scale which can be used to measure absolute and differential values on traces.
In addition, the display lines can also be used to limit the range of search for marker functions.

The FSET provides four different types of display lines:

- two horizontal threshold lines for setting levels or for defining level search ranges – Display Line 1/2,
- two vertical frequency/time lines for indicating frequencies/times or for determining frequency or time search ranges – Frequency/Time Line 1/2,
- a threshold line which, for example, sets the search threshold for maximum levels (Peak Search) – Threshold Line
- a reference line which serves as the basis for mathematical correlation between traces – Reference Line

For purposes of clarity, each line is annotated on the right side of the display diagram by the following abbreviations:

D1	Display Line 1	T1	Time Line 1
D2	Display Line 2	T2	Time Line 2
F1	Frequency Line 1	TH	Threshold Line
F2	Frequency Line 2	REF	Reference Line

The lines for level, threshold and reference are displayed as continuous, horizontal lines over the full width of the diagram. They are movable in the y-direction.
The lines for frequency and time are displayed as vertical, continuous lines over the total height of the diagram. They are movable in the x-direction.

For measurement operations in two separate windows, (Split Screen-Modus), the display lines are available independently in both windows. In the currently active window, the display lines can be activated and/or shifted. Lines previously defined in the currently inactive window remain unchanged.

The *LINES-D LINES* menu, used for switching on and setting the display lines, is dedicated to the chosen display in the active measurement window (span or time). For the display of a spectrum (span ≠ 0), the *FREQUENCY LINE 1* and *FREQUENCY LINE 2* softkeys appear, For the time display (span = 0), the *TIME LINE 1* and *TIME LINE 2* softkeys are displayed.

Note: *The softkeys for setting and switching the display lines on and off operate similar to a three-position switch:*

Initial condition: The line is switched off (softkey has grey background)

1st press: The line is switched on (softkey has red background) and data entry is activated. The position of the display line can be adjusted by using the roll-key, the step keys or through direct numerical inputs via the data-entry keypad. If some other arbitrary function is requested, the data-entry keypad is disabled. In this case, the display line remains switched on (softkey has green background).

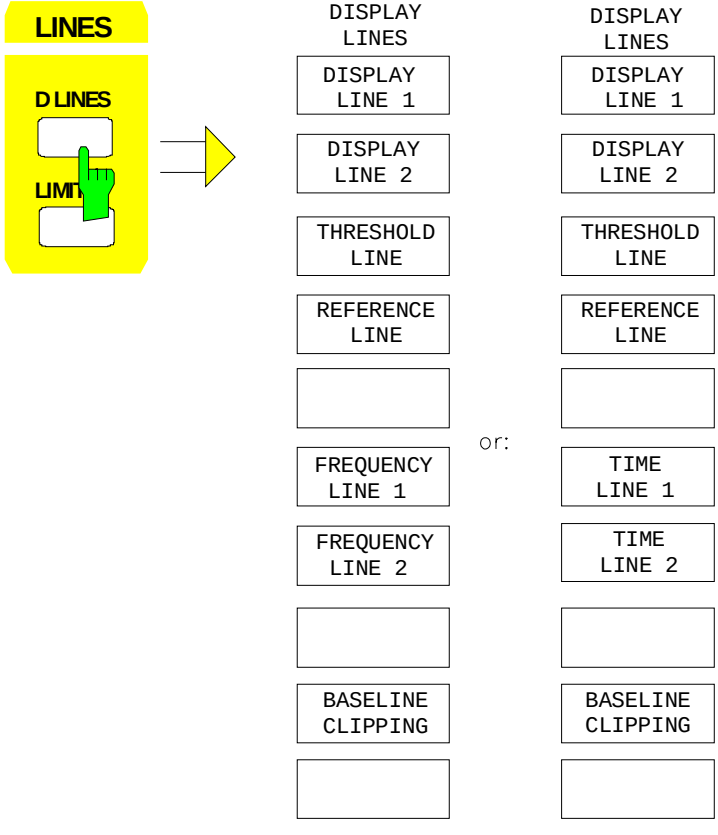
2nd press: The display line is switched off (softkey has grey background).

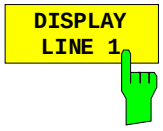
Initial condition: The line is switched on (softkey has green background)

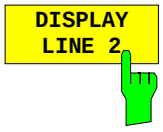
1st press: The line is switched on (softkey has red background) and data entry is activated. The position of the display line can be adjusted by using the roll-key, the step keys or through direct numerical inputs via the data-entry keypad. If any other arbitrary function is requested, the data-entry keypad is disabled. In this case, the display line remains switched on (softkey has green background).

2nd press: The display line is switched off (softkey has grey background).

Menu *LINES-D-LINES* for Span ≠ 0 for Span = 0





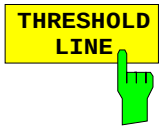


The *DISPLAY LINE 1/2* softkeys switch the display lines on/off and activate the entry of the line location.

The display lines mark the selected levels in the measurement window.

IEC/IEEE-bus commands

```
:CALCulate<1|2>:DLINe<1|2>:STATe  ON | OFF;
:CALCulate<1|2>:DLINe<1|2> -20dBm
```

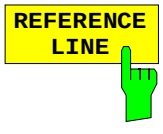


The *THRESHOLD LINE* softkey switches the threshold line on/off and activates the entry of the line location.

The threshold line is a display line which defines a threshold value. This threshold value serves as a lower search limit for maximums/minimums in the marker functions (*MAX PEAK, MIN PEAK, NEXT PEAK* etc.). For signal tracking (*SIGNAL TRACK function*), this threshold value defines the lower search limit (see section "Marker Functions")..

IEC/IEEE-bus commands

```
:CALCulate<1|2>:THReshold ON | OFF;
:CALCulate<1|2>:THReshold -82dBm
```

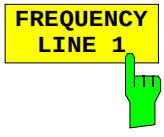


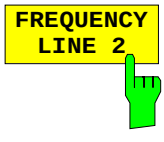
The *REFERENCE LINE* softkey switches the reference line on/off and activates the entry of the line position.

The reference line serves as the basis for mathematical correlation between trace data (see section "Mathematical Operations on Measurement Curves"

IEC/IEEE-bus commands

```
:CALCulate<1|2>:RLINe:STATe ON | OFF;
:CALCulate<1|2>:RLINe -10dBm
```



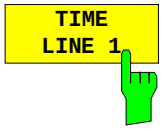


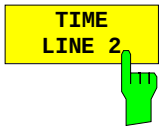
The *FREQUENCY LINE 1/2* softkeys switch the frequency lines 1/2 on/off and activate the entry of the line locations.

The frequency lines mark the selected frequencies in the measurement window or define search ranges (see section "Marker Functions").

IEC/IEEE-bus commands

```
:CALCulate<1|2>:FLINe<1|2>:STATe ON | OFF;
:CALCulate<1|2>:FLINe<1|2> 120 MHz
```





The *TIME LINE 1/2* softkeys switch the time lines 1/2 on/off and activate the entry of line locations.

The time lines mark the selected times or define the search range (see section "Marker Functions").

IEC/IEEE-bus commands

```
:CALCulate<1|2>:TLINe<1|2>:STATe ON | OFF;
:CALCulate<1|2>:TLINe<1|2> 10ms
```



The *BASELINE CLIPPING* softkey switches on or off the *BASELINE CLIPPING* function and allows a limit value to be entered.

The *BASELINE CLIPPING* function is for blanking measured values (for example noise) which are below a preset threshold.
If the *BASELINE CLIPPING* function is active and a measured value is below the preset threshold, the value is set to a lower boundary (-400 dBm). Measured values above the clipping level are not changed.

Note: *It is advisable not to combine the BASELINE CLIPPING function with the AUTOPEAK detector.*
If the set clipping value is within the displayed noise band (AUTOPEAK detector), activation of the CLIPPING function and the resulting clipping of the MIN PEAK values will lead to a drastic enlargement of the displayed noise band.

IEC/IEEE-bus commands

```
:CALCulate<1|2>:CTHReshold:STATe ON | OFF
:CALCulate<1|2>:CTHReshold -82dBm
```

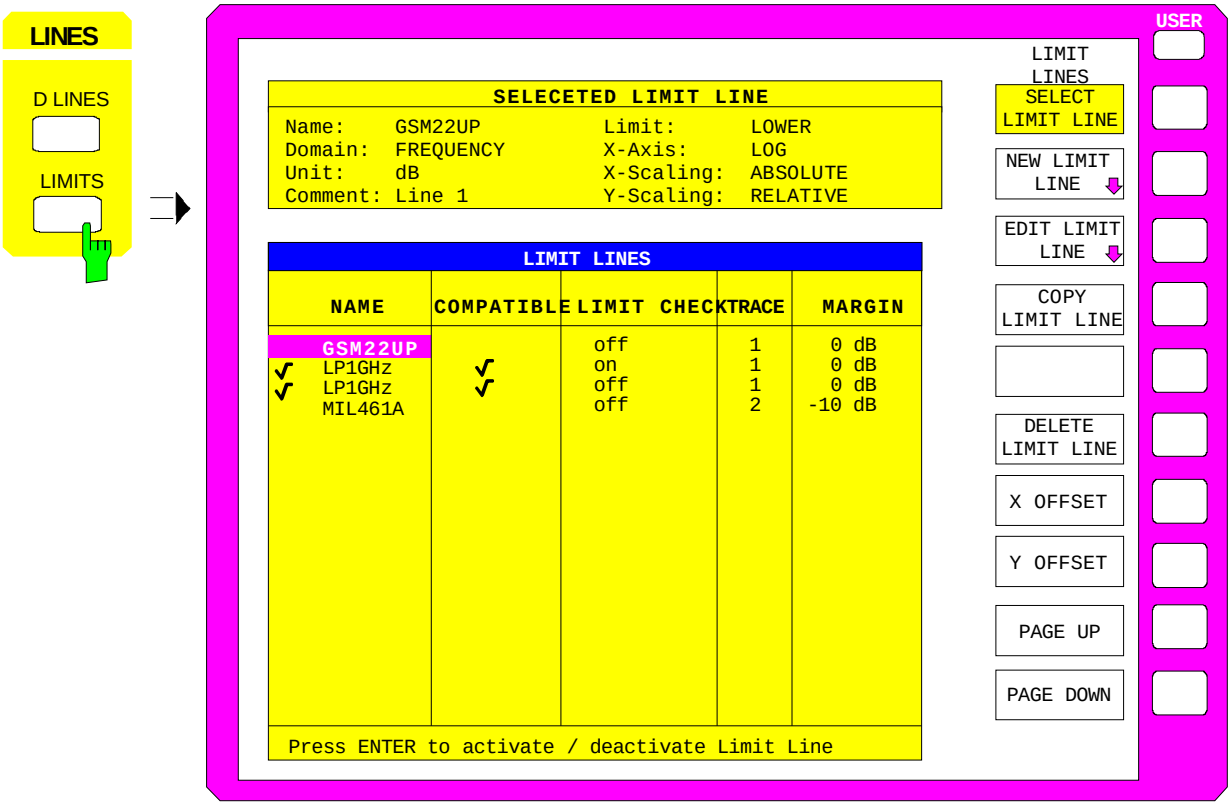
Limit Lines – *LIMITS Key*

Limit lines are used to define limits for amplitude curves or spectral distributions on the screen. They indicate, for example, the upper limits for interference radiation or spurious waves which are permissible from a Unit Under Test (UUT). In the case of TDMA transmissions (e.g., GSM), the amplitude curve of the bursts in a time slot 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 cecked either visually or automatically for any violations of the upper or lower limits (GO/NOGO test).
The FSET instrument supports up to 300 limit lines, each of which may have a maximum of 50 data points. For each limit line, the following characteristics must be defined:

- The name of the limit line. The limit line is stored under this name and is diplayed in the *LIMIT LINES* table.
- The domain in which the limit line is to be used. A distinction is made between the time domain (span = 0 Hz) and the frequency domain (span > 0 Hz).
- The X-coordinates of the interpolation points. The limit line can be specified either in terms of absolute frequencies or times or in terms of frequencies referred to the set center frequency and times referred to the time represented by the left-hand edge of the diagram.
- The Y-coordinates of the interpolation points. The limit line can be selected either for absolute levels or voltages or referred to the set maximum level (Ref Lvl or Max Lvl). If the reference line is switched on, it is used as reference when relative setting has been selected.
- The type of limit line (upper or lower limit). With this definition and the limit checking function on (*LIMIT CHECK*), the FSET checks for compliance with each limit.
- The limit line units. The units for the limit line must be compatible with the level axis in the active measurement window.
- The trace to which the limit line is assigned. For the FSET, this defines the trace 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.
- A comment can also be entered for each limit line, e.g., a description of the application.

In the *LINES LIMIT* menu, the compatible limit lines can be enabled in the *LIMIT LINES* table. The *SELECTED LIMIT LINE* display field provides information about the characteristics of the marked limit lines. New limit lines can be specified and edited in the *NEW LIMIT LINE and EDIT LIMIT LINE* sub-menus.

LINES LIMIT menu

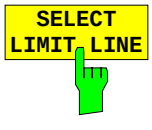


Limit Line Selection

The *SELECTED LIMIT LINES* table provides information about the characteristics of the marked limit line :

Name	name
Domain	frequency or time
Limit	upper/lower limit
X-Axis	linear or logarithmic interpolation
X-Scaling	absolute or relative frequencies/times
Y-Scaling	absolute or relative Y-units
Unit	for vertical scale
Comment	comment

The characteristics of the limit line are set in the *EDIT LIMIT LINE (=NEW LIMIT LINE)* submenu.



The *SELECT LIMIT LINE* softkey activates the *LIMIT LINES* table and the selection bar jumps to the uppermost name in the table.

The columns headfings are as follows:

Name	NAme of the limit line to be selected.
Compatible	Indicates if the limit line is compatible with the measurement window of the given trace.
Limit Check	Activates the automatic "within limits" check.
Trace	Selects the trace to which the limit is assigned.
Margin	Defines a margin.

***Name and Compatible* - Switching on limit lines**

A maximum of 8 limit lines can be switched at any one time. A check mark at the left edge of a cell indicates that this limit line is switched on. A limit line can only be switched on when it has a check mark in the *Compatible* column, i.e., only when the display mode of the x-axis (time or frequency) and y-axis units are ***identical*** to those in the measurement window.

It should be noted that lines with dB scales are compatible with all dB(..) scales of the Y-axis.
If the trace assigned to a line is not switched on, the line is displayed in the window the trace would be displayed in.

Example:
In split screen mode, trace 2 is assigned measuring window B. A line assigned to trace 2 is always displayed in measurement window B.

If the y-axis unit or the domain (frequency or time) are changed, all non-compatible limit lines are automatically switched off in order to avoid misinterpretations. The limit lines must be switched on again when the original display mode is restored.

IEC/IEEE-bus commands

```
:CALCulate<1|2>:LIMit<1..8>:NAME <string>;
:CALCulate<1|2>:LIMit<1..8>:STATe ON | OFF
```

***Limit Check* - Activating the limit check**

When *LIMIT CHECK ON* is activated, a limit check is performed automatically on the active screen. In the center of the screen, a display window containing the results of the limit check test appears:

LIMIT CHECK: PASSED	No out-of-limits conditions.
LIMIT CHECK: FAILED	One or more out-of-limits conditions. 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 line 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 three active limit lines:

```
LIMIT CHECK: FAILED

LINE VHF_MASK: Failed
LINE UHF2MASK: Margin
```

A limit check is performed only if the trace associated with the limit line is turned on.
If *LIM CHECK* is set to *OFF* for all active limit lines, then the limit line check is not executed and the display field not activated.

IEC/IEEE-bus command `:CALCulate<1|2>:LIMit<1...8>:FAIL?`

***Trace* - Selecting the trace to which the limit line is assigned.**

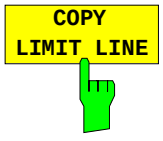
The trace is selected in an entry window. An integer entries 1, 2, 3 or 4 indicating the trace is entered. The default setting is trace 1. If the selected limit line is not compatible with the assigned trace, the limit line is disabled. (display and limit check).

IEC/IEEE-bus command
```
:CALCulate<1|2>:LIMit<1...8>:TRACe 1|2|3|4
```

***Margin* - Setting a margin.**

The margin is defined as the level difference between the limit line and the signal . 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 commands
```
:CALCulate<1|2>:LIMit<1..8>:UPPer:MARGin 10DB
:CALCulate<1|2>:LIMit<1..8>:LOWer:MARGin 10DB
```



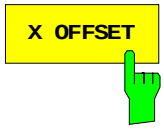
The *COPY LIMIT LINE* softkey copies the data set of the marked limit line and saves it under a new name. In this way, a new limit line can be easily generated by parallel translation or editing of an existing limit line. The name can be arbitrarily chosen and input via an entry window (max. of 8 characters).

IEC/IEEE-bus command
```
:CALCulate<1|2>:LIMit<1..8>:COPY 1..8|<name>
```



The *DELETE LIMIT LINE* softkey erases the selected limit line. Before deletion, a message appears requesting confirmation.

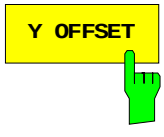
IEC/IEEE-bus command `:CALCulate<1|2>:LIMit<1...8>:DELete`



The *X OFFSET* softkey horizontally shift a limit lines 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 the stop frequency, the line on the display only remains unchanged, if SPAN FIXED is set.*

IEC/IEEE-bus command
```
:CALCulate<1|2>:LIMit<1..8>:CONT:OFFSet 100us
```



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 commands
```
:CALCulate<1|2>:LIMit<1..8>:UPP:OFFSet 3dB
:CALCulate<1|2>:LIMit<1..8>:LOW:OFFSet 3dB
```

Entering and Editing of Limit Lines

A limit line is characterized by

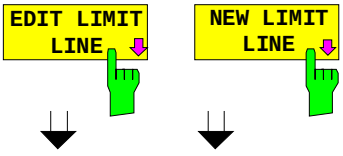
- its name
- the domain assignment (frequency or time)
- whether the scale is absolute or relative (time or frequency)
- linear or logarithmic interpolation
- the vertical unit
- the vertical scale
- the definition of the limit line as either an upper or lower limit.
- the interpolation points for frequency/time and level

When the limit line is entered, the FSET immediately checks all limit lines according to rules that guarantee correct operation.

- The frequencies/times for each interpolation point must be entered in ascending order, however, for any single frequency/time, twodata points may be entered (vertical segment of a limit line).

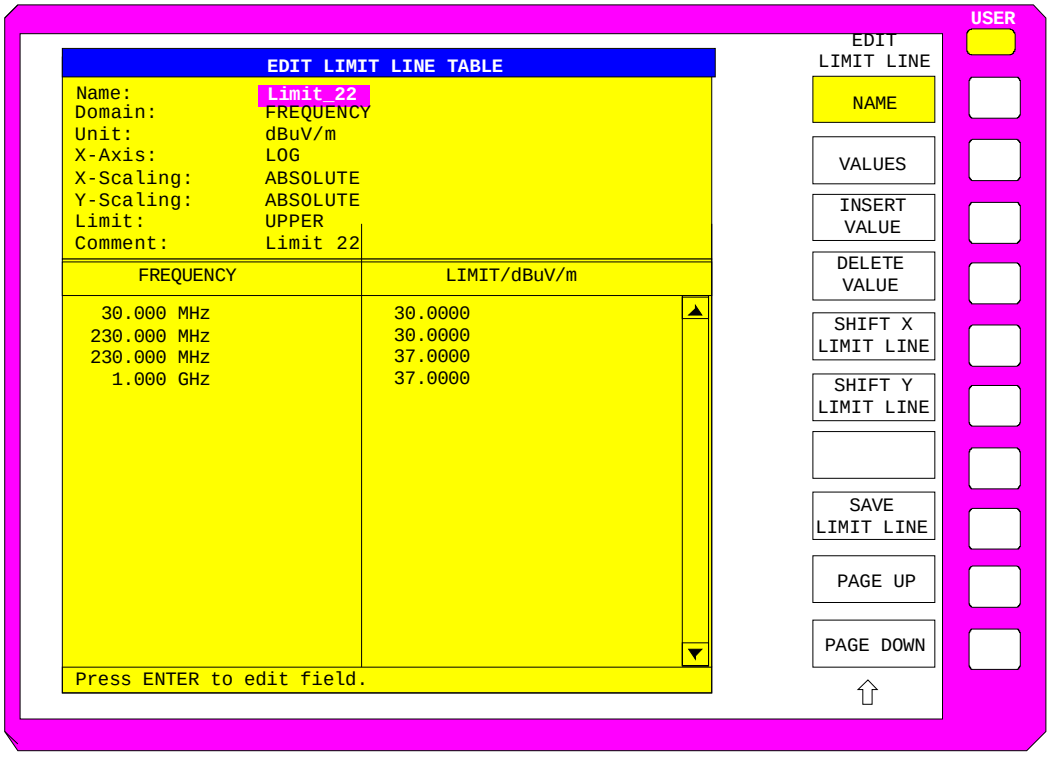
  The interpolation points are allocated in order of ascending frequency/time. Gaps are not allowed. If gaps are desired, two separate limit lines must be defined and then both enabled.
- The entered frequencies/times need not necessarily be capable of selection on the FSET. A limit line may also exceed the frequency or time display range. The minimum frequency for an interpolation point is -200 GHz, the maximum frequency is 200 GHz. For the time domain, negative times may also be entered. The range is -1000 s to +1000 s.
- The minimum/maximum value for a limit line is -200 dB/ +200 dB for the logarithmic scale or 10^{-20}/ 10^{+20} or-99.9%/ + 999.9% for linear amplitude scales.

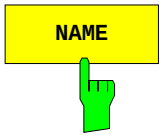
LINES LIMIT-EDIT LIMIT LINE menu



The *EDIT LIMIT LINE* and *NEW LIMIT LINE* softkeys both call the *EDIT LIMIT LINE* submenu used for editing limit lines. In the table heading, the characteristics of the limit line can be entered. The frequency/time and level points are entered in the columns.

Name	Enter name.
Domain	Select domain.
Unit	Select units.
X-Axis	Select interpolation
X-Scaling	Entry of absolute or relative values for the X-axis
Y-Scaling	Entry of absolute or relative values for the Y-axis
Limit	Select upper/lower limit.
Comment	Enter comments.
Time/Frequency	Enter time/frequency points.
Limit/dBm	Enter level points.





The *NAME* softkey activates the entry of characteristics in the table heading.

***Name* - Entry of name**

A maximum of 8 characters are permitted for each name. All names must be compatible with the MS DOS conventions for file names. The instrument automatically stores all limit lines with the .LIM extension.

IEC/IEEE-bus command
```
:CALCulate<1|2>:LIMit<1...8>:NAME <string>
```

***Domain* - Selection of time or frequency domain**

The domain (frequency/time) can only be changed when the limit-line point table is empty. The default setting is frequency.

IEC/IEEE-bus command
```
:CALCulate<1|2>:LIMit<1..8>:CONTrol:DOMain FREQ | TIME
```

***X-Axis* - Indication of interpolation**

Linear or logarithmic interpolation can be carried out between the frequency reference points of the table. The ENTER key toggels between LIN and LOG selection.

IEC/IEEE-bus commands
```
:CALCulate<1|2>:LIMit<1..8>:CONTrol:SPACing LIN | LOG
:CALCulate<1|2>:LIMit<1..8>:UPPer:SPACing LIN | LOG
:CALCulate<1|2>:LIMit<1..8>:LOWer:SPACing LIN | LOG
```

***Scaling* - Selection of absolute or relative scale**

The limit line scale can either be absolute (frequency or time) or relative. Any of the unit keys may be used to toggle between *ABSOLUTE* and *RELATIVE*, the cursor must in the X-*Scaling* or the *Y-Scaling* line

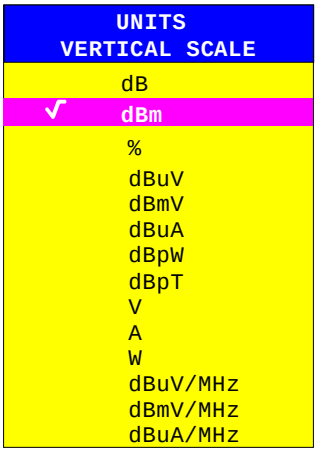
X-Scaling ABSOLUTE	The frequencies or times are interpreted as absolute physical units.
X-Scaling RELATIVE	The frequencies in the limit-line point table are referred to the currently set center frequency. In the time domain, the left boundary of the diagram constitutes the reference.
Y-Scaling ABSOLUTE	The limit values are absolute levels or voltages.
Y-Scaling RELATIVE	The limit values refer to the reference level or, in case a reference line is set, to the reference line. Limit values in dB or % are always relative values.

RELATIVE scaling is always recommended, 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 equal to half the sweep time may be entered to shift the mask in the time domain to the center of the screen.

IEC/IEEE-bus commands
```
:CALCulate<1|2>:LIMit<1..8>:CONTrol:MODE  REL | ABS
:CALCulate<1|2>:LIMit<1..8>:UPPer:MODE  REL | ABS
:CALCulate<1|2>:LIMit<1..8>:LOWer:MODE  REL | ABS
```

***Unit* - Selection of the vertical scale units for the limit line**

Units are selected in a selection box. The default setting is dBm**.**



IEC/IEEE-bus command `:CALCulate<1|2>:LIMit<1...8>:UNIT DB| DBM| PCT |DBUV| DBMW | DBUA | DBPW| DBPT | WATT| VOLT | AMPere | DBUV_MHZ | DBMV_MHZ| DBUA_MHZ | DBUV_M | DBUV_MMHZ | DBUA_M | DBUA_MMHZ`

***Limit* - Selection of upper/lower limit**

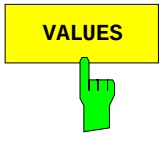
A limit line can be defined as either an upper or lower limit.

IEC/IEEE-bus command `--`
`(defined by the key words :UPPer or :LOWer)`

***Comment* - Enter comments**

Comments are user selectable, but may not exceed 40 characters in length.

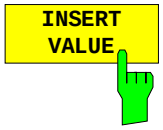
IEC/IEEE-bus command
`:CALCulate<1|2>:LIMit<1..8>:COMMent 'string'`



The *VALUES* softkey activates the entry of the data points in the table columns *Time/Frequency* and *Limit/dB*. Which table column appears depends on the *Domain* selection in the table heading.

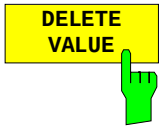
The frequency/time points are entered in ascending order (two repeated frequencies/times are permitted).

IEC/IEEE-bus commands
```
: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>..
```



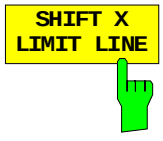
The *INSERT VALUE* softkey creates an empty line above the current cursor position where a new data point can be entered. However, when entering new values, the ascending order for frequency/time values must be kept.

IEC/IEEE-bus command --



The *DELETE VALUE* softkey erases the data point (complete line) at the cursor position. The data points that follow are moved along to fill the gap.

IEC/IEEE-bus command --



The *SHIFT X LIMIT LINE* softkey calls an entry window where the complete limit line may be shifted horizontally.

The shift units are the same as the horizontal scale units:

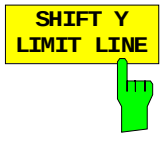
– in the frequency domain in Hz, kHz, MHz or GHz

– in the time domain in ns, µs, ms or s

This means that it is easy to create a new limit line from existing limit line which has been shifted horizontally and stored (*SAVE LIMIT LINE* softkey) under a new name (*NAME* softkey).

IEC/IEEE-bus command

```
:CALCulate<1|2>:LIMit<1..8>:CONTrol:SHIFt 50kHz
```



The *SHIFT Y LIMIT LINE* softkey calls an entry window where the complete limit line may be shifted vertically.

The shift units are the same as the vertical scale units:

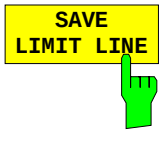
– for relative logarithmic units in dB

– for linear units, as a factor

This means that a new limit line can easily be created from an existing limit line which has been shifted vertically and stored (*SAVE LIMIT LINE* softkey) under a new name (*NAME* softkey).

IEC/IEEE-bus commands

```
:CALCulate<1|2>:LIMit<1..8>:UPPer:SHIFt 20dB
:CALCulate<1|2>:LIMit<1..8>:LOWer:SHIFt 20dB
```



The *SAVE LIMIT LINE* softkey stores the currently edited limit line . The name can be entered in an entry window (max. 8 characters)

IEC/IEEE-bus command -- (automatically executed)

Trace Selection and Setup –*TRACE Key Group*

The FSET can display up to four separate traces at a time on a screen. A trace has of a maximum of 500 pixels along the horizontal axis (frequency or time). If more measured values than pixels are available, several measurement values are assigned to one pixel.

The traces are selected using keys 1 to 4 of the *TRACES* key group. When two measurement windows (*SPLIT SCREEN*) are displayed, traces 1 and 3 are assigned to the upper (*SCREEN A)* and traces 2 and 4 are assigned to the lower (*SCREEN B)* measurement window.

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

A display mode can be selected for each trace. The traces can be overwritten (CLEAR/WRITE mode) after each sweep, averaged (AVERAGE mode) over several sweeps, or the maximum/ minimum value from several sweeps can be displayed (MIN HOLD/MAX HOLD).

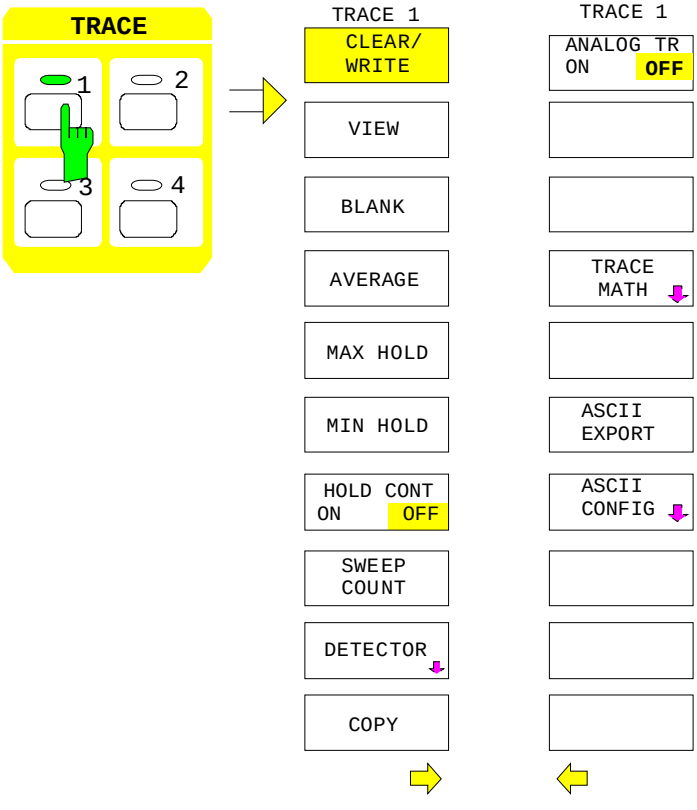
Individual detectors are selectable for each of the traces. The auto-peak detector displays the maximum and minimum values on a vertical line. The max-peak detector and min-peak detector display the maximum and /minimum levels represented by a pixel. The sampling detector displays the instantaneous value of the level at a pixel. The rms detector displays the power (rms) of the spectrum at a pixel, the average detector the average value.

Measurement Function Selection - *TRACE 1 to 4* key

The trace functions are categorized as follows:

- type of trace display (CLEAR/WRITE, VIEW and BLANK)
- evaluation of the trace as a whole (AVERAGE, MAX HOLD and MIN HOLD)
- evaluation of the individual pixels of a trace (AUTOPEAK, MAX PEAK, MIN PEAK, SAMPLE, RMS and AVERAGE)

TRACE 1 menu



The *TRACE* keys 1...4 call a menu whith the setting options for the selected trace.

This menu is used to determine the method for compressing the measurement data in the frequency or time domain to the 500 representable points of the display is determined.

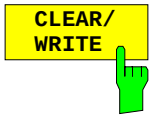
When the measurement is started, a new trace can be displayed or the trace can be based on previous results. The traces can be displayed, blanked and copied.

Traces can also be corrected with the mathematical functions.

The measurement detector for each of the display types may be chosen either directly or selected automatically by the FSET.

All activated traces are marked with a LED at the corresponding key (here, *TRACE 1)*. The default setting is *TRACE 1* with *CLEAR / WRITE* selected. The remaining traces 2...4 are switched off (*BLANK*). For the split screen display, the selection of the trace automatically selects the corresponding screen for entry.

Only one of the *CLEAR/WRITE, MAX HOLD, MIN HOLD, AVERAGE, VIEW* and *BLANK* softkeys can be activated at any one time.

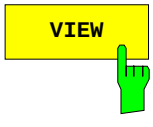


The *CLEAR/WRITE* softkey activates the clear/write display mode.
The trace is displayed without additional trace evaluation. The trace memory is overwritten by each sweep. If more than one data point falls within a pixel, the trace is displayed in bar form with the maximum and minimum values being assigned to one pixel. In the clear/write display mode, all the available detectors are selectable. The autopeak detector is selected in the default mode (detector to *AUTO*).

Whenever the *CLEAR/WRITE* softkey is pressed, the FSET clears the selected trace memory and restarts the measurement.

IEC/IEEE-bus command

```
:DISPlay[:WINDow<1|2>]:TRACe<1..4>:MODE WRITe
```

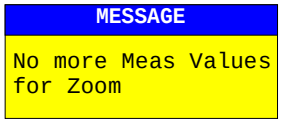


The *VIEW* softkey freezes the current contents of the trace memory and displays them.

If the trace data were formed through *MAX HOLD*, *MIN HOLD* or *AVERAGE,* the sweep is restarted and the trace contents are cleared, after switching to these trace modes.

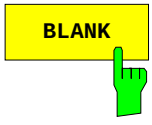
If a trace is frozen by *VIEW*, the instrument settings can be modified without modifying the displayed trace. The fact that the trace and the current instrument setting do not agree anymore is indicated by an enhancement label "*" at the right edge of the grid. The initial instrument setting can be restored using the *ADJUST TO TRACE* softkey in the *TRACE MATH* sub-menu.

If *LEVEL RANGE* or *REF LEVEL* is changed in the *VIEW* display mode, the FSET adjusts the measurement data to the changed display range. Thus, an amplitude zoom can be performed after the measurement so that details of the trace can be seen better. A trace recorded using the capture memory can be zoomed later in the frequency or time axis in the VIEW mode. In the frequency domain zooming is possible by entering a new start and stop frequency or by entering a new span. In the time domain, zooming is possible by entering a new start and stop time. Zooming is possible down to a section whose trace memory/picture memory ratio is 1:1. In the extreme case two measured values joined by a straight line are displayed on the screen. If no more measured values can be zoomed, the following message is displayed:



IEC/IEEE-bus command

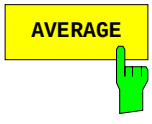
```
:DISPlay[:WINDow<1|2>]:TRACe<1..4>:MODE VIEW
```



The *BLANK* softkey activates the blanking of the trace.
However, the trace remains stored in memory and can be displayed again by pressing *VIEW*. The markers for the blanked trace are also erased. After reactivation of the trace (with *VIEW, CLEAR / WRITE, MAX HOLD, MIN HOLD, AVERAGE*) the markers will be restored their their previous positions.

IEC/IEEE-bus command

```
:DISPlay[:WINDow<1|2>]:TRACe<1..4> OFF
```



The *AVERAGE* softkey activates the trace averaging function. The average is formed over several sweeps. The average can be calculated for each available detector. If the detector is automatically selected by the FSET , the sampling detector is used.

After enabling the averaging mode, the first trace is recorded in *CLEAR*/*WRITE* mode with the selected detector. After the second sweep, the average is then formed for each succeeding sweep. Here, the average is formed over the samples/pixels, i.e., according to the LIN or LOG setting, over amplitudes or levels.

Averaging is restarted every time the *AVERAGE* softkey is pressed. The trace memory is also cleared. This is also the case when the trace is switched from the setting *AVERAGE* to *VIEW* or *BLANK*

IEC/IEEE-bus command

```
:DISPlay[:WINDow<1|2>]:TRACe<1..4>:MODE  AVER
```

Description of averaging:

Averaging is carried out the measurement value samples or over the pixels derived from the samples. For linear level display this means that averaging is over linear amplitude values, for logarithmic level display over levels. For this reason the trace has to be measured again if mode LIN/LOG has been changed. Settings *CONT/SINGLE SWEEP* and sliding averaging are valid for all averaging procedures.

AVERAGE using the sample detector (standard):

For this procedure, averaging is made of the trace recorded in the sample mode. If the trace memory is used (Capture Memory, see section 'Detector Selection'), all measurement values stored in the trace memory are used for averaging. Otherwise, FSET only uses the 500 displayed pixels for averaging. In this case, the trace memory is not used. Either running averaging or averaging by summing all measurement values to be averaged and dividing them by the number of measurement values is possible.

AVERAGE using the autopeak detector

In this case, the average value is obtained from the positive and negative peak value using the autopeak detector. All measurement values recorded in the trace memory or the 500 values from the picture memory are used depending on the state of the trace memory (*ON* or *OFF)*.

AVERAGE using the peak detectors

When using peak detectors (*MAX PEAK* and *MIN PEAK*) the average value is obtained from the positive or negative peak value. All measured values recorded in the trace memory or the 500 values from the picture memory are used depending on the state of the trace memory (*ON* or *OFF)*.

Two calculation procedures are available for averaging. For *SWEEP COUNT*= 0 , a sliding average is calculated using the following equation:

$$\mathrm{TRACE}_n = \frac{9 * \mathrm{TRACE}_{n-1} + \mathrm{Meas_Value}}{10}$$

Because of the relative weighting of the new measurement value and the trace average, past values have practically no no influence on the displayed trace after about 10 sweeps. For this setting, the signal noise is effectively reduced without the need to restart the averaging process even if the signal is changed.

If the *SWEEP COUNT* is >1 averaging takes place over the selected number of sweeps. In this case, the displayed trace is given by the following formula during averaging::

$$\mathrm{TRACE}_n = \frac{1}{n}\left[\sum_{i=1}^{n-1}(T_i) + \mathrm{Meas\ Value}\right]$$

where n is the number of the current sweep (n = 2 ... SWEEP COUNT). For the first sweep, an average is not calculated. The measurement values are stored directly in trace memory. With growing n, the displayed trace becomes increasingly smoother since more individual trace data are available for averaging.

The average is stored in trace memory after the defined number of sweeps. Until this number of sweeps is reached, a preliminary average is displayed.

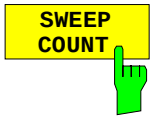
On completion of averaging, ie when the number of sweeps defined with *SWEEP COUNT* has been reached, a sliding average given by the following formula is obtained with *CONTINUOUS SWEEP*

$$\mathrm{TRACE}_n = \frac{(\mathrm{N}-1)\cdot \mathrm{TRACE}_{n-1} + \mathrm{Meas\ Value}}{\mathrm{N}}$$

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

The display "Sweep 200 of 200" then remains constant until there is a new start.

In *SINGLE SWEEP* mode, *SWEEP START* initiates n single sweeps. The sweeps are stopped as soon as the selected number of sweeps has been reached. The number of the current sweep and the total number of sweeps are shown in the display: "Sweep 3 of 200".



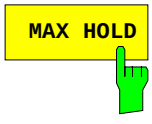
The *SWEEP COUNT* softkey activates the entry of the number of sweeps used for averaging.
The following ranges are possible depending on the use of the trace memory:

CAPT MEM OFF	0 or 2 to 32767 (0 for running averaging over 10 sweeps)
CAPT MEM ON	1 to 1024

The default setting is 10 sweeps. The programming naturally influences the sweep duration. The number of sweeps used for averaging is the same **for all 4 traces**.

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

IEC/IEEE-bus command `:[SENSe<1|2>:]SWEep:COUNt 10`



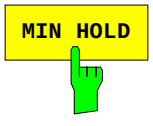
The *MAX HOLD* softkey activates the max hold mode.
In this display mode, the FSET saves for each sweep the largest of the previously stored/currently measured values in the trace memory. The detector is set automatically to *MAX PEAK.* In this way, the maximum value of a signal can be determined over several sweeps.

This is especially useful for measurement of modulated or pulsed signals. The signal spectrum is built up sweep by sweep until all the signal components have been captured.

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

If *MAX HOLD* is enabled, a new start is made after clearing the trace memory for each frequency change, (start frequency, stop frequency, center frequency or frequency span), a reference level change or switching between linear/logarithmic scales.

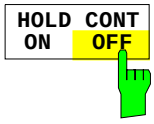
IEC/IEEE-bus command
`:DISPlay[:WINDow<1|2>]:TRACe<1..4>:MODE MAXH`



The *MIN HOLD* softkey activates the min hold mode.
In this display mode, the FSET saves for each sweep the smallest of the previously stored/currently measured values in the trace memory. The detector is set automatically to *MIN PEAK.* In this way, the minimum value of a signal can be determined over several sweeps. This function is, e.g., useful for making an unmodulated carrier in a signals mixture easier to see on the display. Noise, interference or modulated signals are suppressed by the *MIN HOLD* function, whereas a CW signal maintains a constant level.

Pressing the *MIN HOLD* softkey clears the trace memory and the minimum value function starts anew.

IEC/IEEE-bus command
`:DISPlay[:WINDow<1|2>]:TRACe<1..4>:MODE MINH`



The *HOLD CONT* softkey defines whether the traces in the average mode and min hold/max hold mode are reset after some definite parameter changes.

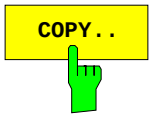
OFF The traces are reset after some definite parameter changes.

ON This mechanism is switched off.

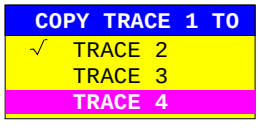
In general, parameter changes require a restart of the measurement before results are evaluated (e. g. with markers). For those changes that are known to require a new measurement (e. g. modification of the span), the trace is automatically reset so that erroneous evaluations of previous results are avoided.
This mechanism can be switched off for those exceptional cases where the described behavior is unwelcome.

IEC/IEEE-bus command

```
:DISPlay[:WINDow<1|2>]:TRACe<1..4>:MODE HCON ON|OFF
```



The *COPY* softkey copies the current trace as display on the screen to another trace memory. A table appears in which the copy procedure can be selected.



For only one window, the selected trace can be copied to any of the other trace memories since here, all four traces are displayed in one diagram with the same frequency boundaries.
In the split screen display, this is only possible as long as the frequencies of screen A and screen B are identical. If this is not the case, the selected trace can only be copied to the corresponding trace memory, i.e., trace 1 to trace 3 and trace 2 to trace 4 or vice versa. In this case, only the available trace is displayed.

After copying, the contents of the destination memory are lost. The destination memory now changes automatically to view mode with the new data.

IEC/IEEE-bus command

```
:TRACe:COPY  TRACE1| TRACE2| TRACE3| TRACE4,
             TRACE1| TRACE2| TRACE3| TRACE4
```

Detector Selection

The FSET detectors are all-digital. The detectors available are the max-peak detector which derives the maximum value from a number of sample values, the min-peak detector which derivess the minimum value from a number of sample values and the sampling detector. The sampling detector passes on the sampled data without modification or performs a data reduction by suppressing non-displayable values. The peak detectors compare the current level with the maximum/minimum levels of the previously sampled data. When the number of samples defined by the instrument settings is reached, the samples are combined as displayable pixels. Each of the 500 pixels of the display therefore represents 1/500 of the sweep range and so all the individual measurements (frequency samples) that fall within this subrange in a compressed form. Even though the recording rate is high, there are no recording gaps thanks to the internal pipeline structure. Pulses that are shorter than the sampling rate of the detector are stretched by means of a pulse stretcher in FSET so that no recording gaps are possible. For each trace display mode, an optimized detector is selected automatically. Since the peak detectors and the sample detector are connected in parallel, a single sweep is sufficient for record and display four traces with four detectors.

Peak value detectors (*MAX PEAK* / *MIN PEAK*)

Peak value detectors are implemented with digital comparators. For each of the levels measured at each of the frequencies represented by one of the 500 pixels, they determine the maximum (max peak) of all positive peaks and the minimum (min peak) of all the negative peaks.
This is repeated for each pixel so that, for wide frequency spans and inspite of the limited display resolution, a larger number of measurements than would otherwise be possible can be used to display the spectrum.

AUTOPEAK detector

The *AUTOPEAK* detector combines the two peak detectors. The max-peak detector and min-peak detector determine the maximum and minimum level over a displayed pixel at the same time and display it as a common measurement value. The maximum and minimum level over a frequency point are joined with a vertical line.

SAMPLE detector

The *SAMPLE* detector passes on all sampled data without further evaluation and either displays them directly or, for speed (short sweep times), first writes them to a memory and subsequently processes them.

Data reduction, i.e., summing of measurement values of neighboring frequencies or time samples is not performed here. If, during a sweep, more measurement values are generated than can be displayed, measurement values will be lost. Discrete signals can thus be lost

Therefore, the sampling detector can only be recommended for a ratio of span-to-resolution bandwidth of up to approximately 250. To ensure that no signal will be suppressed (example: span 1 MHz --> min. bandwidth 5 kHz).

RMS detector

The rms detector finds the rms value of the measured values over a pixel.
The FSET uses the linear display voltage after the envelope detection. The linear samples are squared, summed and the sum is divided through the number of samples (= mean of squares). With the logarithmic display, the logarithm of the sum of squares is taken. With the linear display the mean of the squares is displayed directly. Each pixel represents the total power of the measured values assigned to the pixel.
The rms detector supplies the power of the signal irrespective of the waveform (CW carrier, modulated carrier, white noise or pulse signal). There is no need for the various waveform correction factors which are required when other detectors are used for the power measurement.

Average detector

The average detector averages the measured values over a pixel.
The FSET uses the linear display voltage after envelope detection. The linear samples are summed and the sum is divided by the number of measurement samples (= linear average). With the logarithmic display, the logarithm of the average is taken. With the linear display the average is displayed directly. Each pixel therefore represents the average of the measured values assigned the pixel.
The average detector gives the true average of the signal irrespective of the waveform (CW carrier, modulated carrier, white noise or pulse signal).

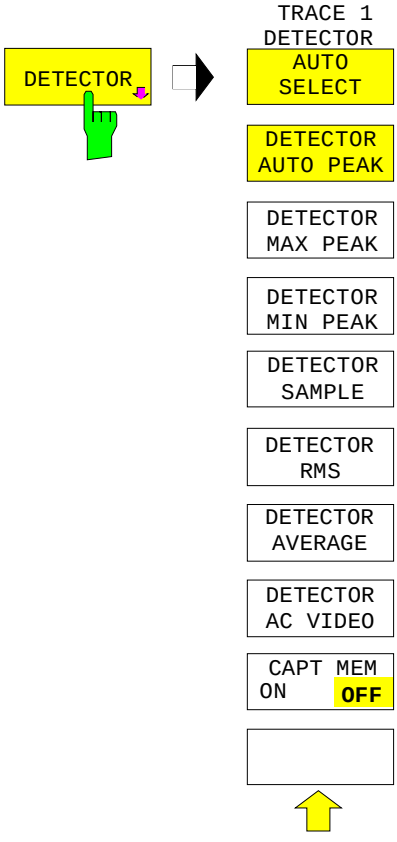
AC video detector

The AC video detector finds the difference (max peak – min peak) of measurement results within a pixel or a result.
For this purpose FSET uses the linear display voltage after envelope detection. The max peak detector and the min peak detector determine the maximum and minimum levels within a shown measurement point and display it as a common measurement result. For logarithmic representation, the logarithm of the difference is formed. For linear representation, the difference itself is shown. This means that for analyzer operation each pixel corresponds to the AC value of the measurement results combined in the pixel. In receiver operation, on the other hand, the AC value determined during the measurement time is shown.
Irrespective of the signal form (CW carrier, modulated carrier, white noise of pulsed signal), the AC video detector always supplies the AC component of the signal.
If during a frequency sweep the dwell time on a certain frequency point is not sufficient, this may lead to incorrect results being displayed.

Notes: *During a sweep, the FSET switches the first oscillator frequency in steps which are smaller than approximately 1/10 of the bandwidth. This guarantees that the level of a signal is correctly measured. For narrow bandwidths and wide spans, a very large number of measurement values are generated. The number of frequency steps is, however, always a multiple of 500 (= number of displayable points). In the sampling mode, only every n^{th} value is displayed. The quantity n depends upon the number of measurement values, i.e on the span, resolution bandwidth and the measurement rate.*

For sweep times < 5ms in the time domain, the same detector is used for all active traces.

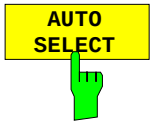
TRACE 1-DETECTOR submenu



The *DETECTOR* softkey opens a submenu to select the detector.

The detector may be independently selected for each trace. Mode *AUTO SELECT* sets the best suitable detector for each trace display mode (Clear Write, Max Hold oder Min Hold).

Only one of the softkeys for the detectors can be activated at any one time.



The *AUTO SELECT* softkey selects the optimum detector for the selected trace display mode (clear write, max hold, min hold).

Trace-mode	**Detector**
Clear/Write	Max Peak
Average	Sample
Max Hold	Max Peak
Min Hold	Min Peak

IEC/IEEE-bus command

```
:[SENSe<1|2>:]DETector<1..4>:AUTO ON|OFF
```



The *DETECTOR AUTOPEAK* softkey selects the autopeak detector.

IEC/IEEE-bus command `:[SENSe<1|2>:]DETector<1..4> APEak`



The *DETECTOR MAX PEAK* softkey selects the max peak detector= default. It is recommended for pulse-like signals.

IEC/IEEE-bus command `:[SENSe<1|2>:]DETector<1..4> POSitive`



The *DETECTOR MIN PEAK* softkey selects the min peak detector. Weak sinewave signals can be brought out clearly against noise by using this detector. For a composite signal made up of sinewaves and pulse-like-like signals the pulse signals are suppressed.

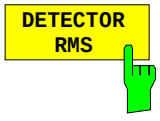
IEC/IEEE-bus command `:[SENSe<1|2>:]DETector<1..4> NEGative`



The *DETECTOR SAMPLE* softkey selects the sample detector.

It is used for measuring uncorrelated signals such as noise. The power can be determined by means of fixed correction factors for evaluation and the log amplifier.

IEC/IEEE-bus command `:[SENSe<1|2>:]DETector<1...4> SAMPle`



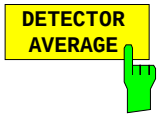
The *DETECTOR RMS* softkey activates the rms detector.

The rms detector gives the true power of the signal irrespective of the waveform. The mean of the squares of all level samples is formed as a pixel is swept. The sweep time, therefore, determines the number of values averaged and, with increasing sweep time, better averaging is obtained. The rms detector is therefore an alternative to averaging over several sweeps (see *TRACE AVERAGE*).

In the time domain (SPAN = 0), the rms detector is only available for sweep times ≥ 5 ms. Moreover, the combination of the rms detector with the pretrigger function and the gaped sweep function is not permissible.

The video bandwidth has to be set to at least 10 times the resolution bandwidth (RBW) so that the rms value of the signal is not invalidated by video filtering.

IEC/IEEE-bus command `:[SENSe<1|2>:]DETector<1...4> RMS`



The *DETECTOR AVERAGE* softkey activates the average detector.

In contrast to the rms detector, the average detector supplies the straight average of all the level sampleds as a pixel is swept over.

The same restrictions as those of the rms detector apply (see above).

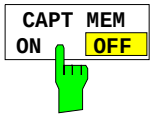
IEC/IEEE-bus command `:[SENSe<1|2>:]DETector<1...4> AVERage`



The *DETECTOR AC VIDEO* softkey activates the *AC VIDEO* detector.

Irrespective of the signal form, the *AC VIDEO* detector always supplies the AC component of the signal. For this purpose the difference is formed of all maximum and minimum level values collected during the runtime of the pixel / the set measurement time. The sweep / measurement time therefore determines the number of values to be considered, so the AC component is determined more accurately with increasing sweep / measurement time. The *AC VIDEO* detector can thus be used as an alternative for the detection of modulated signals.

IEC/IEEE-bus command `:[SENSe<1|2>:]DETector<1..4> ACVideo`



The *CAPT MEM ON/OFF* softkey starts the recording of measurement data in an expanded c*apture memory*. The saved measurement data can be zoomed over the frequency and time axis subsequently (*Capture Zoom*).
Measured values can only be recorded for Trace 1 in the analyzer mode. The softkey does not exist in the detector menus for Trace 2 to 4.
If a frequency zoom or a gap sweep is activated, they are automatically deactivated if *Capture Memory* is switched off.
Capture Memory is switched off automatically if the analyzer mode is left.

IEC/IEEE-bus command

```
:[SENSe<1|2>:]DETector:CMEM[:STATe] ON|OFF
```

Averaging using the extended trace memory

FSET stores all measurement values for averaging prior to compressing the data for display. The measurement values are written into a 1-MByte extended trace memory (capture RAM). In he capture RAM up to 1024 traces can be added. The measurement data are then reduced to 500 pixels for display. To this effect, if required, several test points are combined to form a point in frequency or time on the screen. The points are displayed as a straight line with the maximum and minimum value of the combined test points being joined. Thus, the progression of averaging can be seen any time on the screen and may be aborted, if required.
The advantage of this averaging procedure is that only those measurement values are averaged which are related in frequency and time. Moreover, uncompressed raw data are always available in the extended trace memory and thus, the frequency and time resolution can be increased at a later time by changing the span in mode *VIEW* until 1 test point is obtained per pixel (zoom function).

Quasi Analog Display

Normally, when measured values are displayed they are joined together with line segments to form a trace which is deleted and redrawn after each sweep. When analog measurements are performed, the persistence of the screen makes it possible to assess the signal's frequency of occurrence. Frequently occurring events appear brighter on the screen than events that occur less frequently.

The *ANALOG TRACE* function simulates an analog display.
In this case, a measured value is represented by a single pixel on the screen. After the trace has been explicitly cleared with *CLEAR / WRITE, this pixel is reset.* As the trace is build up from several sweeps, the frequency distribution is, in effect, indicated by the varying brightness of the trace.

TRACE 1 side menu



The ANALOG TR ON/OFF switches the quasi-analog display mode on and off for the selected trace

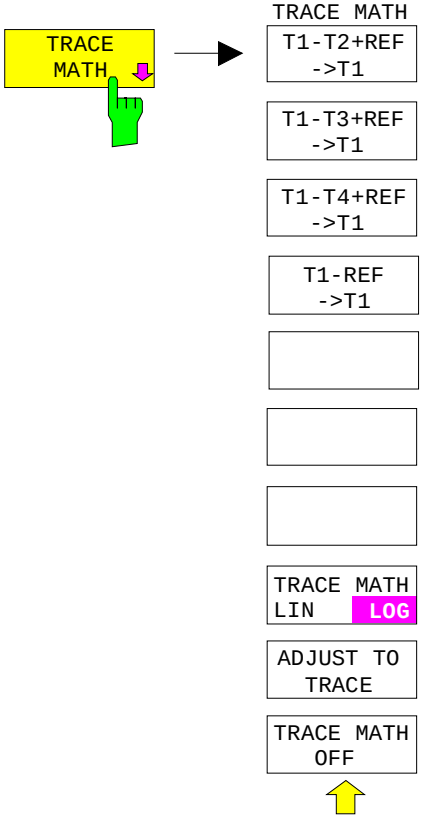
The measurement is always made with the selected detector.

IEC/IEEE-bus command

```
:DISPlay[:WINDow<1|2>]:TRACe<1..4>:MODE:ANALog ON | OFF
```

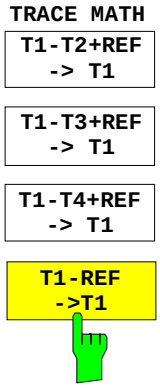
Mathematical Functions for Traces

TRACE 1-TRACE MATH submenu:



The *TRACE MATH* softkey opens a submenu in which a differential curve for the selected trace is calculated.

For logarithmic level display, the differential curve can be obtained with the displayed levels or with the linear display voltages. The differential curve of levels corresponds to a division of linear display voltages.



The *T1-T2+REF, T1-T3+REF*, *T1-T3+REF* and *T1-REF* softkeys subtract the traces and add the set level to the difference. If the reference line is switched on (see key D LINES), the level value of the reference line instead of the reference level is added to the difference. Thus, the differential curve can be positioned anywhere on the screen by shifting the reference line. The difference of the two traces with respect to the reference line is displayed.

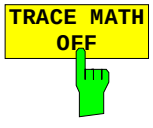
The *T1-REF* softkey subtracts the level of the reference line from the trace level.

To indicate that the trace is a difference trace, a enhancement label is displayed at the right margin of the measurement value diagram (1-2, 1-3, 1-4, 1-R). In *TRACE 1* main menu, the *TRACE MATH* softkey is on a coloured background to show that the function is being used.

***Important**: For a display with two measurement windows, not all combinations are allowed if the sweep data for screen A and screen B are not the same. Only the traces allowed in the screen can be combined (in screen A, only trace 1 with trace 3; in screen B, only trace 2 with trace 4).*

IEC/IEEE-bus command

```
:CALCulate<1|2>:MATH<1..4>:STATe ON
:CALCulate<1|2>:MATH<1..4>[:EXPRession][:DEFine] <expr>
```



The *TRACE MATH OFF* softkey switches the math function off. The softkey is only available when a conversion function is enabled.

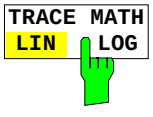
IEC/IEEE-bus command `:CALCulate<1|2>:MATH<1...4>:STATe OFF`



The *ADJUST TO TRACE* softkey restores the original instrument settings when the corresponding trace is set to *VIEW* and the current instrument settings are different than those of the trace data.

If a trace is frozen with *VIEW*, changes in the instrument settings can be made without influencing the trace. An asterisk(*) at the edge of the display screen indicates that the current instrument settings are different than those in effect when the trace was recorded. In this case, the *ADJUST TO TRACE* softkey is presented with which the original instrument setting can be restored.

IEC/IEEE-bus command `--`



The *TRACE MATH LIN/LOG* selects linear or logarithmic calculation of mathemathical functions.

IEC/IEEE-bus command

```
:CALCulate<1|2>:MATH<1...4>MODE LINear | LOGarithmic
```

Trace Export

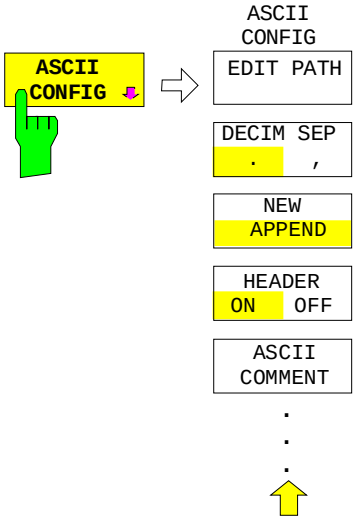
TRACE 1 menu:



The *ASCII EXPORT* softkey stores the active trace in a file with ASCII format. Upon pressing the *ASCII EXPORT* softkey, a file name can be entered. The default name is TRACE.DAT. Then the measured data of the trace are stored. The function can be configured in the *ASCII CONFIG* submenu.

IEC/IEEE-bus command `:MMEMory:STORe:TRACe 1..4,<path>`

TRACE 1 menu:

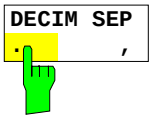


The *ASCII CONFIG* softkey calls a submenu for various settings for the *TRACE ASCII EXPORT* function.



The *EDIT PATH* softkey defines the directory in which the file is to be stored.

IEC/IEEE-bus command `--`



The *DECIM SEP* softkey selects the decimal separator for the ASCII file. The choice is '.' (decimal point) or ',' (comma).
This means that the decimal separator used in various language versions of evaluation programs (e.g. MS-Excel) can be selected so that the packages are supported. .

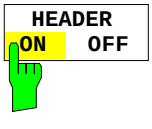
IEC/IEEE-bus command
`:FORMat:DEXPort:DSEParator POINt|COMMA`



The *APPEND NEW* softkey defines whether output data are to be written to an existing file or a new file.

- With *APPEND*, the data are added to an existing file.
- With *NEW*, either a new file is generated or an existing file is overwritten by storage of the data.

IEC/IEEE-bus command `:FORMat:DEXPort:APPend ON | OFF`



The *HEADER ON/OFF* softkey defines whether important instrument settings should be stored at the beginning of the file.

IEC/IEEE-bus command `:FORMat:DEXPort:HEADer ON | OFF`



The *ASCII COMMENT* softkey activates the entry of commentary concerning the current ASCII data set. A total of 60 characters are available for this purpose.

IEC\IEEE bus command `:FORMat:DEXPort:COMMent 'string'`

Structure of the ASCII file:

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.

	Content of file	Description
File header	Type;FSET7;	Instrument model
	Version;2.10;	Firmware version
	Date;01.Jul 2001	Date record storage date
	Comment; test	Comment
	Mode;Spectrum;	Instrument operating mode
	Start;10000;Hz Stop;100000;Hz	Start/stop of the display range. Unit: Hz for span > 0, s for span = 0,
	Center Freq;55000;Hz	Center frequency
	Span;90000;Hz	Frequency range (0 Hz for zero span)
	Freq Offset;0;Hz	Frequency offset
	x-Axis;LIN;	Scaling of x axis linear (LIN) or logarithmic (LOG)
	y-Axis;LOG;	Scaling of y axis linear (LIN) or logarithmic (LOG)
	Ref.Level;-30;dBm	Reference level
	Level Offset;0;dB	Level offset
	Max Level	Maximium level
	Level Range;100;dB	Display range in y direction. Unit: dB for x axis LOG, % for 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
	Sweep Count;20;	Number of sweeps set
Data section of the file	Trace 1:;	Selected trace
	x-Unit;Hz;	Unit of x values: Hz for span > 0; s for span = 0; dBm/dB for statistics measurements
	y-Unit;dBm;	Unit of y values: dB*/V/A/W depending on the selected unit for y axis LOG or % for y axis LIN
	Values;500;	Number of measurement 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 AUTOPEAK detector and containing in this case the smaller of the two measured values for a measurement point.

Example:

```
Type;FSET7;
Version;2.10;
Date;20.Sep 2000;
Comment; test
Mode;Spectrum;
Start;0.000000;Hz
Stop;3500000000.000000;Hz
Center Freq;1750000000.000000;Hz
Span;3500000000.000000;Hz
Freq Offset;0.000000;Hz
x-Axis;LIN;
y-Axis;LOG;
Level Range;100.000000;dB
Ref. Level;-20.000000;dBm
Level Offset;0.000000;dBm
Max. Level;-20.000000;dBm
RF Att;10.000000;dB
RBW;3000000.000000;Hz
VBW;3000000.000000;Hz
SWT;0.005000;s
Trace Mode;CLR/WRITE;
Detector;AUTOPEAK;
Sweep Count;0;
TRACE 1:
x-Unit;Hz;
y-Unit;dBm;
Values;500;
0.000000;-44.465958;-60.190887
7014028.056112;-49.233063;-81.451668
14028056.112224;-75.692101;-101.811501
21042084.168337;-75.147057;-101.229843
28056112.224449;-75.114517;-95.358429
35070140.280561;-71.769005;-100.755981
...
```

If all traces are to be stored in one file with the header information stored only once, the following procedure is recommended:

[TRACE 1] [MENU ⇒][ASCII CONFIG]	
[ASCII CONFIG] [NEW]	Generate new file
[ASCII CONFIG] [HEADER ON]	with header
[TRACE 1] [MENU ⇒][ASCII EXPORT]	Store trace 1 with header
[TRACE 2] [MENU ⇒][ASCII CONFIG]	
[ASCII CONFIG] [APPEND]	Append to end of file
[ASCII CONFIG] [HEADER OFF]	without header
[TRACE 2] [MENU ⇒][ASCII EXPORT]	Write trace 2 to file
[TRACE 3] [MENU ⇒][ASCII EXPORT]	Write trace 3 to file
[TRACE 4] [MENU ⇒][ASCII EXPORT]	Write trace 4 to file

Sweep Control – *SWEEP Key Group*

Using the *SWEEP* key group, the parameters are entered which determine the sweep characteristics. These are the coupled functions resolution bandwidth, video bandwidth and sweep time (*COUPLING* key), the trigger used for starting the sweep (*TRIGGER* key) and the type of sweep (*SWEEP* key).

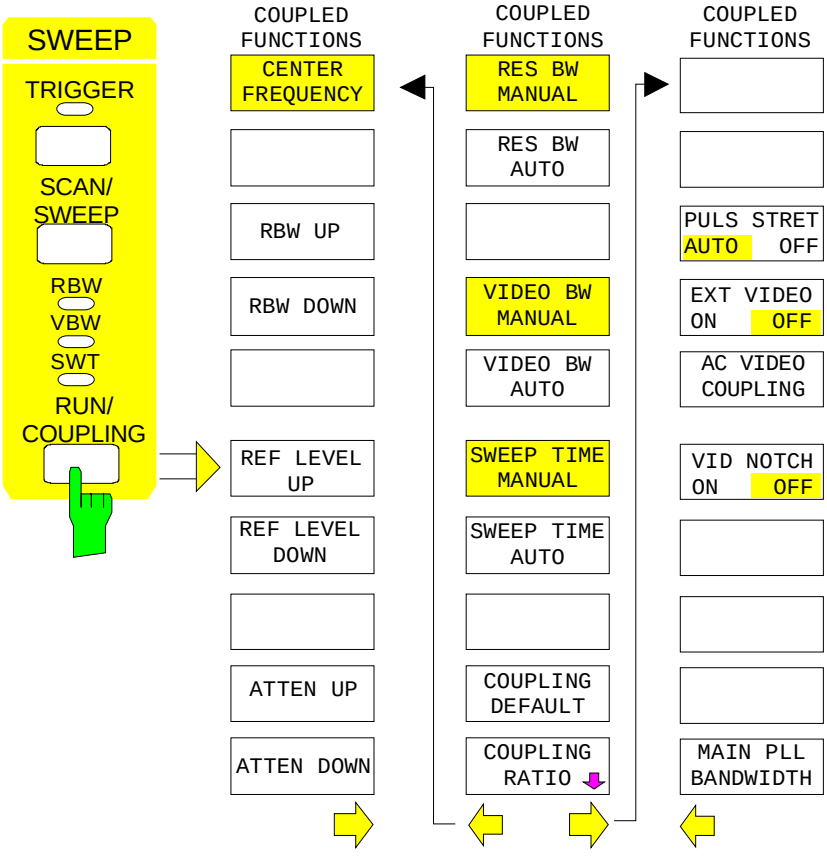
Coupled Settings – *COUPLING* Key

The *COUPLING* key calls a menu for entering the sweep parameters resolution bandwidth *(RBW)*, video bandwidth *(VBW)* and sweep time *(SWT)*. The parameters may be coupled as a function of the span, coupled to each other or set by the user. When working with a split screen display, the settings always refer to the active window.

The FSET resolution bandwidths between 10 Hz and 1 kHz are implemented by means of digital filters with Gaussian characteristics. They behave like analog filters. The bandwidths between 2 kHz and 200 kHz are implemented by transient-optimized crystal or LiTa filters. For the bandwidths between 500 kHz and 10 MHz the IF filters consist of critically coupled LC circuits. From 20 MHz, the IF filters at the second IF (741.4 MHz) are implemented by critically coupled ceramics resonance filters.
The video bandwidths are available in 1/2/5 steps between 1 Hz and 500 MHz. They can be set depending on the resolution bandwidth. Video bandwidths between 1 Hz and 10 kHz are available for bandwidths up to 1 kHz and video bandwidths between 1 Hz and 500 MHz for bandwidths above 2 kHz. The video filters are used to smooth traces. Small video bandwidths in relation to the resolution bandwidth average out noise peaks and pulse-like signals, so that the signal average is displayed. A large video bandwidth in relation to the resolution bandwidth is therefore recommended when measuring pulse-like signals (VBW $\geq$ 10 x RBW) so that the amplitude of pulses can be measured correctly.

Setting and Coupling the Coupling Resolution, Video Bandwidth and Sweep Time

SWEEP COUPLING menu



The *COUPLING* key calls a menu and a supplementary menu for setting the resolution bandwidth, video bandwidth, sweep time and their coupled states.

The *AUTO* softkeys are used to couple the functions. The coupling ratios are selected in the *COUPLING RATIO* sub-menu.

The *MANUAL* softkeys request that the respective parameter be entered in the entry window. This parameter is not coupled to the other parameters.

To simplify operation, the center frequency, resolution bandwidth, reference level and input attenuation can be set in the submenu at the left. In the menu at the right further settings can be made for filters and PLL bandwidth.



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

Automatic coupling of the resolution bandwidth to span is always recommended when, for the measurement problem on hand, a favorable setting of the resolution bandwidth in relation to the selected span is desired.
The coupling ratio is set in the *COUPLING RATIO* sub-menu.
The coupling is indicated by illumination of the softkey and the active *RBW* LED.

For FSET, the selected resolution bandwidth again controls the input-filter combination in Preselector FSET-Z.. if operating mode *COUPLED TO RBW* is selected in menu *CONFIGURE SETUP PRESELECT CONFIG*.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 `:[SENSe<1|2>:]BWIDth[:RESolution]:AUTO ON`



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

Depending on the input used, the following settings in 1/2/5-steps are possible for the resolution bandwidth:

Input used	**Available resolution bandwidths**
RF Input:	10 Hz to 500 MHz ,
Balanced input:	10 Hz to 10 kHz .

The 6-dB bandwidths are the nominal values for the resolution bandwidths.

For numerical inputs, the values are always rounded to the next valid bandwidth. For rollkey or the UP/DOWN key entries, the bandwidth is adjusted in steps either upwards or downwards.

For manual input of the resolution bandwidth (coupling off), the *RBW* LED on the front panel remains off.

IEC/IEEE-bus commands

```
:[SENSe<1|2>:]BWIDth[:RESolution]:AUTO OFF
:[SENSe<1|2>:]BWIDth[:RESolution] 1MHz
```



The *VIDEO BW AUTO* softkey couples the video bandwidth of the FSET 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 maximum sweep time for a selected resolution bandwidth is to be obtained. Small video bandwidths require longer sweep times due to the longer settling time. Large bandwidths reduce the signal/noise ratio.

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

The coupling is indicated by illumination of the softkey and the lighted *VBW* LED on the front panel.

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

IEC/IEEE-bus command `:[SENSe<1|2>:]BWIDth:VIDeo:AUTO ON`



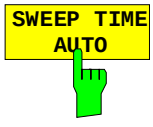
The *VIDEO BW MANUAL* softkey activates the manual entry for the video bandwidth.

The video bandwidth can be selected in 1/2/5-steps between 1 Hz and 500 MHz. For bandwidths up to 1 kHz, the maximum video bandwidth is 10 kHz, for larger resolution bandwidths, there is no restriction to the video bandwidth.

For numerical entries, rounding is made to the next valid bandwidth. For rollkey or UP/DOWN entries, the bandwidth is adjusted in steps either downwards or upwards.

For manual input, the video bandwidth (coupling disabled) *VBW* LED on the front panel is turned off.

IEC/IEEE-bus commands `:[SENSe<1|2>:]BWIDth:VIDeo:AUTO OFF`
`:[SENSe<1|2>:]BWIDth:VIDeo 10kHz`



The *SWEEP TIME AUTO* softkey couples the sweep time to the span, video bandwidth (VBW) and resolution bandwidth (RBW). The sweep time is automatically adjusted whenever the span, resolution bandwidth or video bandwidth are changed. The FSET always selects the shortest sweep time which will not lead to spurious measurements.

The coupling is indicated by illumination of the softkey and turning on the *SWT* LED.

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

IEC/IEEE-bus command `:[SENSe<1|2>:]SWEep:TIME:AUTO ON`



The *SWEEP TIME MANUAL* softkey activates the manual entry for the sweep time. At the same time, the coupling of the sweep is cancelled and the *SWT* LED is turned off. Other couplings (*VIDEO BW, RES BW*) remain in effect.

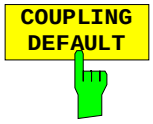
In the frequency domain (span > 0 Hz) and for resolution bandwidths ≥ 2 kHz, sweep times from 5 ms through 16000 s are allowed in steps that are at most 5% of the sweep time. The digital resolution filters from 10 Hz to 1 kHz allow a minimum sweep time of 20 ms.

In the time domain (span = 0 Hz), the sweep time range is 1 µs to 2500 s, selectable in steps that are at most 5% of the sweep time.

Numerical entries are rounded to the next valid sweep time. For rollkey or UP/DOWN entries, the sweep time is adjusted in steps either downwards or upwards.

If the selected sweep time is too small for the selected span and bandwidth, measurement errors will occur. This happens because the available settling time for the resolution filter or the video filter is too short. The FSET, therefore, outputs *UNCAL* on the display

IEC/IEEE-bus commands `:[SENSe<1|2>:]SWEep:TIME:AUTO OFF`
`:[SENSe<1|2>:]SWEep:TIME 10s`



The *COUPLING DEFAULT* softkey sets all coupled functions to *AUTO*. The *RBW / VBW* ratio is also set to *SINE [1]* and the *SPAN/RBW* ratio is set to 50 in the *COUPLING RATIO* submenu (default setting, *COUPLING RATIO* softkey not illuminated).The pulse stretcher of FSET is set to *AUTO*, *EXT VIDEO* is set to OFF.

The relevant softkeys are then illuminated.

IEC/IEEE-bus commands

```
:[SENSe<1|2>:]BWIDth[:RESolution]:AUTO ON;
:[SENSe<1|2>:]BWIDth:VIDeo:AUTO ON;
:[SENSe<1|2>:]SWEep:TIME:AUTO ON
```

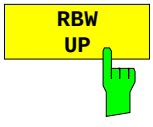
Left side menu:

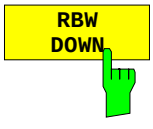


The *CENTER FREQUENCY* softkey activates the manual entry for the center frequency. This entry is activated automatically whenever possible to simplify operation.

IEC/IEEE-bus command

```
:[SENSe<1|2>:]FREQuency:CENTer 1.3 GHz
```

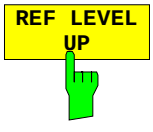


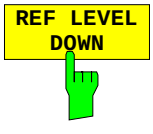


The *RBW UP* and *RBW DOWN* softkeys increment or decrement the resolution bandwith. At their range end the softkeys are disabled.
The entry of the center frequency (see above) is then active again.

IEC/IEEE-bus commands

```
:[SENSe<1|2>:]BWIDth[:RESolution]:AUTO OFF
:[SENSe<1|2>:]BWIDth[:RESolution] 1MHz
```



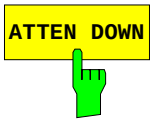


The *REF LEVEL UP* and *REF LEVEL DOWN* softkeys increment or decrement the reference level by steps of 1 dB. The step width is the same as that of the spinwheel. At their range end the softkeys are disabled.
The entry of the center frequency (see above) is then active again.

IEC/IEEE-bus command

```
:DISPlay[:WINDow<1|2>]:TRACe<1..4>:Y:RLEVel -60DBM
```

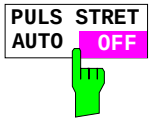




The *ATTEN UP* and *ATTEN DOWN* softkeys increment or decrement the attenuator by steps of 1 dB or 10 dB. The step width is the same as that of the spinwheel. At their range end the softkeys are disabled. With minimum attenuation attained, the preamplifier is switched on automatically.
The entry of the center frequency (see above) is then active again.

IEC/IEEE-bus command `:INPut<1|2>:ATTenuation 40DB`

Right side menu:



The *PULS STRET AUTO/OFF* softkey switches the pulse stretcher at IF bandwidths >5 MHz on or switches it off for all bandwidths.

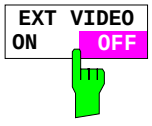
AUTO The pulse stretcher is switched into the video path at resolution bandwidths >5 MHz. Thus, at large bandwidths too, the video signal can be digitized by the A/D converter without any signal loss. Narrow pulses are changed such that pulse peaks are always sampled correctly by the A/D converter.
For smaller resolution bandwidths, the pulse stretcher is automatically switched off.

OFF The pulse stretcher remains switched off irrespective of the bandwidth.

If the pulse stretcher is used, the enhancement label **PLS** is displayed. In the split screen mode, the enhancement label is displayed next to the corresponding measurement window.

IEC/IEEE-bus commands

```
:[SENSe<1|2>:]DETector<1..4>:PSTRetch ON | OFF
:[SENSe<1|2>:]DETector<1..4>:PSTRetch:AUTO ON | OFF
```



The EXT VIDEO ON / OFF softkey switches an external video filter on or off.

For FSET, an external video filter can be looped into the signal path at the rear. The internal video filters can be used even if an external video filter is looped in. In case of automatic coupling of the sweep time, FSET does not take the transient response of an external video filter into account.

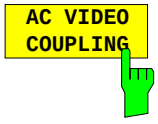
After switch-on of an external video filter a short calibration of FSET is recommended to compensate for any attenuation. Calibration of attenuation is only possible for DC. A frequency response of the filter is not compensated. A short calibration is recommended also after switch-off of the video filter.

Attention: *If EXT VIDEO is switched to ON make sure that an external filter is connected or the corresponiding connector is connected to the rear since the signal path of FSET might otherwise be interrupted so that a measurement will not be possible.*

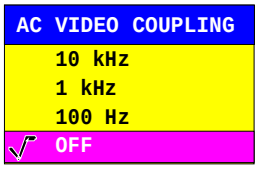
Enhancement label **EVD** is displayed to indicate that an external video filter is used.

IEC/IEEE-bus command

```
:[SENSe<1|2>:]BWIDth:VIDeo:EXT:STATe ON|OFF
```



The *AC VIDEO COUPLING* softkey opens a table in which the required highpass limit frequency for the AC coupling is selected.



To suppress the DC voltage components of the video signal, the video voltage of FSET can be AC coupled. Thus, the carrier is suppressed for AM-modulated signals, for example and only the modulation is displayed. Thus, a display of the modulation is possible with much higher resolution than with the carrier, especially for small modulation depths.

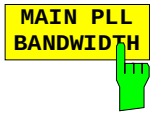
The enhancement label **ACV** is displayed to indicate that AC coupling is switched on.

Attention: *AC coupling of the video voltage does not influence the selection of the video bandwidth. Therefore, it has to be made sure that the signal to be measured is not suppressed by a too high limit frequency of the AC coupling in conjunction with a small video bandwidth.*

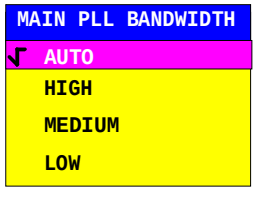
The separation of the DC component in the video signal causes that both positive and negative voltages are present in the video signal as otherwise the positive video voltage is always missing. The spectrum or the time signal is thus displayed around a zero line which is in the middle of the Y axis of the measurement value diagram. For a 20-dB span, scaling is eg from -10 dB to +10 dB.

IEC/IEEE-bus commands

```
:[SENSe<1|2>:]FILTer:HPASs:STATe ON | OFF
:[SENSe<1|2>:]FILTer:HPASs 10kHz|1kHz|100Hz
```



The *MAIN PLL BANDWIDTH* softkey opens a selection window for setting the PLL control bandwidth.



The first local oscillator is synchronized with the PLL control bandwidth. The control bandwidth determines the characteristic of the phase noise. A medium or high control bandwidth improves the phase noise for frequency differences smaller than 10 kHz to the carrier, whereas a low control bandwidth improves the phase noise for frequency differences larger than 100 kHz to the carrier. If the control bandwidth is set unfavorably, the phase noise is deteriorated.

The PLL bandwidth is set in the AUTO mode depending on the RBW and SPAN according to the following tables:

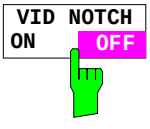
MAIN PLL BANDWIDTH	SPAN ≤ 100 kHz and RBW < 3kHz	SPAN > 100 kHz or RBW ≥ 3kHz
HIGH	X	
MEDIUM		X
LOW		

The setting is chosen such that the phase noise for small spans with small resolution bandwidth near the carrier is optimized.

For measurements with small span but with a relatively large frequency difference to the carrier (>100kHz), the automatic bandwidth setting deteriorates the phase noise relative to the optimal setting. The *MAIN PLL BANDWIDTH* softkey allows to by-pass this automatic setting. Optimal settings are, as a function of the carrier difference @:

MAIN PLL BANDWIDTH	@ ≤ 10 kHz	10 kHz < @ < 100 kHz	@ ≥ 100 kHz
HIGH	X		
MEDIUM		X	
LOW			X

If a larger control bandwidth is needed due to the sweep velocity, the processor automatically increases the control bandwidth as far as necessary.



The *VID NOTCH ON/OFF* softkey switches the notch filters on or off.

To suppress the modulation of test signals by hum voltages, video filters up to 1 kHz can be followed by n x 50-Hz notch filters which suppress the modulation hum. Thus, small modulations become more clearly visible on hummed signals.

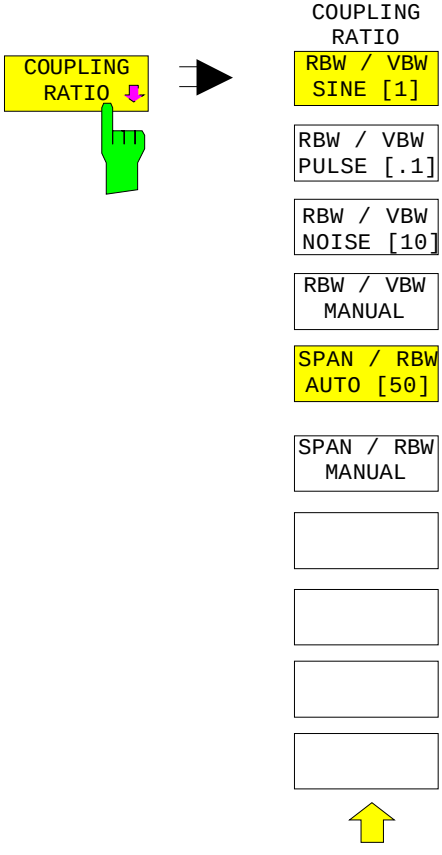
If broad video filters are used, the notch filters are automatically switched off.

IEC/IEEE-bus command

```
:[SENSe<1|2>:]FILTer:NOTCh:STATe ON | OFF
```

Sweep Coupling Ratio

SWEEP COUPLING-COUPLING RATIO submenu:



The *COUPLING RATIO* softkey opens a sub-menu in which the coupling ratio between resolution bandwidth, video bandwidth and the span can be defined.

These settings are effective only for the selected parameters in ...*AUTO* of the main menu.

The softkeys *RBW/VBW PULSE, RBW/VBW SINE, RBW/VBW NOISE, RBW/VBW MANUAL* are selection keys. Only one softkey can be enabled (illuminated) at any one time.

The same is valid for the softkeys *SPAN/RWB AUTO [50]* and *SPAN / RWB MANUAL.*



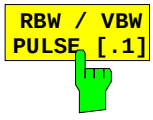
The *RBW / VBW SINE [1]* softkey always sets the video bandwidth equal to the resolution bandwidth.

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

This coupling ratio is recommended when sine-wave signals are to be measured.

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

IEC/IEEE-bus command `:[SENSe<1|2>:]BWIDth:VIDeo:RATio SINe`



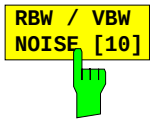
The *RBW / VBW PULSE* softkey sets the following coupling ratio:

video bandwidth = 10 x resolution bandwidth
or
video bandwidth = 500 MHz (= maximum video bandwidth).

This coupling ratio is recommended when the amplitude of pulsed signals is to be measured. The IF filter characteristics alone determine the pulse shape. No additional weighting is provided by the video filter.

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

IEC/IEEE-bus command `:[SENSe<1|2>:]BWIDth:VIDeo:RATio PULSe`



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

At this coupling ratio, noise and pulsed signals are suppressed in the video section. For noise signals, the FSET displays the average value.

This softkey is disabled unless *VBW AUTO* is selected in the main menu.

IEC/IEEE-bus command
`:[SENSe<1|2>:]BWIDth:VIDeo:RATio NOISe`

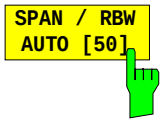


The *RBW / VBW MANUAL* softkey activates the entry of the coupling ratio for resolution bandwidth to video bandwidth.

The range for the RBW/VBW ratio is 0,001 to 1000.

This softkey is disabled unless *VBW AUTO* is selected in the main menu.

IEC/IEEE-bus command `:[SENSe<1|2>:]BWIDth:VIDeo:RATio 10`

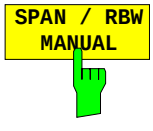


The *SPAN / RBW AUTO [50]* softkey sets the following coupling (rounding is made to the next higher value):
resolution bandwidth = span/50

This coupling corresponds to the default state.

This softkey is disabled unless *RBW AUTO* is selected in the main menu.

IEC/IEEE-bus command
`:[SENSe<1|2>:]BWIDth[:RESolution]:RATio 0.02`



The *SPAN / RBW MANUAL* softkey activates the entry for the coupling of resolution bandwidth and span.

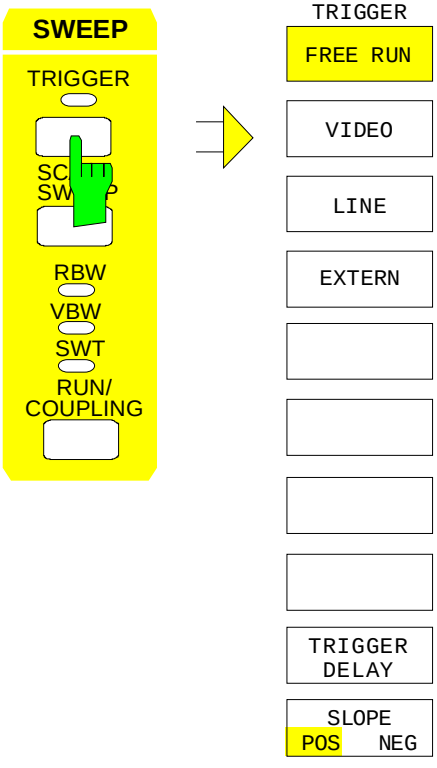
The range for the SPAN/RBW ratio is 1 to 10000.

This softkey is disabled unless *RBW AUTO* is selected in the main menu.

IEC/IEEE-bus command
`:[SENSe<1|2>:]BWIDth[:RESolution]:RATio 0.1`

Sweep Trigger – TRIGGER Key

SWEEP TRIGGER menu:



The *TRIGGER* key opens a menu for selecting the various trigger sources and the trigger polarity. The active trigger mode is indicated by illumination of the corresponding softkey.

For triggering modes in which the trigger threshold can be entered, the corresponding entry window is activated and, if appropriate, a horizontal trigger line is displayed.

The *FREE RUN, VIDEO, LINE,* and *EXTERN* softkeys are selection switches. Only one key can be enabled at any one time (illuminated). For sweep operations controlled by a gate signal, the *FREE RUN* setting is the only setting possible.

If triggering has taken place, the trigger LED is turned on at the beginning of the sweep and then turned off at the end of sweep.

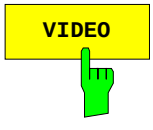
To indicate that the FSET is set for triggering (= not free run), the enhancement label **TRG** is shown on the display. If two measurement windows are displayed, TRG appears next to the window which is configured for triggering.



The *FREE RUN* softkey activates the free-run sweep mode (default setting), i.e. the start of a sweep is not explicitly triggered. Once a measurement is completed, another is started immediately.

IIEC/IEEE-bus command

```
:TRIGger<1|2>[:SEQuence]:SOURce  IMMediate
```

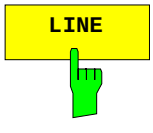


The *VIDEO* softkey activates triggering by the displayed voltage.

For the video triggering mode, a level line showing the trigger threshold is displayed. Using the level line, the threshold can be adjusted with the roll-key or the UP/DOWN keys.

IEC/IEEE-bus commands

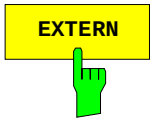
```
:TRIGger<1|2>[:SEQuence]:SOURce  VIDeo
:TRIGger<1|2>[:SEQuence]:LEVel:VIDeo 50PCT
```



The *LINE* softkey activates triggering derived from the mains (line) frequency. The power supply generates a trigger pulse at the line frequency which is used to trigger a new sweep.

IEC/IEEE-bus commands

```
:TRIGger<1|2>[:SEQuence]:SOURce LINE
```



The *EXTERN* softkey activates triggering by an external voltage (-5V...+5V) at the input connector *EXT TRIGGER/GATE* on the rear panel.

The trigger threshold can be set in an entry window within a range of -5V...+5V.

External triggering in the sweep mode "gated sweep" (*SWEEP SWEEP-GATE ON)* is not possible, because the *EXT TRIG/GATE* connector is used to control the sweep. The softkey is not illuminated in these modes.

IEC/IEEE-bus commands

```
:TRIGger<1|2>[:SEQuence]:SOURce EXTernal
:TRIGger<1|2>[:SEQuence]:LEVel 2.5V
```



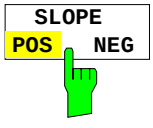
The *TRIGGER DELAY* softkey activates the entry window for delay time or a pretrigger.

The triggering is delayed or advanced relative to the trigger signal by the entered delay time. The delay time can be set in the range from -100 s to 100 s (default = 0 s).

Note: *A negative delay time (pretrigger) can be set in the time domain (SPAN < 0 Hz) only. The maximum range and the maximum resolution of the pretrigger is limited by the set sweep time:*
max. range = - 499/500 x sweep time
max. resolution = sweep time/500.
Pretriggering is not possible when the rms or the average detector is activated.

IEC/IEEE-bus command

```
:TRIGger<1|2>[:SEQuence]:HOLDoff 500us
```



The *SLOPE POS/NEG* softkey selects the trigger slope.

The sweep starts after a positive or negative trigger signal edge. The selected setting is illuminated.

The selection is valid for all trigger modes with the exception of *FREE RUN*.

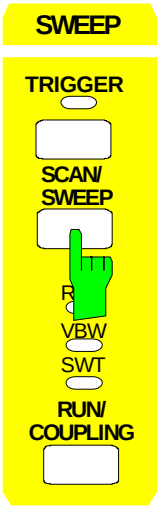
The default mode is *SLOPE POS.*

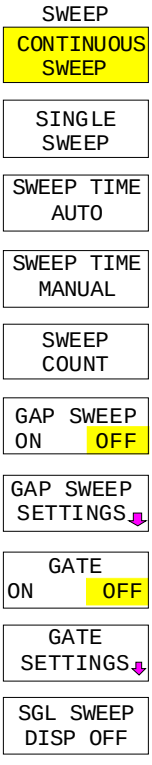
IEC/IEEE-bus command

```
:TRIGger<1|2>[:SEQuence]:SLOPe POS |NEG
```

Sweep Setup – SWEEP Key

SWEEP SWEEP menu:

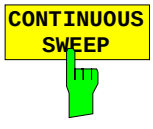




The *SWEEP* key calls a menu in which the type of sweep (sweep mode) is determined. In split screen mode, the entries are valid only for the active measurement window.

In the menu, continuous or single sweep mode, gap-sweep settings or the external gate function can be selected.

The *CONTINUOUS SWEEP* and *SINGLE SWEEP* softkeys are selection switches. Only one softkey can be active at any one time.



The *CONTINUOUS SWEEP* softkey sets the continuous sweep mode. This means, that the sweep takes place continuously according to the trigger conditions.

In the case of split screen display with different settings in each measurement window, screen A is swept first and then screen B. After pressing the softkey, the sweep is initialized and restarted.

CONTINUOUS SWEEP is the default setting of the FSET.If a switchover in the sweep range is required with mechanical switches such as the filters of Preselection FSET-Z.., *SINGLE SWEEP* is activated in the default setting to protect the relays.

IEC/IEEE-bus commands `:INITiate<1|2>:CONTinuous ON;`
`:INITiate`

SINGLE SWEEP

The *SINGLE SWEEP* softkey starts a series of n sweeps according to the triggering definition. The number of sweeps, n, is determined by the *SWEEP COUNT* softkey.

In split screen display mode, the spans of each window are swept sequentially. If a displayed curve is averaged, the span is swept n times (n = sweep count). For n = 0, a single sweep takes place.

To indicate that the FSET is set for single sweep, the enhancment label **SGL** is shown on the display.

IEC/IEEE-bus commands
```
:INITiate<1|2>:CONTinuous OFF;
:INITiate
```

SWEEPTIME AUTO

SWEEPTIME MANUAL

The *SWEEPTIME AUTO* and *SWEEPTIME MANUAL* softkeys activate the automatic or manual selection of the sweep time. These functions are identical to the entries in the *COUPLING* menu (see section "Setting and Coupling the Coupling Resolution, Video Bandwidth and Sweep Time").

IEC/IEEE-bus commands
```
:[SENSe<1|2>:]SWEep:TIME:AUTO ON | OFF
:[SENSe<1|2>:]SWEep:TIME 10s
```

SGL SWEEP DISP OFF

The *SGL SWEEP DISP OFF* softkey switches off the display during a single sweep. The trace is displayed when the sweep has been completed.

IEC/IEEE-bus commands
```
:INITiate<1|2>:DISPlay ON | OFF;
:INITiate
```

SWEEP COUNT

The *SWEEP COUNT* softkey activates the entry of the number of sweeps performed by the FSET after the start of a single sweep. If trace average, max hold or min hold is switched on, this also determines the number of averages or minimua/maxima that are taken.

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

The FSET performs the max hold function over 10 sweeps.

The following ranges of values are possible depending on the use of the capture memory:

CAPT MEM OFF	0 or 1 to 32767 (0 for sliding averaging over 10 sweeps)
CAPT MEM ON	1 to 1024

The default setting totals 10 sweeps.

Note: *The setting for the number of sweeps in the TRACE menu is equivalent to the setting in the SWEEP menu. In SINGLE SWEEP mode, the measurement is stopped after reaching the chosen number of sweeps.*

IEC/IEEE-bus command
```
:[SENSe<1|2>:]SWEep:COUNt 0
```

Gated Sweep

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

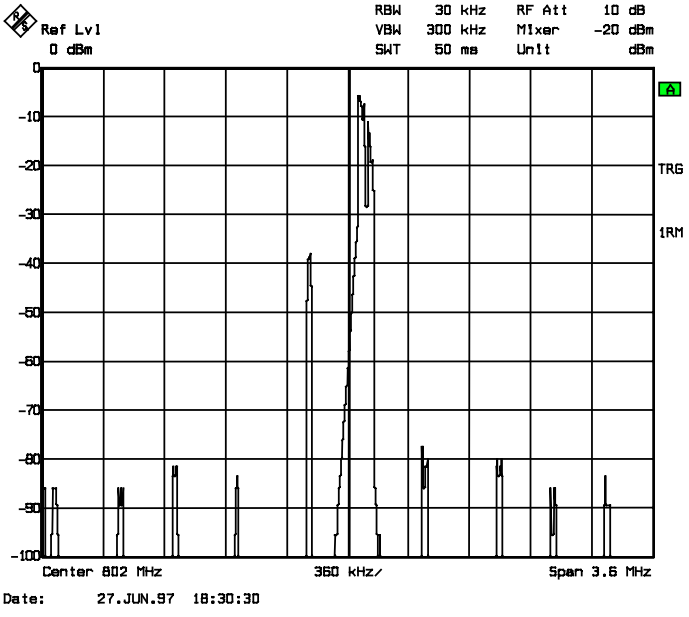


Fig. 4-7 Pulsed signal with GATE OFF

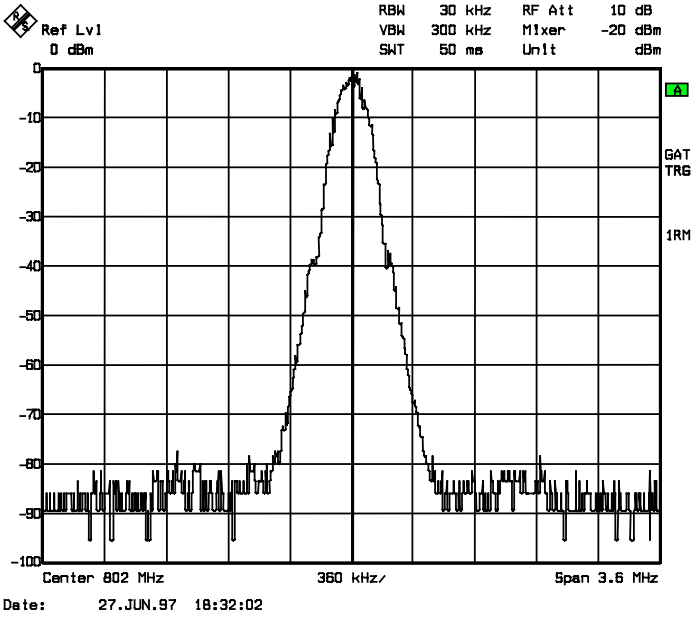
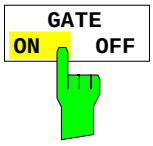


Fig 4-8 TDMA-signal with GATE ON

The 'gated sweep' mode is activated by the *GATE ON/OFF* softkey. The mode is set in the *GATE SETTINGS* sub-menu.

SWEEP SWEEP menu:



The *GATE ON / OFF* softkey switches the sweep mode with an internal or external gate on/off.

When *GATE ON* is selected, a signal applied to the rear panel connector *EXT TRIGGER/GATE* or the internal RF power detector controls the sweep of the analyzer. The sweep can be stopped and then continued. A switch from an edge triggered to a level triggered mode can also be made.

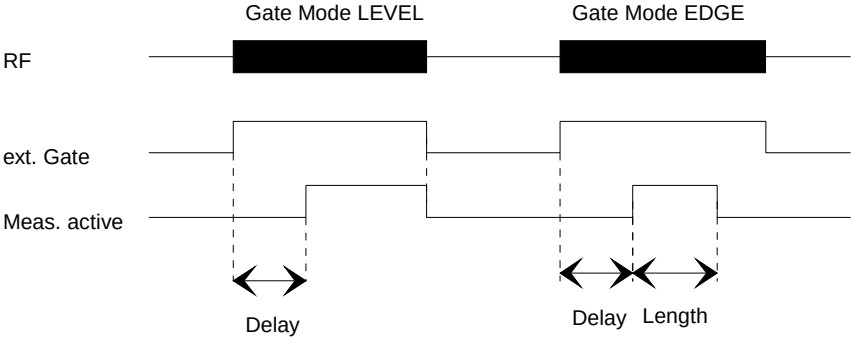


Fig. 4-9 Interaction of the parameters *GATE MODE*, *GATE DELAY* and *GATE LENGTH*

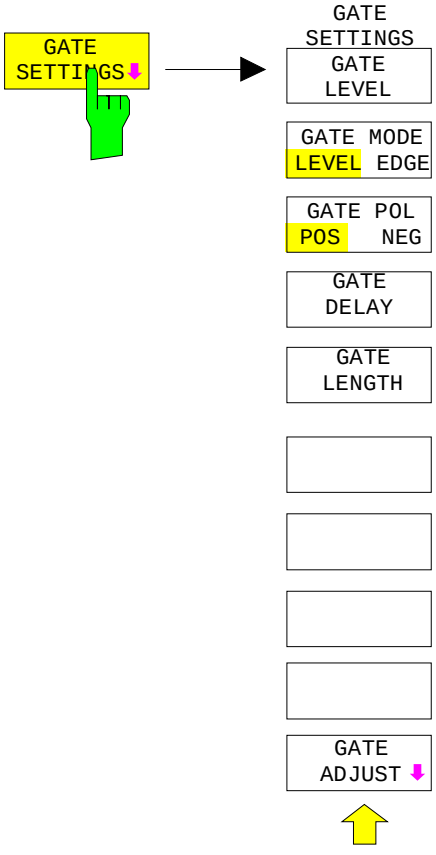
The softkey is only available in the frequency domain (span > 0).

GATE ON is only possible when the trigger mode is set to *FREE RUN* (*SWEEP TRIGGER* menu) .

To indicate that the FSET is set for sweep mode with external gate, the enhancement label GAT is displayed on the screen. GAT appears next to the window for which the gate is configured.

IEC/IEEE-bus command `:[SENSe<1|2>:]SWEep:EGATe ON | OFF`

SWEEP SWEEP-GATE SETTINGS sub-menu:



In the *GATE SETTINGS* submenu, all settings are made which are necessary for 'gated sweep' operation.

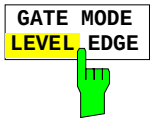
On switching to the time domain, the *GATE DELAY* and *GATE LENGTH* times are represented by horizontal time lines which allow simple adjustment of the gate time.



The *GATE LEVEL* softkey activates the entry window for defining the threshold value of the external gate signal.

The threshold can be set between -5V and +5V.

IEC/IEEE-bus command `:[SENSe<1|2>:]SWEep:EGATe:LEVel 3V`



The *GATE MODE LEVEL/EDGE* softkey selects the trigger mode. The sweep mode *GATE* can be operated either as level or as edge triggered.

For level triggering, the *GATE LENGTH* softkey is deactivated and can not be used.

IEC/IEEE-bus command

`:[SENSe<1|2>:]SWEep:EGATe:TYPE LEVel | EDGE`



The *GATE POL* softkey determines the polarity of the *GATE* control line.

If level triggering with *GATE POL POS* is set, the sweep is stopped when the gate signal is a logic ´ 0 ' (input signal < gate level) at the *EXT TRIGGER/GATE* input and then, when the gate signal goes to a logic ' 1 ', the sweep is continued after a delay time of *GATE DELAY*.

In the 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.

IEC/IEEE-bus command

`:[SENSe<1|2>:]SWEep:EGATe:POLarity POS|NEG`



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

This may be usefull in allowing for a delay between the gate signal and the stabilization of an RF carrier.

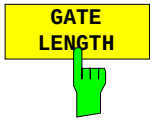
Gate delay values can be selected between 1 µs and 100 s. The resolution is dependent upon the absolute value of the delay time:

Gate delay	Resolution
0 - 500 µs	1 µs
0.5 - 5 ms	5 µs
5 - 50 ms	50 µs
50 - 500 ms	500 µs
0.5 - 5 s	5 ms
5 - 50 s	50 ms
50 - 100 s	500 ms

In the time domain, a time line is displayed separated from the trigger point by the gate delay time. This simplifies the adjustment of the necessary delay time.

The values for *GATE DELAY* and *GATE LENGTH* are displayed by two time lines. The duration of the active sweep for span > 0 (continuation of sweep: GATE DELAY line, stopping of sweep: GATE LENGTH line) is described by these two lines. A change in parameters causes a shift of the corresponding line position. After switching to span > 0, the selected times for the gated sweep are effective.

IEC-bus command `:[SENSe<1|2>:]SWEep:EGATe:HOLDoff 100us`



The *GATE LENGTH* softkey activates the entry window for defining the FSET sweep duration.

GATE LENGTH can be set to values between 1µs and 100 s. The resolution is dependent upon the absolute value of the gate length:

Gate length	Resolution
0 - 500 µs	1 µs
0.5 - 5 ms	5 µs
5 - 50 ms	50 µs
50 - 500 ms	500 µs
0.5 - 5 s	5 ms
5 - 50 s	50 ms
50 - 100 s	500 ms

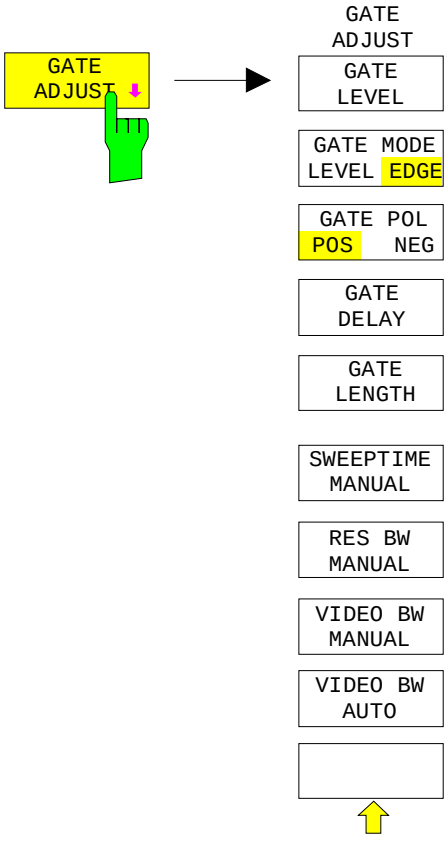
In the time domain *(ZERO SPAN)*, a time line is displayed separated from the *GATE DELAY* time by the *GATE LENGTH* time.

The softkey is only available for the *GATE MODE EDGE* setting (edge triggering). It is disabled for the *GATE MODE LEVEL* setting (level triggering).

IEC/IEEE-bus command `:[SENSe<1|2>:]SWEep:EGATe:LENGth 10ms`

Setting the Gate Times

SWEEP SWEEP- GATE SETTINGS - GATE ADJUST submenu:



The *GATE ADJUST* softkey opens a submenu comprising all softkeys that are used to set the parameters relevant for the 'gated sweep' function.

On pressing this softkey, the display is switched to the time domain (zero span setting) so that all necessary times can be checked by means of cursor lines.

The values for Res BW, Video BW and sweep time are taken from the corresponding settings in the frequency domain.

To make sure that the times can be set correctly corresponding to the conditions in the frequency domain, the settings for the resolution bandwidth and the video bandwidth should not be changed.

The sweep time must be selected such that, e. g., a full burst is displayed. It usually differs from the sweep time in the frequency range.

Finally, *GATE DELAY* and *GATE LENGTH* can be used to set the times in such a way that the desired section in the spectral range is covered.

On quitting the submenu, the original settings in the frequency range are restored so that the measurement can be directly performed with the required parameters.

Measurement example:

The modulation spectrum of a GSM or PCS1900 signal to be measured using the 'gated sweep' function. The signal is generated by the test sender SME03. Its RF-output is directly connected to the RF input of the FSET.

Settings on the 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 provides a GMSK-modulated TDMA-signal (GSM)

Operation steps on the FSET:

[PRESET]	
[CENTER:	{802} **MHz]**
[SPAN	{3.6} **MHz]**
[REF LVL:	{0} **dBm**: *RF ATTEN MANUAL*: {10} **dB]**
[COUPLING:	*RES BW MANUAL*: {30} **kHz]**
[TRACE 1:	*DETECTOR*: *RMS]*
[SWEEP:	*SWEEPTIME MANUAL*: {50} **ms**;
	GATE ON
	GATE SETTINGS: *GATE MODE EDGE: GATE POL POS: GATE RF POWER*
	GATE ADJUST: *SWEEPTIME MANUAL* {1} **ms**: *GATE DELAY* {300} **µs**: *GATE LENGTH*: {250} **µs]**

Note: ***[KEY]*** *Menu called by the KEY. All indications inside the bracket refer to this menu.*
{Number} *Numeric value to be entered for the corresponding parameter*
SOFTKEY *Softkey used to select a parameter or enter a value.*

The following figure shows the screen display for gate parameter setting: The vertical lines for gate delay (GL) and gate length (GL) can be adapted to the burst signal by entering numbers or with the rollkey.

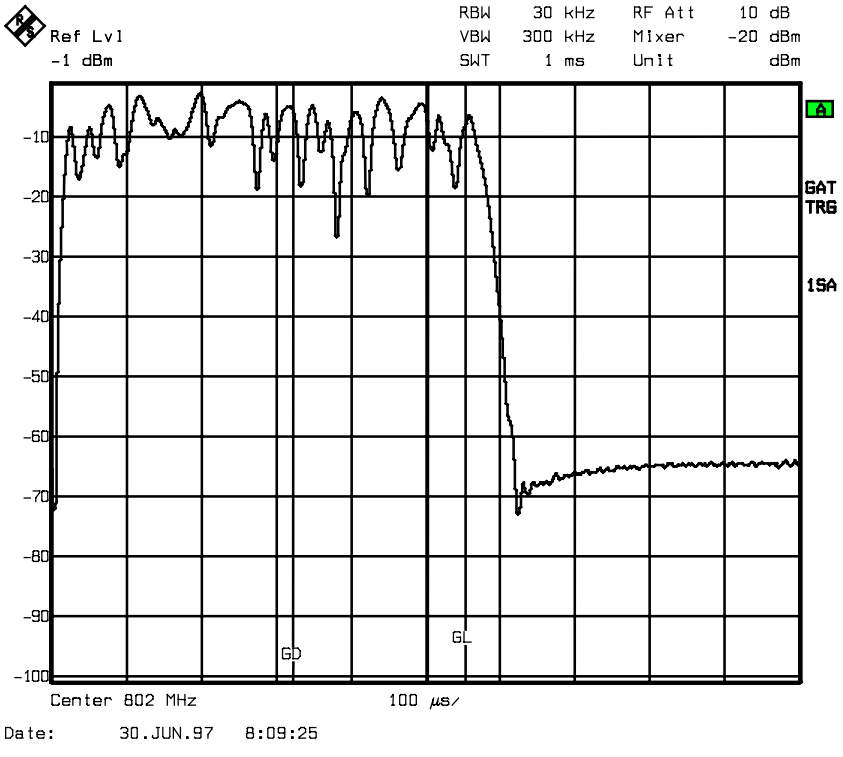


Fig. 4-10 Setting the GATE DELAY and GATE LENGTH times in the time domain using the GD and GL lines

On quitting the menu *GATE ADJUST,* the FSET returns to spectral representation.

Sweep Blanking – Gap Sweep

For measurements in the time domain, the *GAP SWEEP* function offers a high degree of flexibility with regard to the display of measurement data. With the *PRE TRIGGER* softkey, it is possible to display measurements taken before the trigger time. With the *GAP TIME* softkey, the measurements within a predefined time range can be blanked. Thus, it is possible to display the rising and falling edge of a signal with high resolution on a single diagram.

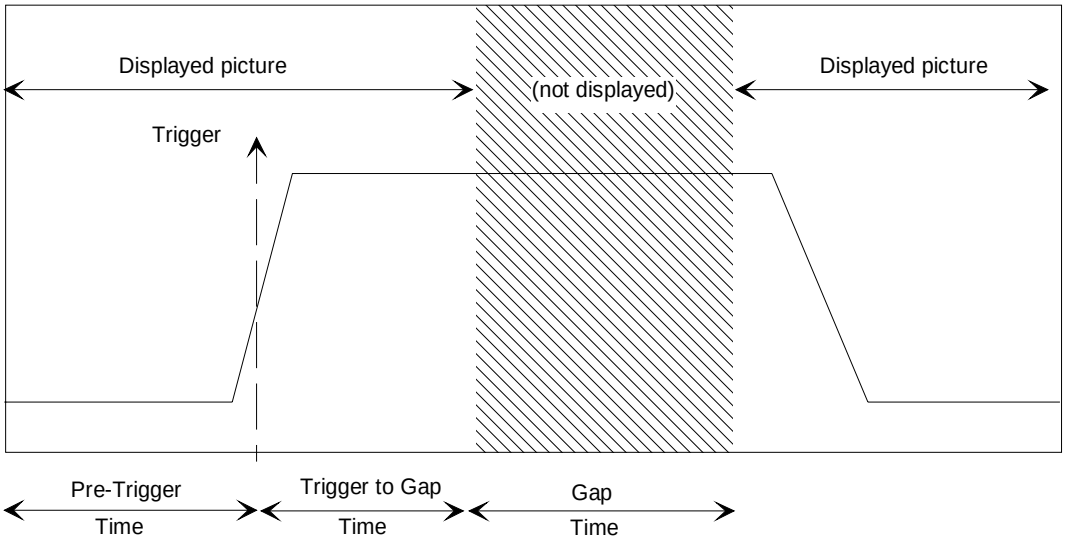


Fig 4-11 Trace blanking in sweep mode.– Gap Sweep

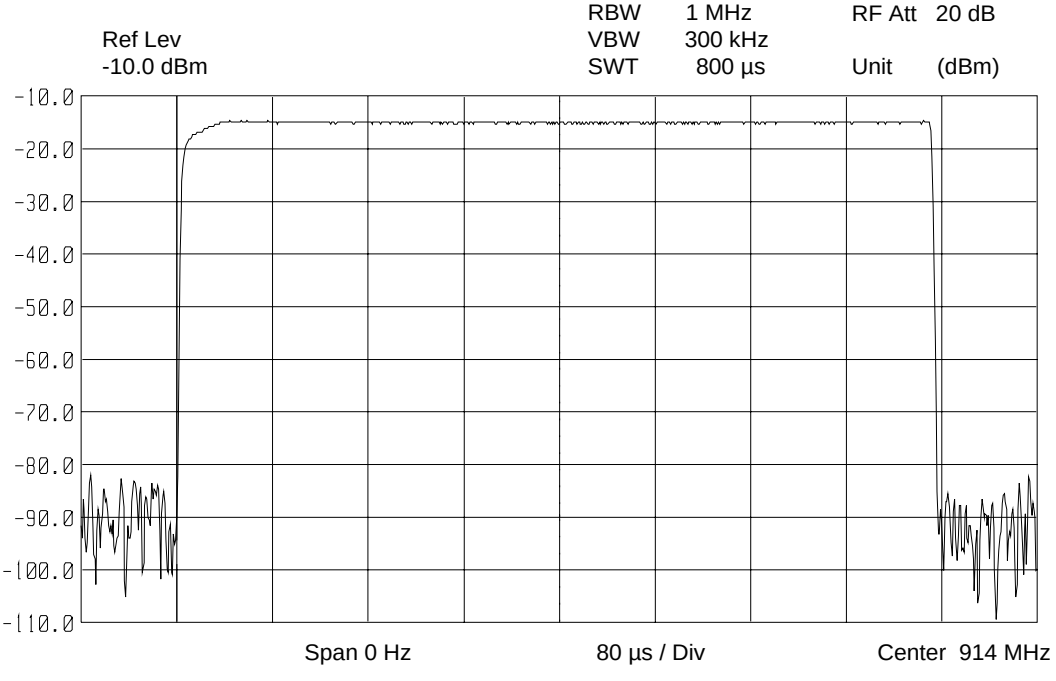


Fig. 4-12 Display of a burst without gaps

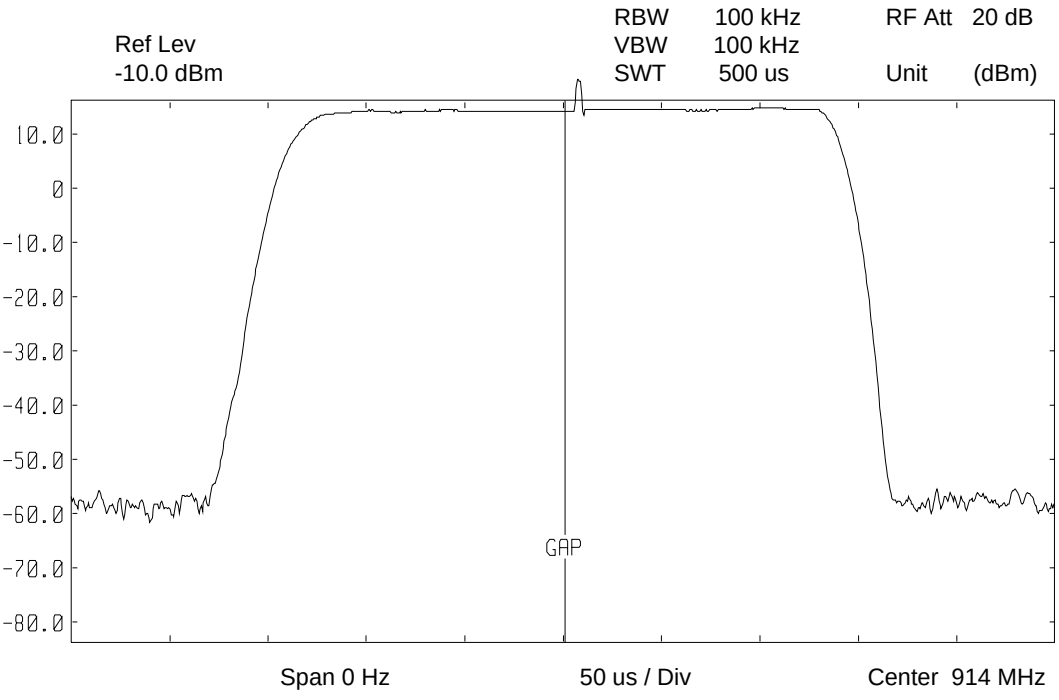
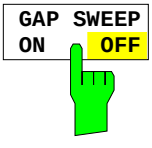


Fig. 4-13 Display of a burst with a gap

The *GAP SWEEP* measurement is activated by the *GAP SWEEP ON/OFF* softkey. The mode settings are made in the *GAP SWEEP SETTINGS* sub-menu.

SWEEP SWEEP menu:

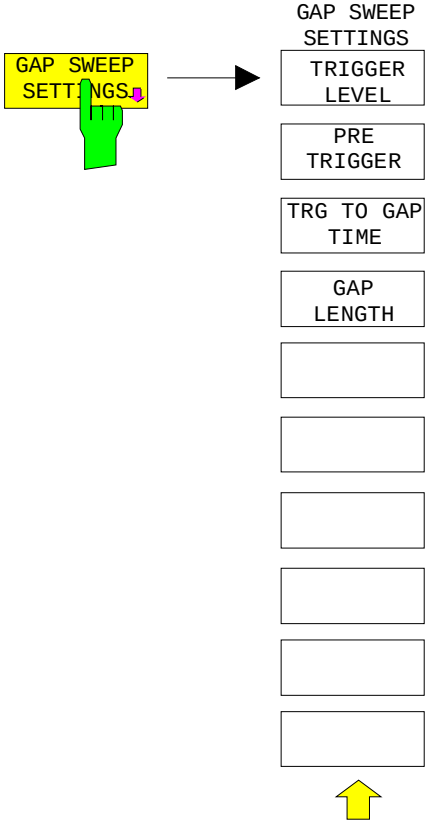


The *GAP SWEEP ON/OFF* softkey switches the *GAP SWEEP* measurement on/off.

The softkey is available only in the time domain.

IEC/IEEE-bus command `:[SENSe<1|2>:]SWEep:GAP ON | OFF`

SWEEP SWEEP-GAP SWEEP SETTINGS sub-menu:



The *GAP SWEEP SETTINGS* softkey opens a sub-menu in which the parameters for the gap can be selected.

The trigger time corresponds to t = 0. Events occurring before the trigger time are displayed in negative time.



The *TRIGGER LEVEL* softkey activates the entry window for trigger level.

This function corresponds to the setting in the trigger menu.

IEC/IEEE-bus command

```
:TRIGger<1|2>[:SEQuence]:LEVel:VIDeo 50PCT
```



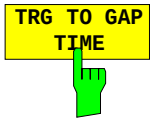
The *PRE TRIGGER* softkey activates the entry window for the pre-trigger time. The pre-trigger time defines the separation between the left edge of the grid and the trigger time (t = 0).
At the same time the gap sweep is switched on (exception : entry t = 0)

The minimum pre-trigger time is –100 s, the maximum pre-trigger time depends on the sweep time and the trigger to gap time (max = 100 s). The maximum resolution is 50 ns.

The *PRE TRIGGER* value can be entered in the frequency domain (span > 0) as well as in the time domain and *GAP SWEEP OFF* mode. It is, however, only effective when the *GAP SWEEP* measurement is enabled.

IEC/IEEE-bus command

```
:SENSe<1|2>:]SWEep:GAP:PRETrigger 100us
```



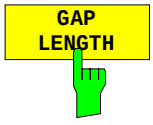
The *TRG TO GAP TIME* softkey opens an entry window for defining the distance between the trigger time and the beginning of the gap.

The *TRIGGER TO GAP TIME* range is from 0 to 100 s with a resolution of 50 ns. The length of the gap is defined by *GAP LENGTH*. If the *GAP LENGTH* is 0 s, the entered value of *TRG TO GAP TIME* is only stored.

The *TRG TO GAP TIME* value can be entered in the frequency domain (span > 0) as well as in the time domain and for the *GAP SWEEP OFF* mode. It has an effect on the measurement only after the *GAP SWEEP ON* is switched on.

IEC/IEEE-bus command

```
:[SENSe<1|2>:]SWEep:GAP:TRGTogap 50us
```



The *GAP LENGTH* softkey activates the entry window for defining the gap within which the measurement values are to be blanked.

The beginning of the gap is defined by *TRG TO GAP TIME*.

GAP LENGTH can be set to values between 150 ns and 100 s in 1/2/3/5 steps. The resolution is dependent upon the absolute value of the gap length:

Gap length	Resolution
150 ns - 50 µs	50 ns
50 - 500 µs	500 ns
0.5 - 5 ms	5 µs
5 - 50 ms	50 µs
50 - 500 ms	500 µs
0.5 - 5 s	5 ms
5 - 50 s	50 ms
50 - 100 s	500 ms

The *GAP LENGTH* value can be entered in the frequency domain (span > 0) as well as in the time domain and for the *GAP SWEEP OFF* mode. It has an effect on the measurement only after the *GAP SWEEP ON* is switched on.

IEC/IEEE-bus command

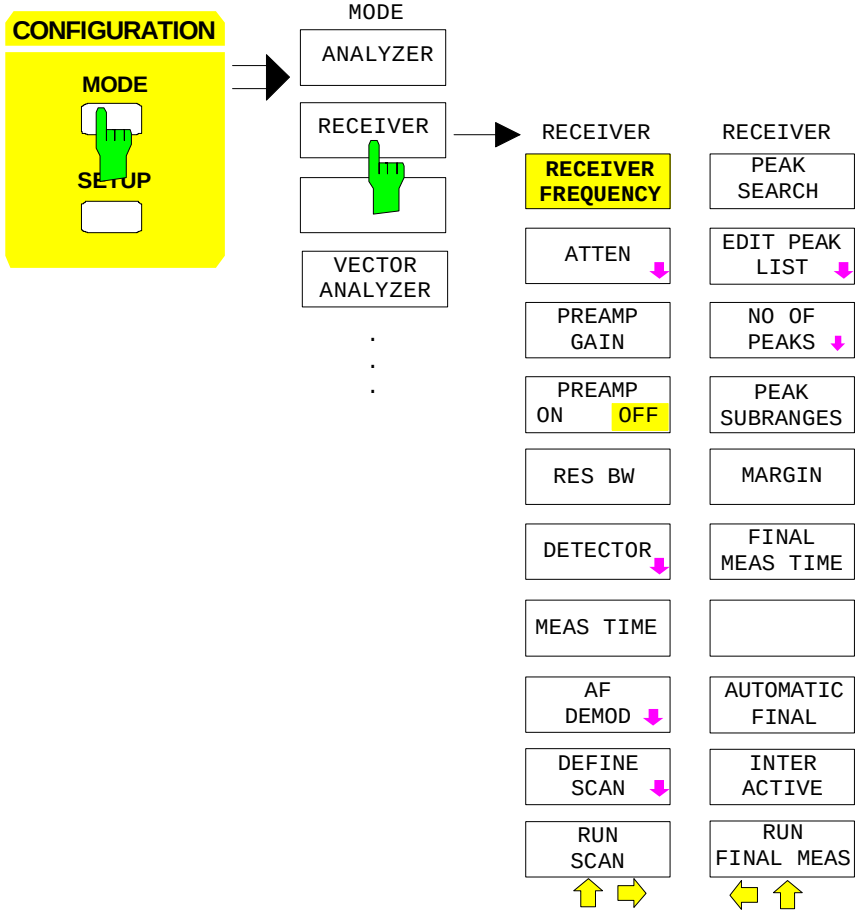
```
:[SENSe<1|2>:]SWEep:GAP:LENGth 400us
```

RECEIVER Mode

The mode is selected in the *CONFIGURATION MODE* menu.

The *RECEIVER* softkey selects the receiver mode and activates the menu for setting the receiver parameters.
A window for receiver operation is opened.

The entry for the receiver frequency is automatically active (*FREQUENCY* softkey).



IEC/IEEE-bus command `:INSTrument[:SELect] RECeiver`

In the receiver mode, FSET acts as a test receiver, ie it measures the level at the set frequency with a selected bandwidth and measurement time (*RES BW* and *MEAS TIME* softkeys). Signal weighting is by means of the average, max peak, min peak, and RMS detectors (*DETECTOR* softkey).
The attenuation of the employed input can be selected (*ATTEN* softkey). The total noise figure can be reduced by means of a preamplifier (*PRAMP ON/OFF* softkey).

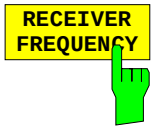
A frequency scan can be performed after setting the start and stop frequency and the step width. The scan subranges can be defined in a table (*DEFINE SCAN* softkey).
The scan is started with the *SCAN* softkey or the *COUPLING* key in the *SWEEP* field.

When the receiver mode is active, the *MODE* key directly opens the main receiver menu. For a change to the ANALYZER mode, the main menu must be called first.

Operation on a Discrete Frequency

Setting the Receive Frequency

CONFIGURATION MODE - RECEIVER submenu



The *RECEIVER FREQUENCY* softkey activates the entry field of the receive frequency.

The receive frequency can also be activated with the *FREQ* key in the *FREQUENCY* field without quitting the currently selected menu. A precondition is that the frequency and level display is active.

Input : 100 Hz to f_{max}

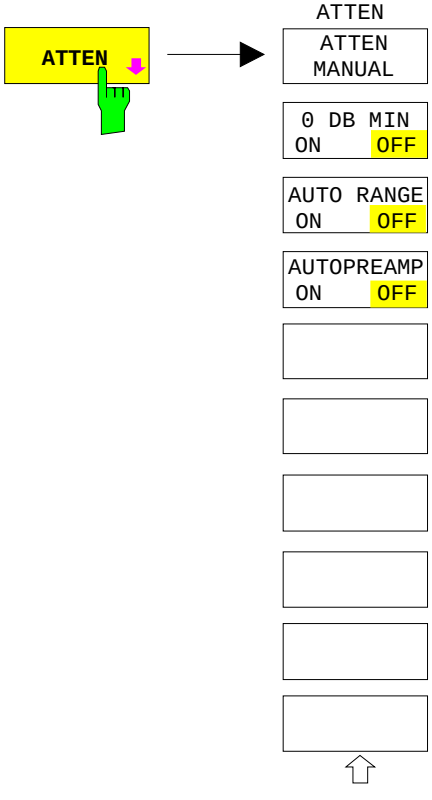
When the tuning frequency is lower than twice the IF bandwidth, the IF bandwidth is automatically reduced so that this condition is met again.
If the frequency is increased again, the original IF bandwidth is restored. The memory is cleared when the IF bandwidth is manually changed.

The resolution of the receive frequency is always 0.1 Hz.

IEC/IEEE-bus command `:[SENSe:]FREQuency[:CW|FIXed] <num_value>`

Setting the RF Attenuation

CONFIGURATION MODE - RECEIVER submenu



The *ATTEN* softkey opens a submenu where the input attenuator can be configured. The submenu includes setting the RF attenuation and the autorange function.



The *ATTEN MANUAL* softkey activates the attenuation entry field.

The following attenuation settings are possible depending on the frequency:

During operation with Preselector FSET-Z..:

FSET7:

- 100 Hz to 2 GHz :	0 to 80 dB	in 1-dB steps

FSET22:

- 100 Hz to 2 GHz :	0 to 80 dB	in 1-dB steps,
- 2 GHz to 22 GHz:	0 to 70 dB	in 10-dB steps

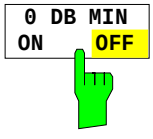
FSET7 and **FSET 22** without Preselector FSET-Z..:

- 100 Hz to f_{max}	0 to 70 dB	in 10-dB steps

Other entries are rounded to the next higher integer values.

IEC/IEEE-bus command

```
:INPut:ATTenuation <numeric_value>
```



The *0 DB MIN* softkey determines whether the 0 dB setting of the attenuator may be used in the manual or automatic setting of the attenuator.

0 DB MIN OFF is the default value, ie an RF attenuation of at least 10 dB is always set on FSET to protect the input mixer.

An attenuation of 0 dB cannot be set manually either. This avoids 0 dB being switched on inadvertently.

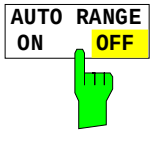
Caution:



If 0 dB RF attenuation is used with autoranging, care must be taken that the permissible signal level at the RF input is not exceeded. Exceeding this level would damage the input mixer. The 0 dB attenuation should under no circumstances be used when RFI voltage measurements are performed with artificial networks as in this case very high pulses occur during phase switching.

IEC/IEEE-bus command

```
:INPut:ATTenuation:PROTection ON | OFF
```

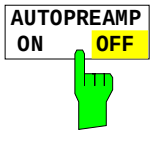


The *AUTO RANGE ON/OFF softkey* switches the autorange function on and off.

With the autorange function active, FSET automatically sets the attenuation so that a good S/N ratio is obtained without the receiver stages being overdriven.

IEC/IEEE-bus command

```
:INPut:ATTenuation:AUTO ON | OFF
```



The *AUTOPREAMP ON/OFF* softkey switches the autopreamp function and or off.

With the autopreamp function active, the preamplifier is considered in the autorange procedure. The preamplifier is cut in when the RF attenuation is reduced to the minimum settable value.

IEC/IEEE-bus command `:INPut:GAIN:AUTO ON | OFF`

Preamplifier

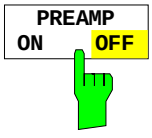
With FSET equipped with die Option Preselector and Preamplifer FSET-Z.., the noise of FSET can be greatly reduced depending on the gain. The preamplifiers are located after the preselector so that the risk of overloading caused by strong out-of-band signals is minimized.

FSET7: The preamplifer can be switched between 10 dB, 20dB and 30 dB.

FSET22: The preamplifer can be switched between 10 dB, 20dB and 30 dB in the 2-GHz frequency range. With the 22-GHz frequency range selected, the preamplifer is fixed to 20 dB over the whole frequency range, ie also for frequencies below 2 GHz. The frequency range is selected in menu CONFIGURATION MODE (FREQ RANGE 2 GHZ and FREQ RANGE 22 GHZ softkeys).

The preselector has to be activated for the preamplifer to become effective (DIRECT MODE OFF softkey).
In the 22-GHz frequency range, the 20-dB preamplifers are coupled to the preselctor. Therefore, the 20-dB preamplifier gain will be switched on automatically once the preselector is activated.

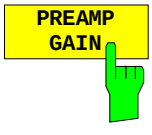
CONFIGURATION SETUP menu



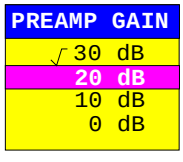
The *PREAMP ON/OFF* softkey switches the preamplifier of option FSET-Z. on or off.

The softkey is only available, if the measurement has been activated with the preselector and if the 2-GHz frequency range has been selected. In the 22-GHz frequency range, the 20-dB preamplifier gain is always switched on if the preselctor is active.

IEC/IEEE-bus command `:INPut:GAIN:STATe ON | OFF`



The *PREAMP GAIN* softkey opens a table for selecting the preamplifer gain.



The softkey is only available if the measurement has been activated with the preselector and if the frequency range of 2 GHz has been selected.

Default value is 30 dB.

If the preset reference level cannot be set at the given preamp gain, it will be adapted and a corresponding warning will be output.

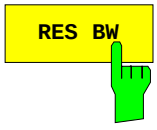
IEC/IEEE-bus command `:INPut:GAIN 30 dB`

Setting the Resolution Bandwidth

Depending on the input used, the following settings are possible for the resolution bandwidth:

Input used	**Available resolution bandwidths**
RF Input:	10 Hz to 500 MHz,
Balanced input:	10 Hz to 10 kHz .

CONFIGURATION MODE - RECEIVER submenu



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

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

The bandwidth is limited by the set receive frequency:

$RES\ BW \leq f_{in}/2$

IEC/IEEE-bus command

```
:[SENSe:]BANDwidth:RESolution <num_value>
```

Selecting the Detector

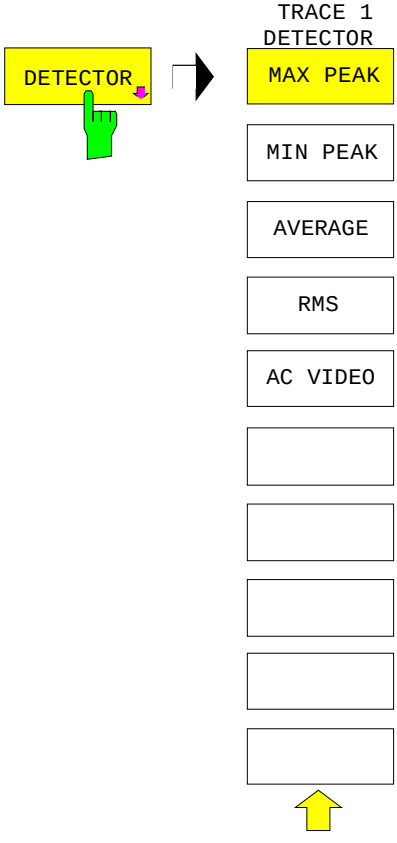
The FSET detectors are implemented by pure digital techniques. Five different detectors can be selected for weighting the receive signal. The input signal of FSET can be displayed weighted by three detectors.

Peak detectors (*MAX PEAK/ MIN PEAK*)	Peak detectors are implemented by digital comparators, which determine the largest sample values (max peak) or the smallest sample values (min peak) of the levels measured during the set measurement time.
Average detector (*AVERAGE*)	The average detector yields the average level of the samples measured during the set measurement time. To this effect, FSET uses the linear display voltage after envelope detection. The linear sample values are summed up and the sum is divided by the number of measurement samples (= linear average value). In case of logarithmic display, the logarithm is then formed from the average value. The average detector supplies the average value of the signal independent of the waveform (CW carrier, modulated carrier, white noise or pulse signal).
RMS detector (*RMS*)	The average detector yields the rms level of the samples measured during the set measurement time. To this effect, FSET uses the linear display voltage after envelope detection. The linear values are squared, summed and the sum is divided through the number of samples (= root mean square). In case of logarithmic display, the logarithm is then formed from the square sum. The rms detector supplies the power of the signal independent of the waveform (CW carrier, modulated carrier, white noise or pulse signal). The correction factors required by other detectors for the power measurement of the different signal classes are omitted.

AC Video detector

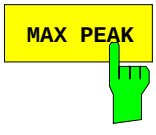
The AC video detector yields the difference (max peak – min peak) of measurement results over a pixel or a result.
For this purpose FSET uses the linear display voltage after envelope detection. The max peak detector and the min peak detector determine the maximum and minimum levels within a shown measurement point and display it as a common measurement result. In receiver operation, the AC value determined during the measurement time is shown.
Irrespective of the signal form (CW carrier, modulated carrier, white noise of pulsed signal), the AC video detector always supplies the AC component of the signal.
If during a frequency sweep the dwell time on a certain frequency point is not sufficient, this may lead to incorrect results being displayed.

CONFIGURATION MODE - RECEIVER submenu:



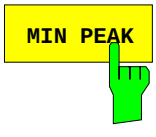
The *DETECTOR* softkey opens a submenu to select the detector.

Multiple detection is activated by switching on up to three single detectors. The MIN PEAK, RMS and AC VIDEO detector cannot be switched on simultaneously.



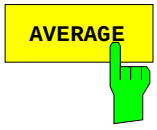
The *MAX PEAK* softkey selects the max peak detector.

IEC/IEEE-bus command
`:[SENSe:]DETector:RECeiver[:FUNCtion] POSitive`



The *MIN PEAK* softkey selects the min peak detector.

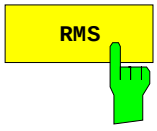
IEC/IEEE-bus command
`:[SENSe:]DETector:RECeiver[:FUNCtion] NEGative`



The *AVERAGE* softkey activates the average detector.

The average detector supplies the linear average of the signal during the measurement time.

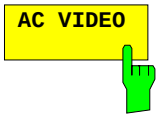
IEC/IEEE-bus command
```
:[SENSe:]DETector:RECeiver[:FUNCtion] AVERage
```



The RMS softkey activates the rms detector.

The rms detector supplies the rms value of the signal. To this effect the root mean square of all sampled values is formed during the measurement time.

IEC/IEEE-bus command
```
:[SENSe:]DETector:RECeiver[:FUNCtion] RMS
```



The *AC VIDEO* softkey activates the *AC VIDEO* detector.

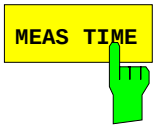
Irrespective of the signal form, the *AC VIDEO* detector always supplies the AC component of the signal. For this purpose the difference is formed of all maximum and minimum level values collected during the runtime of the pixel / the set measurement time. The sweep / measurement time therefore determines the number of values to be considered, so the AC component is determined more accurately with increasing sweep / measurement time. The *AC VIDEO* detector can thus be used as an alternative for the detection of modulated signals.

IEC/IEEE-bus command
```
:[SENSe:]DETector:RECeiver[:FUNCtion] ACVideo
```

Setting the Measurement Time

The measurement time is the time during which FSET measures the input signal and forms a measurement result weighted by the selected detector. The measurement time does not include settling times. FSET automatically waits until transients are over.

CONFIGURATION MODE - RECEIVER submenu



The *MEAS TIME* softkey activates the entry field for the measurement time.

The measurement time can be set in steps of 1-2-5 in the range 100 µs to 100 s. A measurement time of 15 s is available in addition.

The smallest settable measurement time depends on the bandwidth.

Bandwidth	Shortest measurement time AV, RMS	Shortest measurement time PK +, PK -, AC Video
≤ 10 Hz	1 s	10 ms
100 Hz	100 ms	1 ms
200 Hz	50 ms	1 ms
1 kHz	10 ms	0.1 ms
10 kHz	1 ms	0.1 ms
≥ 100 kHz	0.1 ms	0.1 ms

IEC/IEEE-bus command `:[SENSe:]SWEep:TIME <numeric_value>`

Effect of measurement time with different weighting modes:

MIN/MAX PEAK measurement: With peak weighting selected, the maximum or the minimum level during the selected measurement time is displayed. The peak detector is reset at the beginning of each measurement. At the end of the measurement time the maximum or the minimum level occurred during the measurement time is displayed. Since the peak detector of FSET is a digital detector, discharging is irrelevant even with long measurement times.
Unmodulated signals can be measured with the shortest possible measurement time. When pulses are measured, the selected measurement time must be long enough for at least one pulse to occur during the measurement time.

AC video measurement: Since the AC video detector is a combination of a min and a max peak detector, the considerations for the peak measurement apply here too.
The longer the measurement time, the better the acquisition of the AC voltage component of the test signal.

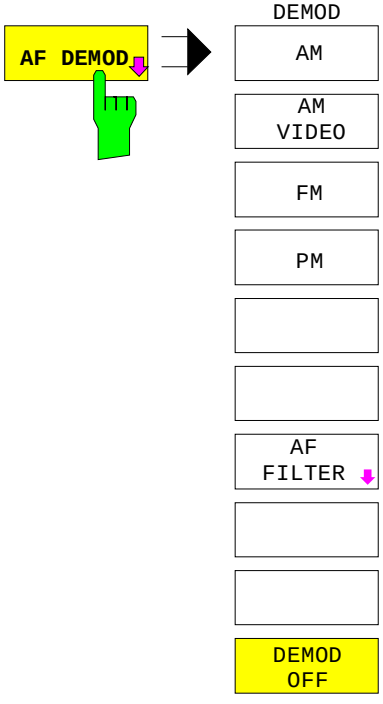
Average measurement: With average detection selected, the video voltage (envelope of IF signal) is averaged during the measurement time. Averaging is digital, ie the digitized values of the video voltage are summed up and divided by the number of samples at the end of the measurement time. With unmodulated signals the shortest possible measurement time can be selected. With modulated signals the measurement time is determined by the lowest modulation frequency to be averaged. With pulse signals, the selected measurement time should be long enough for sufficient number of pulses (>10) to occur in the measurement window for averaging.

RMS measurement: With RMS weighting the same applies to the measurement time as with the average measurement.

Measurement with several detectors: If several detectors are used simultaneously, a measurement time suiting the slowest detector should be selected to obtain correct results for all detectors. It is therefore recommended to set a measurement time that matches the average detector when the peak and average detectors are used.

AF Demodulation

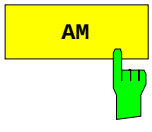
CONFIGURATION MODE - RECEIVER menu



The *AF DEMOD* softkey opens a submenu for selecting the type of modulation.

Amplitude demodulation (*AM* or *AM VIDEO*), frequency demodulation (*FM*) and phase demodulation (*PM*) can be selected. AF demodulation is switched off by means of the *DEMOD OFF* softkey.
These softkeys are selection switches of which only one can be active.

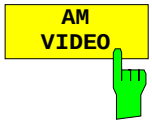
The filters for AF-band limitation are selected in the *AF FILTER* submenu.
The volume for the loudspeaker and the headphones is controlled by the volume control knob on the front panel of FSET.



The *AM* softkey switches the AM demodulation on.

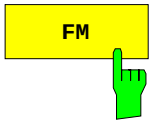
For AM demodulation, resolution bandwidths from 2 to 100 kHz are available. If the resolution bandwidth is outside this range upon switch-on, it is set to the next possible value for demodulation.

IEC/IEEE-bus command :[SENSe<1|2>:]DEMod AM



The *AM VIDEO* softkey switches the unregulated AM video signal into the AF path of FSET.

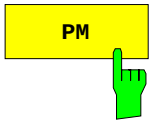
IEC/IEEE-bus command :[SENSe<1|2>:]DEMod AMVideo



The *FM* softkey switches the FM demodulation on .

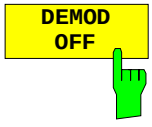
For FM demodulation, resolution bandwidths (RBW) from 2 kHz to 10 MHz are available. If the resolution bandwidth is outside this range upon switch-on, it is set to the next possible value for demodulation.
The demodulated signal is always available DC or AC coupled at the AM/FM output (rear panel) (settable with *AF FILTER*).
For the display, irrespective of the above, the DC component can be separated by *AC VIDEO COUPLING*. This is recommended if a frequency sweep is carried out by means of the FM demodulator to suppress unmodulated carriers and to display only modulated signals.

IEC/IEEE-bus command :[SENSe<1|2>:]DEMod FM



The *PM* softkey switches the phase demodulation on. For phase demodulation, resolution bandwidths from 2 to 100 kHz are available. If the resolution bandwidth is outside this range upon switch-on, it is set to the next possible value for demodulation.

IEC/IEEE-bus command `:[SENSe<1|2>:]DEMod PM`



The *DEMOD OFF* softkey switches the AF demodulation off.

This is the default setting of FSET.

IEC/IEEE-bus command `:[SENSe<1|2>:]DEMod OFF`

Selection of AF Filter

To improve the S/N ratio at AF, lowpass filters for the screen display and the AM/FM output at the rear of the unit are provided.
The video filters which are available in the analyzer mode can also be used for screen display, ie lowpass filters between 1 Hz and 10 MHz can be switched. Operation is the same as that for spectrum display using the *COUPLING* key and the *VIDEO BW* softkeys.
In the default setting the AF lowpass filters are coupled to the selected resolution bandwidth (RBW).

The following audio filters are available:

Broadband FM demodulator:

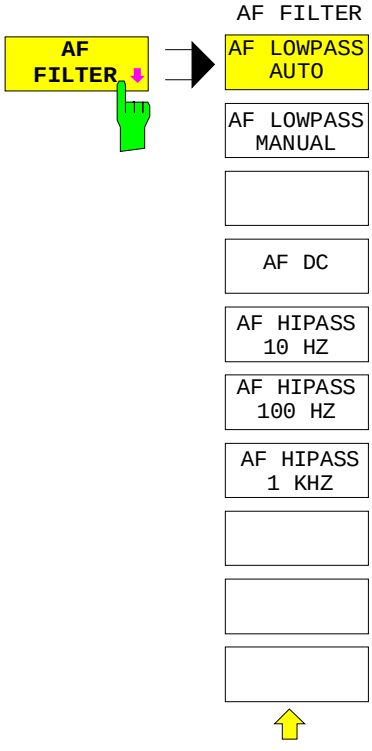
Lowpass filter	Coupled to bandwidths
30 kHz	can only be set manually
100 kHz	200 / 500 kHz
300 kHz	1 MHz
1 MHz	2 / 5 MHz
5 MHz	10 MHz

Narrowband AM/FM demodulator:

Lowpass filter	Coupled to bandwidths
3 kHz	<10 kHz
10 kHz	20 / 50 kHz
30 kHz	≥100 kHz

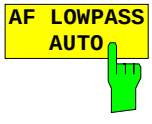
Note: *The AF filters are located directly after the demodulators and also influence the bandwidth when the demodulated signal is displayed on the screen. This means that the maximum bandwidth is determined by the AF filters. Additional band limitation is provided for the AF signal when the video filter is selected. For larger bandwidths, the AF bandwidth is limited by the set AF filter.*

CONFIGURATION MODE - RECEIVER - AF FILTER submenu



The *AF FILTER* softkey opens the submenu for selecting the filter for the band limitation at AF.

The default setting is *AF LOWPASS AUTO* in which the AF bandwidth is coupled to the selected IF bandwidth according to the list above.



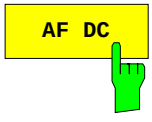
The *AF LOWPASS AUTO* softkey couples the AF bandwidth to the selected IF bandwidth according to the list above. *AF LOWPASS AUTO* is the default setting.

IEC/IEEE-bus command
`:[SENSe<1|2>:]DEMod:FILTer[:LPASs]:AUTO ON`



The *AF LOWPASS MANUAL* softkey activates the manual entry of the desired AF bandwidth. Entries different from the set of filters offered are set to the next smaller value.

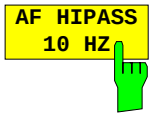
IEC/IEEE-bus command
`:[SENSe<1|2>:]DEMod:FILTer[:LPASs]:FREQ <num_value>`

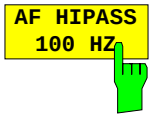


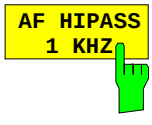
The *AF DC* softkey activates the DC coupling of the AM/FM output. DC coupling is only possible for FM.

With DC coupling of the AM/FM output (*AF DC*) the screen display can only be switched to AC coupling. In this case, activate the function *AC VIDEO COUPLING* (with the COUPLING key in the menu on the right).

IEC/IEEE-bus command `:[SENSe<1|2>:]DEMod:FILTer:HPASs:FREQ 0`







The *AF HIPASS* softkeys switch on a highpass filter with the given limit frequency to separate the DC component.

1 kHz has to be selected if a short transient time is required. The highpass filters affect the AM/FM output and the display in case of *AF DISPLAY ON*.

IEC/IEEE-bus command
`:[SENSe<1|2>:]DEMod:FILTer:HPASs:FREQuency 10| 100| 1000`

Frequency Scan

In the scan mode, FSET measures in a predefined frequency range with selectable step width and measurement time for each frequency.
Up to 10 subranges which need not be next to each other can be defined within one scan. The subranges are then scanned by FSET one after the other. Measurement ranges should not overlap. The parameters for the measurement in each subrange can be selected independently.

Transducer factors or transducer sets, preselector sets and limit lines can be defined and displayed separately and are not part of the scan data record.

The scanned frequency range is defined by the start and stop frequency set independently of the scan table. A scan table can thus be defined for each measurement task, which can be stored and reloaded. The required frequency range can be defined by means of two parameters which can be set via keys so that no elaborate editing has to be done in the scan table.

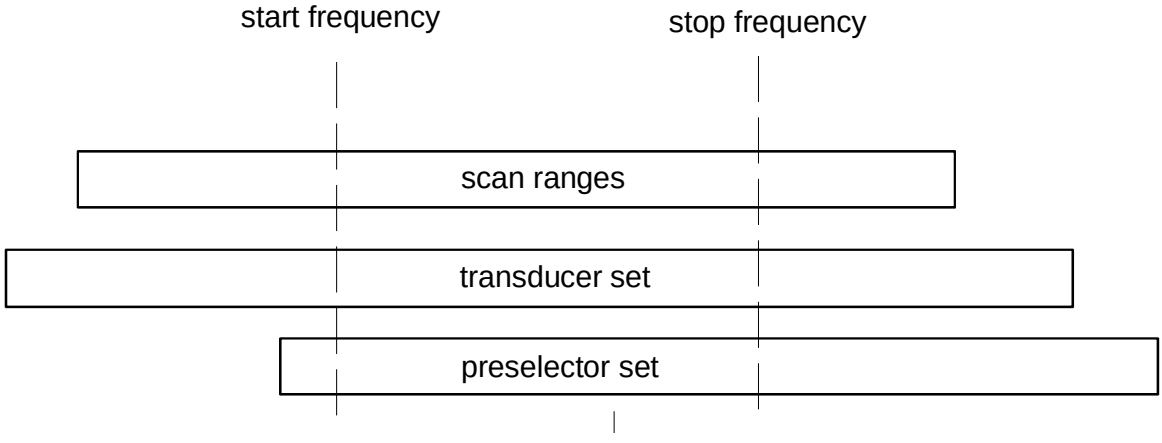


Fig. 4-14 Definition of scan range

Full-screen or split-screen mode can be selected for result display. In the full-screen mode, the result diagram covers the whole screen area. In the split-screen mode, the upper half of the screen is used for frequency and level readout. The diagram is displayed in the lower half. During the scan FSET automatically selects full-screen display.

Up to 4 detectors can be measured simultaneously. Since the detectors are set only once, it is not possible to measure with different detectors in different the subranges.

The scan can be performed as a single scan or continuously. Scanning is started with the *RUN SCAN* softkey and in the case of single scan it is stopped when the stop frequency is reached. The continuous scan can be interrupted with the *HOLD SCAN* softkey or terminated with *STOP SCAN.*

The maximal number of measured frequencies which can be measured, is limited and depends on the number of the traces which are switched on.

Number of traces	**Measured values /trace**
1	250.000
2	150.000
3	100.000
4	80.000

They are stored for postprocessing, eg zooming. If the scan subranges are defined so that more than the possible values would be measured, a respective message is output upon the scan start. Afterwards the scan is performed up to the maximum value.

Entry of Scan Data

A scan is defined in the form of tables. Each scan range is determined by the start frequency, stop frequency, step width and by the measurement parameters valid for the range. Frequency and level axes can be user-selected and are defined for the whole scan.

The *DEFINE SCAN* softkey opens a submenu where existing scan tables can be edited or new ones created. Tables with the current scan settings are displayed.

Pressing the *SCAN* key in the *SWEEP* field also opens the *DEFINE SCAN* submenu.

The *SCAN* table at the top specifies limit frequencies for the diagram, linear or logarithmic frequency switching and the display mode for the frequency axis.

The *SCAN RANGES* table at the bottom gives settings for the scan subranges. It contains 5 columns for 5 subranges and lines for entering the parameters for the different subranges. Up to 10 subranges can be defined.

At least one scan is defined in the list. Two subranges with the limit frequencies 150 kHz and 30 MHz and 30 MHz and 1 GHz are defined in the default setup. All other parameters are shown in the following table:

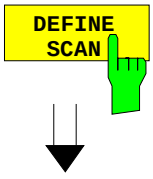
Table 4-3 Default setup of scan table

	Range 1	**Range 2**
Start frequency	150 MHz	30 MHz
Stop frequency	30 MHz	1 GHz
Step width	8 kHz	80 kHz
IF bandwidth	10 kHz	100 kHz
Measurement time	1 ms	100 µs
Auto ranging	off	off
RF attenuation	10 dB	10 dB
Preamplification	off	off
Auto-Preamp	off	off
Input	RF Input 50 Ohm	RF Input 50 Ohm

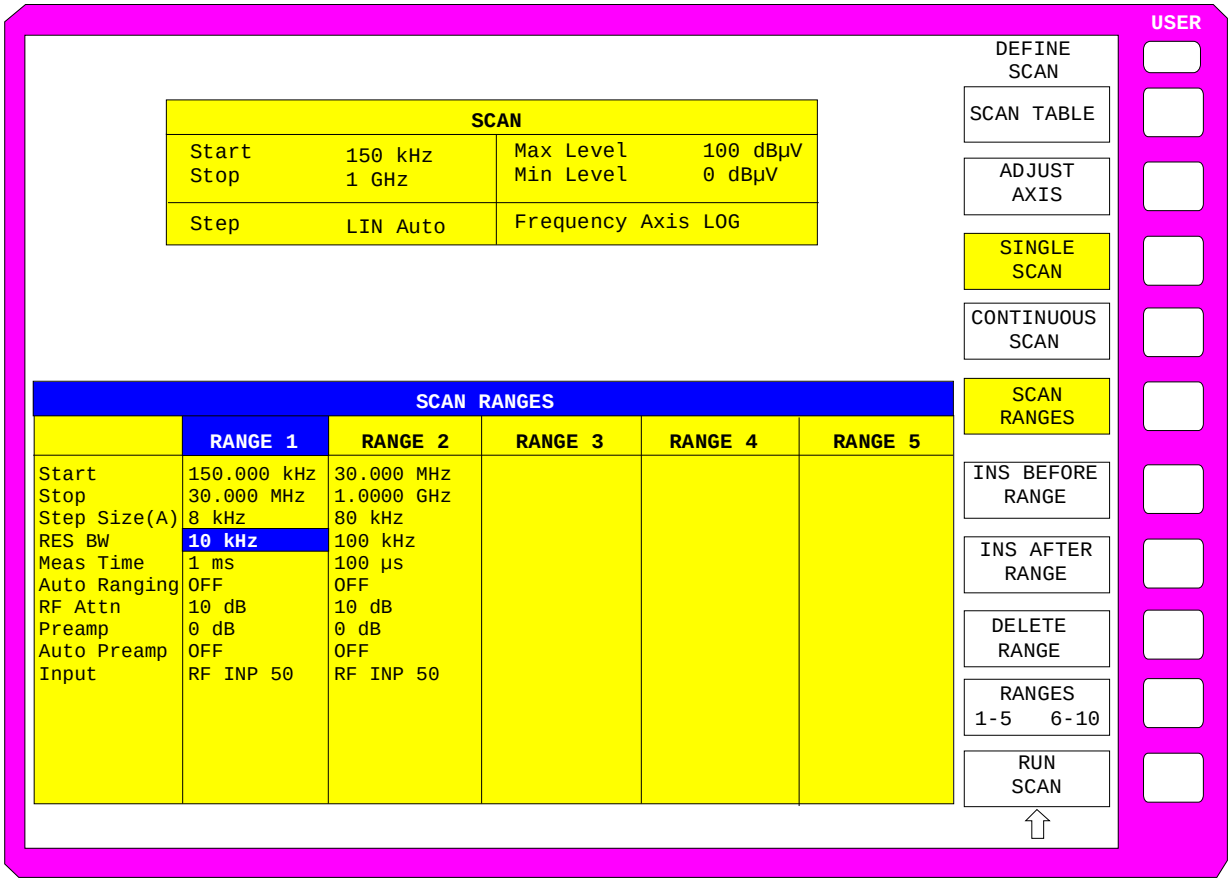
The diagram parameters to be defined are: start frequency 150 kHz, stop frequency 1 GHz, min. level 0 dBµV, max. level 100 dBµV, linear frequency switching and log. frequency axis.

When the menu for creating and editing scans is quit and no runnable scan is available, the last scan data record is activated.

CONFIGURATION MODE - RECEIVER submenu

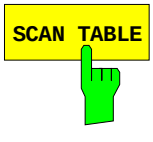


The *DEFINE SCAN* softkey opens a submenu where existing scan tables can be edited or new ones created. Tables with the current scan settings are displayed.
.



Limits for the diagram and the type of frequency switching can be entered in the *SCAN TABLE* .

Start	lower frequency limit
Stop	upper frequency limit
Step	linear or logarithmic frequency switching
Max Level	upper level limit
Min Level	lower level limit
Frequency	linear or logarithmic frequency axis



The *SCAN TABLE* softkey activates the entry field for the limits in the *SCAN* table.

IEC/IEEE-bus commands

```
:[SENSe:]FREQuency:STARt <num_value>
:[SENSe:]FREQuency:STOP  <num_value>
:[SENSe:]SWEep:SPACing  LIN | LOG | AUTO
:DISPlay:TRACe:Y[:SCALe]:TOP <num_value>
:DISPlay:TRACe:Y[:SCALe]:BOTTom <num_value>
:DISPlay:TRACe:X:SPACing  LIN | LOG
```

In the *SCAN RANGES* table the parameters for the individual subranges can be set.

Start
Entry of start frequency
The following conditions should be observed:
The start frequency of a subrange must be equal to or greater than the stop frequency of the previous subrange.
The start frequency of the next subrange must always be greater than the stop frequency of the already defined one.
When the start frequency is entered, the entry field for the stop frequency is automatically activated.

Stop
Entry of stop frequency
The following conditions should be observed:
The stop frequency of a subrange must be equal to or greater than the start frequency of the subrange. The stop frequency of a subrange must always be lower than the start frequency of the next subrange.

When start and stop frequencies are entered, the adjacent subranges are automatically adapted to ensure that the above-mentioned conditions are met.

Step Size
Entry of step size
In the case of linear frequency increments, step widths between 1 Hz and the maximum FSET frequency can be set. When a step size greater than the scan range is entered (from start to stop), FSET performs a measurement at the start and stop frequency.
With logarithmic frequency increments, values between 0.1% and 100% can be set with steps of 1/2/3/5.
With *STEP AUTO* selected, the step size cannot be changed because it is automatically set with respect to 80% of the IF bandwidth (=RES BW).

RES BW
Entry of IF bandwidth

Meas Time
Entry of measurement time
The measurement time can be set between 100 µs and 100 s separately for each subrange.

Auto Ranging
Activates the autorange function
With automatic attenuation setting selected, FSET automatically sets the input attenuation as a function of the signal level.

***Caution**: If 0 dB RF attenuation is used with auto-ranging, care must be taken that the permissible signal level at the RF input is not exceeded. Exceeding this level would damage the input mixer.*

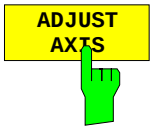
RF Atten
Entry of a fixed RF attenuation

Preamp
Switching the preamplifier on and off

Auto Preamp Activates the auto preamp function
The preamplifier is considered in autoranging. It is only cut in after the attenuation has been reduced to the minimum settable value.

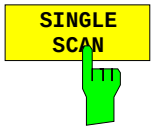
Input Activates the following table for configuration of the RF input.

INPUT
✓ RF INP 50
BAL INP 150
BAL INP 600
BAL INP 10k



The *ADJUST AXIS* softkey automatically sets the limits of the diagram so that the lower limit frequency corresponds to the start frequency of range 1 and the upper limit frequency to the stop frequency of the last range.

IEC/IEEE-bus command --

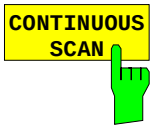


Pressing the *SINGLE SCAN* softkey triggers a frequency scan. FSET stops at the end frequency.

The enhancement label SGL displayed at the screen edge indicates that the single-scan mode is set.

IEC/IEEE-bus command

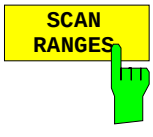
```
:INITiate:CONTinuous OFF; INITiate[:IMMediate]
```



The *CONTINUOUS SCAN* softkey selects the continuous scan mode. FSET scans continuously until the scan is stopped.

IEC/IEEE-bus command

```
:INITiate:CONTinuous ON; INITiate[:IMMediate]
```



The *SCAN RANGES* softkey activates the entry of scan settings in the *SCAN RANGES* table.

IEC/IEEE-bus commands

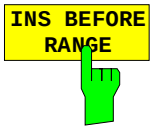
```
:[SENSe:]SCAN<1..10>:RANGes[:COUNt] 1...10
:[SENSe:]SCAN<1..10>:STARt <num_value>
:[SENSe:]SCAN<1..10>:STOP <num_value>
:[SENSe:]SCAN<1..10>:STEP <num_value>
:[SENSe:]SCAN<1..10>:BANDwidth:RESolution  <num_value>
:[SENSe:]SCAN<1..10>:TIME <num_value>
:[SENSe:]SCAN<1..10>:INPut:ATTenuation:AUTO  <num_value>
:[SENSe:]SCAN<1..10>:INPut:ATTenuation  <num_value>
:[SENSe:]SCAN<1..10>:INPut:GAIN <num_value>
:[SENSe:]SCAN<1..10>:INPut:GAIN:STATe ON|OFF
:[SENSe:]SCAN<1..10>:INPut:GAIN:AUTO ON|OFF
:[SENSe:]SCAN<1..10>:INPut:COUPling DC|AC
:[SENSe:]SCAN<1..10>:INPut:TYPE BALanced|RF
```

Editing a Scan

The parameters of a scan subrange in a scan data record can be modified or complete subranges can be added or deleted. When changing the scan limit frequencies, care should be taken that the scan ranges do not overlap.

Complete scan ranges can be cleared or added with the *INSERT RANGE* and *DELETE RANGE* softkeys.

CONFIGURATION MODE - RECEIVER - DEFINE SCAN submenu



The *INS BEFORE RANGE* softkey shifts the active scan range in the table to the left by one column. A new column with identical settings is created. The limit frequencies can be changed accordingly.

IEC/IEEE-bus command - -



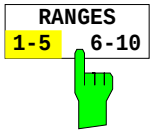
The *INS AFTER RANGE* softkey shifts the active scan range in the table to the right by one column. A new column with identical settings is created. The limit frequencies can be changed accordingly.

IEC/IEEE-bus command - -



The *DELETE RANGE* softkey clears the activate scan range. All other ranges are shifted to the left by one column.

IEC/IEEE-bus command - -



With the *RANGES 1-5/6-10* softkey a switchover can be made between ranges 1-5 and 6-10.

IEC/IEEE-bus command - -

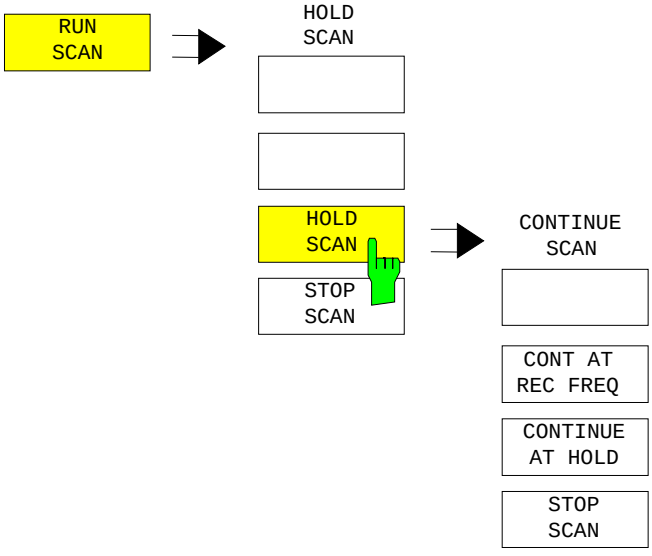
Running a Scan

The scan is started with the *RUN SCAN* softkey.

It can also be started with the *RUN* key in the *SWEEP* field.

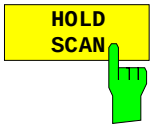
At the beginning of the scan, FSET sets up the diagram as specified in the scan table and starts the scan in the selected mode (*SINGLE* or *CONTINUOUS*). With *SINGLE* selected, FSET performs a single scan and stops at the end frequency. With *CONTINUOUS* selected, the scan is performed continuously until it is deliberately stopped.
The measurement can be interrupted with *HOLD SCAN* or stopped with *STOP SCAN*. The two softkeys are displayed instead of the menu shown before the scan is started.

CONFIGURATION MODE - RECEIVER submenu



The *RUN SCAN* softkey starts the frequency scan with the selected settings. The *HOLD SCAN* submenu is displayed instead of the menu shown before the scan is started.

IEC/IEEE-bus command
`:INITiate2[:IMMediate]`

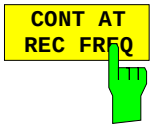


The *HOLD SCAN* softkey interrupts the scan.

The *CONTINUE SCAN* submenu is displayed. The scan stops at the frequency at which it was interrupted until it is continued with the *CONT AT REC FREQ* or *CONTINUE AT HOLD* softkeys.

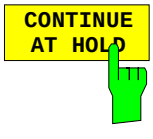
While the scan is stopped, the receiver settings can be changed, eg for a detailed analysis of the recorded trace.

IEC/IEEE-bus command `:HOLD`



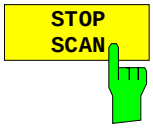
With the *CONT AT REC FREQ* softkey the scan is continued at the current receiver frequency when the receiver frequency is lower than the frequency at which the scan was interrupted. Otherwise the scan continues at the frequency at which it was interrupted.

IEC/IEEE-bus command `:INITiate2[:IMMediate]`



With the *CONT AT HOLD* softkey the scan is continued where it was interrupted. The scan is always continued with the settings in the scan table.

IEC/IEEE-bus command --



The *STOP SCAN* softkey stops the scan. Upon restart, scanning starts at the beginning. The results of the previous measurement are lost.

IEC/IEEE-bus command `:ABORt`

Data Reduction and Peak List

The spectrum is first pre-analyzed in a fast prescan to optimize the duration of the measurement. Data reduction follows so that the time-consuming final measurement is performed at important frequencies:

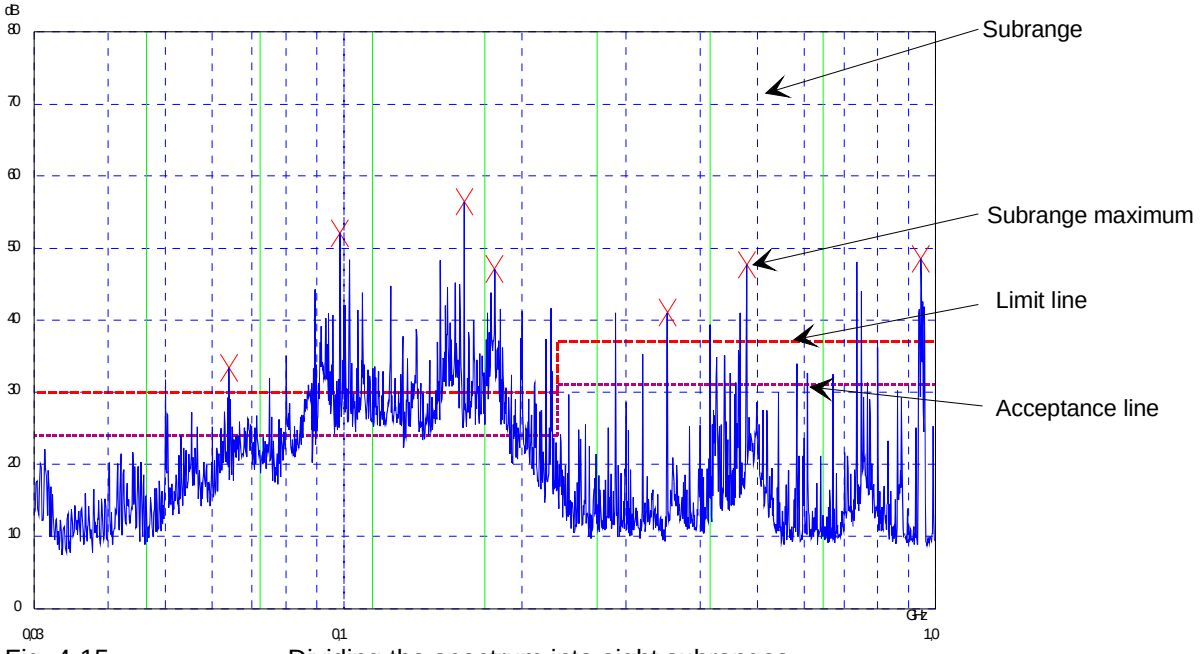


Fig. 4-15 Dividing the spectrum into eight subranges

Data reduction is of crucial importance. It is initiated by the user pressing a key after the prescan and then automatically performed by the receiver. Data reduction is used to select frequencies with a very high interference level. Several data reduction methods are used:

- Acceptance analysis, ie the interference spectrum is further analyzed at frequencies with levels above a line parallel to a limit line.
- Generating subrange maxima, ie the interference spectrum is further analyzed at frequencies with the highest interference level of a frequency subrange (search method SUBRANGES).
- Determination of a specific number of peak values relative to the limit lines with the level values being independent of their frequency spectral distribution (search method PEAKS).

For generation of subrange maxima, the whole frequency range is divided into equidistant subranges. A subrange maximum is determined for each subrange (search method SUBRANGES).
Determining the level maxima irrespective of their distribution in the frequency spectrum (search mode PEAKS) is suitable for measurement regulations that demand determination of the relatively highest level irrespective of the distribution in the measured frequency range.
If the prescan is performed in parallel with several detectors, eg with peak value and average value, the maxima are determined separately for the two detectors so that the distribution of narrowband and wideband sources of interference can be taken into account. For example, the frequency of the maximum determined with the average detector can be used for the final measurement performed with this detector and the frequency found in the prescan carried out with the peak detector is taken for the final measurement using the peak detector.

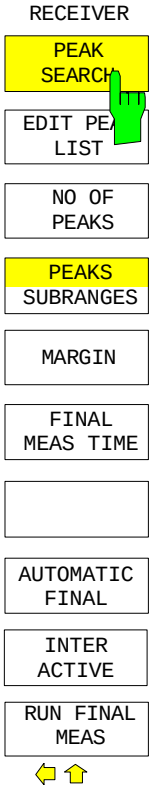
Consideration of the limit lines ensures that the final measurement is not performed at frequencies at which the inference level is far below the limit value. The margin between the acceptance line and the limit line can be selected by the user in dB as the *MARGIN*. Each limit line is allocated to a trace, ie different limit lines are taken for the different detectors.
Two values should therefore be defined for this purpose:

- the number of subranges or highest level values (*NO OF PEAKS* in the range from 1 to 500; default value: 25)
- the acceptance margin (*MARGIN*; default value: 6 dB). It is valid for all limit lines.

As an alternative method, it is possible to preset a list of frequencies at which the final measurements are performed. A typical application is, for example, the statistical analysis of several units.
The peak list can be either edited manually or can be filled with desired values by adopting the marker values.

If no limit lines are activated, the measurement procedure is as if all measured values would exceed the limit line.

CONFIGURATION MODE - RECEIVER menu (right side menu)



The *PEAK SEARCH* softkey starts the determination of the subrange maxima list from the available scan results. The procedure can be repeated as often as desired to try out different settings of margin and number of subranges.

IEC/IEEE-bus command

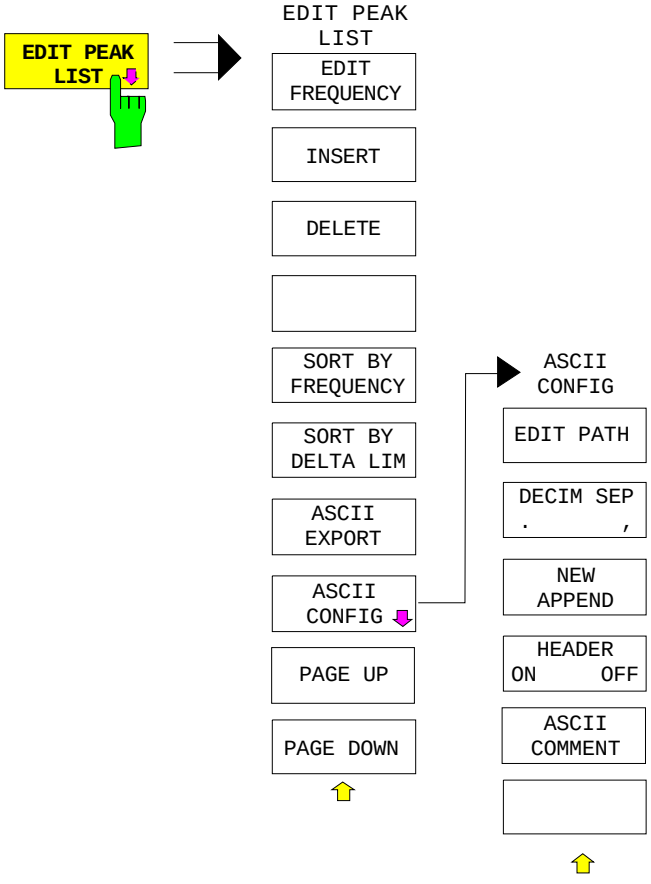
```
:CALCulate<1|2>:PEAKsearch[:IMMediate]
```

The following table shows the peak list which is determined by the peak-search function after the prescan:

EDIT PEAK LIST (Prescan Results)

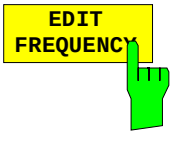
Trace1: 014MP		Trace2: 014AV	
Trace3: ---		Trace4: ---	
TRACE	FREQUENCY	LEVEL dBpT	DELTA LIMIT dB
2 Average	80.0000 MHz	35.34	-3.91
2 Average	89.4800 MHz	38.83	-0.91
1 Max Peak	98.5200 MHz	47.53	-2.63
2 Average	98.5200 MHz	46.63	6.47
1 Max Peak	100.7200 MHz	54.14	3.88
2 Average	102.3200 MHz	50.89	10.56
1 Max Peak	113.2400 MHz	49.68	-1.08
2 Average	116.9200 MHz	44.81	3.91
1 Max Peak	125.8800 MHz	55.01	3.78
2 Average	125.8800 MHz	53.55	12.33
1 Max Peak	138.4800 MHz	45.68	-5.95
2 Average	138.4800 MHz	42.17	0.53
2 Average	144.0400 MHz	43.72	1.90
2 Average	167.0400 MHz	44.77	2.32
2 Average	176.2400 MHz	45.52	2.83
1 Max Peak	200.4800 MHz	52.49	-0.75
2 Average	200.4800 MHz	48.76	5.51
1 Max Peak	210.2800 MHz	60.55	7.09
2 Average	226.5600 MHz	59.02	15.24
2 Average	230.0000 MHz	48.59	4.75

CONFIGURATION MODE - RECEIVER menu (right side menu)



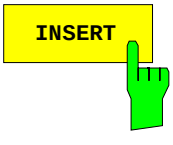
The *EDIT PEAK LIST* softkey calls the *EDIT PEAK LIST* submenu used for editing the peak list. A frequency list can thus be predefined and a final measurement carried out at these frequencies.

A peak list can also be generated by adopting the marker values (see section "Changing the device settings with Markers marker →")



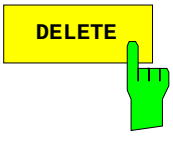
The *EDIT FREQUENCY* softkey activates table *EDIT PEAK LIST*. The cursor marks the upper field of column *FREQUENCY*.

IEC/IEEE-bus command - - -



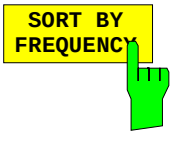
The *INSERT* softkey creates an empty line above the current cursor position

IEC/IEEE-bus command - - -



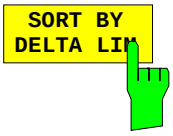
The *DELETE* softkey erases the complete line at the cursor position. Before deletion, a message appears requesting confirmation..

IEC/IEEE-bus command - - -



The softkey *SORT BY FREQUENCY* sorts the table in a descending order according the entries in the *FREQUENCY* column.

IEC/IEEE-bus command - - -



The softkey *SORT BY DELTA LIM* sorts the table in a descending order according to the entries in the *DELTA LIMIT* column (see table below).

IEC/IEEE-bus command ---

The following table shows the peak list sorted according to the margin to the limit value list:

EDIT PEAK LIST (Prescan Results)

Trace1: 014MP Trace2: 014AV

Trace3: --- Trace4: ---

TRACE	FREQUENCY	LEVEL dBpT	DELTA LIMIT dB
2 Average	226.5600 MHz	59.02	15.24
2 Average	125.8800 MHz	53.55	12.33
2 Average	102.3200 MHz	50.89	10.56
1 Max Peak	210.2800 MHz	60.55	7.09
2 Average	98.5200 MHz	46.63	6.47
2 Average	200.4800 MHz	48.76	5.51
2 Average	230.0000 MHz	48.59	4.75
2 Average	116.9200 MHz	44.81	3.91
1 Max Peak	100.7200 MHz	54.14	3.88
1 Max Peak	125.8800 MHz	55.01	3.78
2 Average	176.2400 MHz	45.52	2.83
2 Average	167.0400 MHz	44.77	2.32
2 Average	144.0400 MHz	43.72	1.90
2 Average	276.9200 MHz	45.81	1.16
2 Average	138.4800 MHz	42.17	0.53
2 Average	267.2800 MHz	44.44	-0.05
1 Max Peak	200.4800 MHz	52.49	-0.75
2 Average	89.4800 MHz	38.83	-0.91
1 Max Peak	113.2400 MHz	49.68	-1.08
1 Max Peak	98.5200 MHz	47.53	-2.63



The *ASCII EXPORT* softkey stores the final measurement data in a file with ASCII format.
Upon pressing the ASCII EXPORT softkey, a file name can be entered. The default name is TRACE.DAT. Then the measured data of the trace are stored.
The function can be configured in the *ASCII CONFIG* submenu.

IEC/IEEE-bus command
`:MMEMory:STORe:FINal <path with filenames>`



In the *ASCII CONFIG* submenu, various settings for the *TRACE ASCII EXPORT* function can be made (see Section "Trace Export").

Structure of the ASCII file:

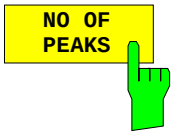
RECEIVER mode, final measurement data:

	Content of file	Description
File header	Type;FSET;	Instrument model
	Version;2.09;	Firmware version
	Date;01.Sep 2000;	Date record storage date
	Mode;Receiver;	Instrument operating mode
	Start;10000;Hz Stop;100000;Hz	Start/stop of the display range. Unit: Hz
	x-Axis;LIN;	Scaling of x axis linear (LIN) or logarithmic (LOG)
	Scan Count;1;	Number of scans set
	Transducer;TRD1;	Transducer name (if switched on)
	Scan 1:	Loop over all defined scan ranges (1-10)
	Start;150000;Hz	Range - start frequency in Hz
	Stop;1000000;Hz	Range – stop frequency in Hz
	Step;4000;Hz	Range - step width in Hz for linear step width or in % (1-100) for logarithmic step width
	RBW;100000;Hz	Range - resolution bandwidth
	Meas Time;0.01;s	Range - measurement time
	Auto Ranging;ON;	Auto ranging on - or off for current range
	RF Att;20;dB	Range - input attenuation
	Auto Preamp;OFF;	Auto Preamp on or off for current range
	Preamp;0;dB	Range - preamplifier on(10, 20, 30 dB) or off (0dB)
	Input;RF;	Range - input (RF, BAL 150, BAL 600 or BAL 10K)
Data section of the file	TRACE 1 FINAL:	Selected trace
	Trace Mode;AVERAGE;	Trace mode: CLR/WRITE,AVERAGE,MAX HOLD,MIN HOLD, VIEW, BLANK
	Final Detector	Final detector MAX PEAK, MIN PEAK, RMS, AVERAGE, AC VIDEO
	x-Unit;Hz;	Unit of x values:
	y-Unit;dBuV;	Unit of y values:
	Final Meas Time;1.000000;s	Final measurement time
	Margin;6.000000:s	Margin
	Values;8;	Number of test points
	2;154000.000000; 81.638535 1;158000.000000; 86.563789 2;1018000.000000; 58.689873 ...	Measured values: <Trace>;<x-value>, <y-value>

Example :

```
Type;FSET ;
Version;2.09;
Date;01.Sep 2000;
Mode;Receiver;
Start;150000.000000;Hz
Stop;30000000.000000;Hz
x-Axis;LOG;
Scan Count;1;
Transducer;;
Scan 1:
Start;150000.000000;Hz
Stop;30000000.000000;Hz
Step;4000.000000;Hz
RBW;9000.000000;Hz
Meas Time;0.001000;s
Auto Ranging;OFF;
RF Att;10.000000;dB
Auto Preamp;OFF;
Preamp;0.000000;dB
Input;RF;
Scan 2:
Start;30000000.000000;Hz
Stop;1000000000.000000;Hz
Step;40000.000000;Hz
RBW;120000.000000;Hz
Meas Time;0.000100;s
Auto Ranging;OFF;
RF Att;10.000000;dB
Auto Preamp;OFF;
Preamp;0.000000;dB
Input;RF;
TRACE 1 FINAL:
Trace Mode;CLR/WRITE;
Final Detector;AVERAGE;
TRACE 2 FINAL:
Trace Mode;CLR/WRITE;
Final Detector;AVERAGE;
x-Unit;Hz;
y-Unit;dBuV;
Final Meas Time;1.000000;s
Margin;6.000000;dB
Values;11;
2;154000.000000;81.638535
1;158000.000000;86.563789
2;1018000.000000;58.689873
2;302000.000000;63.177345
2;3294000.000000;56.523022
2;1122000.000000;53.849747
2;10002000.000000;47.551216
1;3390000.000000;59.762917
1;9998000.000000;58.309189
2;20002000.000000;45.142456
2;7502000.000000;36.406967
```

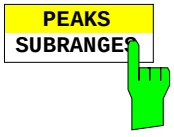
CONFIGURATION MODE - RECEIVER menu (right side menu)



Der Softkey *NO OF PEAKS* activates the entry field of the number of subranges or peaks for the determination of the peak list. The range of values is 1 to 500.

IEC/IEEE-bus command

```
:CALCulate<1|2>:PEAKsearch:SUBRanges 1 to 500
```



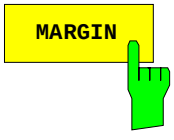
The *PEAKS SUBRANGES* softkey defines the search method with which maxima are searched for within a scan.

PEAKS — Determination of a specific number of peak values relative to the limit lines with the level values being independent of their frequency spectral distribution.

SUBRANGES — Generating subrange maxima, ie the interference spectrum is further analyzed at frequencies with the highest interference level of a frequency subrange.

IEC/IEEE-bus command

```
:CALCulate<1|2>:PEAKsearch:METHod SUBRange | PEAK
```



The *MARGIN* softkey activates the entry field of the margin, ie of an additional acceptance threshold for the determination of the peak list. The limit line currently used is shifted by this amount for defining the maxima. The range of values is -200 dB to 200 dB.

IEC/IEEE-bus command

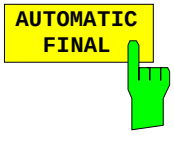
```
:CALCulate<1|2>:PEAKsearch:MARGin -200dB to 200dB
```



The *FINAL MEAS TIME* softkey activates the entry field of the time of final measurement.

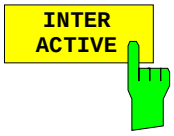
IEC/IEEE-bus command

```
:[SENSe:]SWEep:FMEasurement <num_value>
```



The *AUTOMATIC FINAL* softkey selects the automatic routine for the final measurement. This routine is run according to the available frequency list without user interaction.

IEC/IEEE-bus command --

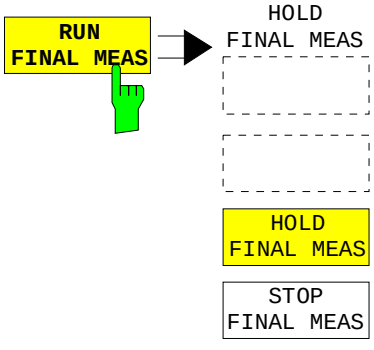


The *INTERACTIVE* softkey selects the following sequence for the final measurement:

- A frequency from the frequency list is set on the receiver together with the associated settings from the corresponding partial scan.
- The marker is set on this frequency in the scan diagram.
- The final measurement sequence switches to the *Interrupted* status.
- The signal can be exactly analyzed by modifying the receiver settings.
- *CONTINUE AT HOLD* starts the actual final measurement, the receiver settings being restored except the frequency.
- The current frequency replaces the original one in the frequency list (drifting interference sources)
- Next frequency of frequency list.....

Note: *With the AUTOMATIC FINAL softkey in the CONTINUE FINAL MEAS submenu a switchover can be made to the automatic mode before the measurement is started anew.*

IEC/IEEE-bus command - -



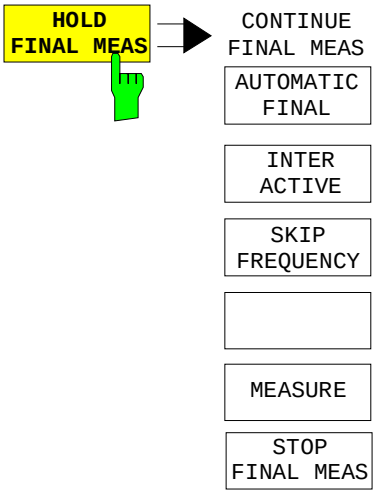
The *RUN FINAL MEAS* softkey starts the final measurement sequence as described above. The *HOLD FINAL MEAS* submenu is called.

The detectors used for the final measurement replace those used in the list or for the prescan.
The out-of-limit condition is shown by a plus sign preceding the values in the DELTA LIMIT column (see table below).

IEC/IEEE-bus command - -

Note: *The final measurement function is only available in the manual mode. For operation under program control it is preferable to read the prescan results and the data-reduced peak list, if any, from the FSET with the controller and carry out the individual measurements with the controller. This considerably makes the control of the interactive mode easier.*

CONFIGURATION MODE - RECEIVER menu (right side menu)



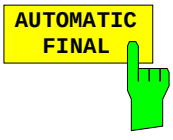
The *HOLD FINAL MEAS* softkey interrupts the automatic run of the final measurement.

The *CONTINUE FINAL MEAS* submenu appears.

With the final measurement halted all receiver settings can be modified for example for examining the signal in detail.
The mode of the measurement (automatic or interactive) can again be selected.

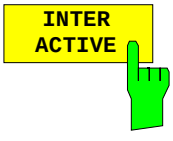
The final measurement can be started with the *MEASURE* softkey.

IEC/IEEE-bus command - -



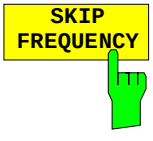
The *AUTOMATIC FINAL* softkey selects the automatic mode for the final measurement (see above).

IEC/IEEE-bus command - -



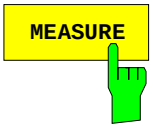
The *INTERACTIVE* softkey selects the interactive mode for the final measurement as described above.

IEC/IEEE-bus command - -



The *SKIP FREQUENCY* softkey skips the next entry in the FREQUENCY column.

IEC/IEEE-bus command - -



The *MEASURE* softkey continues with the final measurement. The final measurement starts at the next frequency entry on the peak list or at a marked frequency if one or several lines have been skipped with the SKIP FREQUENCY softkey.

IEC/IEEE-bus command - -



The *STOP FINAL MEAS* softkey halts the final measurement. The final measurement starts from the beginning on a new start. The previously collected data are lost.

IEC/IEEE-bus command - -

The peak list available after the final measurement:

EDIT PEAK LIST (Final Measurement Results)			
Trace1: 014MP		Trace2: 014AV	
Trace3: ---		Trace4: ---	
TRACE	FREQUENCY	LEVEL dBpT	DELTA LIMIT dB
2 Average	80.0000 MHz	29.99	-9.26
2 Average	89.4800 MHz	35.64	-4.09
1 Max Peak	98.5200 MHz	49.94	-0.22
2 Average	98.5200 MHz	48.32	8.15
1 Max Peak	100.7200 MHz	55.33	5.07
2 Average	102.3200 MHz	50.86	10.53
1 Max Peak	113.2400 MHz	42.50	-8.26
2 Average	116.9200 MHz	44.44	3.53
1 Max Peak	125.8800 MHz	54.91	3.68
2 Average	125.8800 MHz	53.86	12.64
1 Max Peak	138.4800 MHz	41.83	-9.81
2 Average	138.4800 MHz	39.38	-2.25
2 Average	144.0400 MHz	40.77	-1.04
2 Average	167.0400 MHz	44.82	2.37
2 Average	176.2400 MHz	46.56	3.87
1 Max Peak	200.4800 MHz	50.93	-2.31
2 Average	200.4800 MHz	48.27	5.02
1 Max Peak	210.2800 MHz	58.71	5.25
2 Average	226.5600 MHz	59.07	15.29
2 Average	230.0000 MHz	46.90	3.05

Selection of Detectors for Final Measurement

The selection of detectors for the final measurement is made in the *TRACE* menu (see section "Selection and setting of traces ").

The detectors to be used for the final measurement can be set here for each trace, ie any combination of prescan and final measurement is possible. The required flexibility is thus obtained for the diverse test specifications which are covered by means of the FSET.

Traces 3 and 4 can be used for displaying the final measurement values. For this purpose, the *FINAL MEAS* softkey should be activated in the associated menu. Trace 3 represents the allocated final measurement values referring to trace 1 with the symbol "x" and trace 4 the final measurement values for trace 2 with "+".
The results of prescan and final measurement in a diagram:

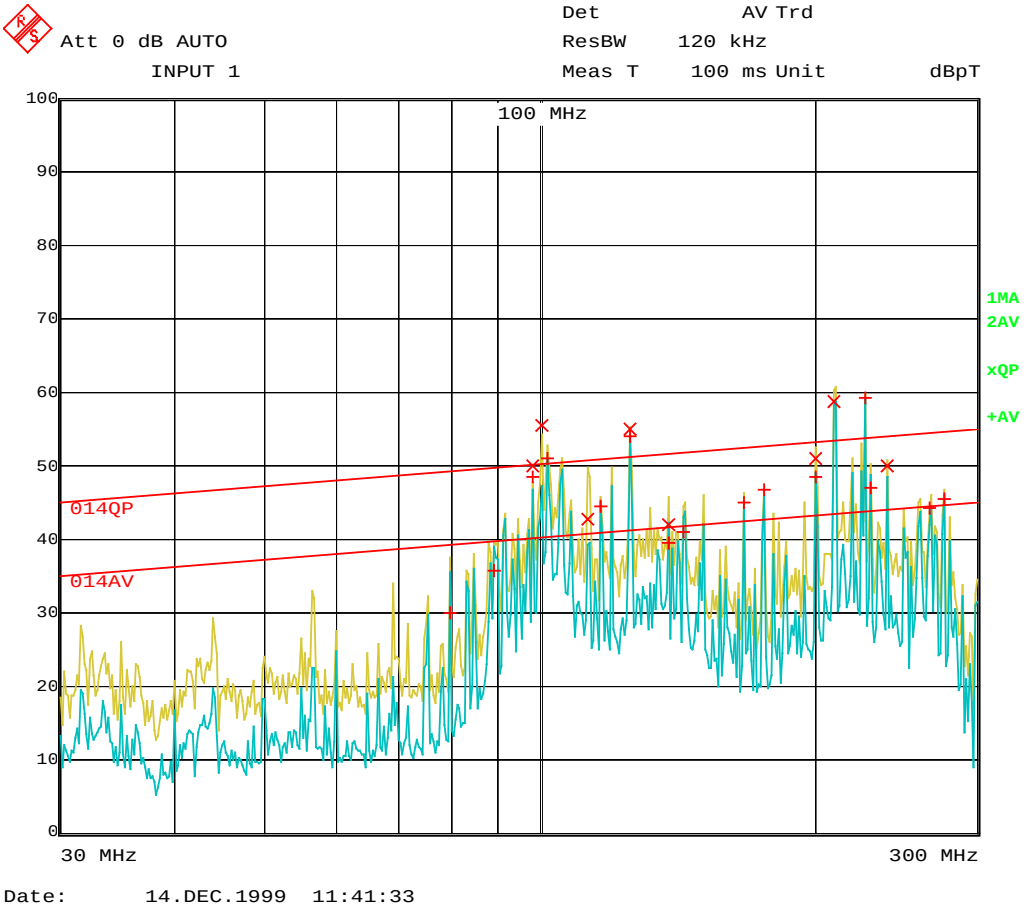


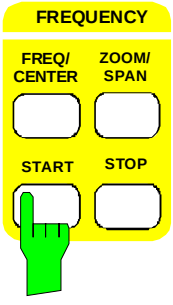
Fig. 4-16 Results of prescan and final measurement

Frequency and Span Selection – *FREQUENCY Key Group*

The *FREQUENCY* key group is used to specify the receiver frequency and the frequency axis of the active measurement . The frequency axis is defined by the start and stop frequency.
After pressing one of the keys *FREQ, START* or *STOP*, the value of the corresponding parameter can be defined in the appropriate dialog window.

Start Frequency – *START Key*

FREQUENCY – START menu:



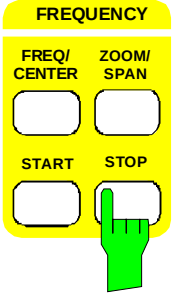
The *START* key opens a window where the start frequency of the scan diagram can be entered.

The start frequency can be selected in the FSET frequency range independent of scan range limits.

IEC/IEEE bus command `:[SENSe:]FREQuency:STARt <num_value>`

Stop Frequency – *STOP Key*

FREQUENCY – STOP menu:



The *STOP* key opens a window where the stop frequency of the scan diagram can be entered.

The stop frequency can be selected in the FSET frequency range independent of scan range limits.

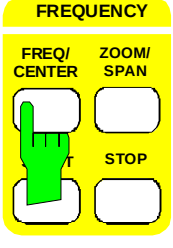
The permissible value range for the stop frequency is:

$f_{stop} > f_{start}$

IEC/IEEE bus command `:[SENSe:]FREQuency:STOP <num_value>`

Receiver Frequency – CENTER Key

FREQUENCY – FREQ menu:



The *FREQ/CENTER* key opens a window where the receiver frequency can be entered.
A precondition is that the frequency and level readout is active.

The permissible value range is:

100 Hz to f_{max}

If the tuning frequency is lower than twice the IF bandwidth, the IF bandwidth is automatically reduced so that this condition is met again.
If the frequency is increased again, the original IF bandwidth is restored. The memory is cleared when the IF bandwidth is manually changed.

The resolution of the receive frequency is always 0.1 Hz.

IEC/IEEE bus command `:[SENSe:]FREQuency:STOP <num_value>`

Receiver Frequency Step Size

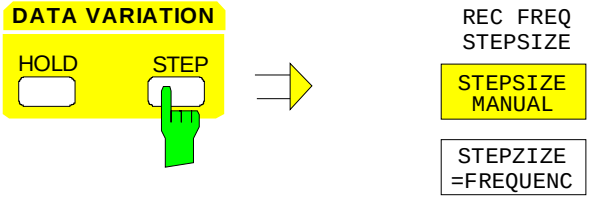
The *STEP* key in the *DATA VARIATION* key group opens a menu for setting the step size of the receiver frequency. The step size can be coupled to the receiver frequency or be manually set to a fixed value.

In order to change the step size, the entry window for the receiver frequency must already be active. After pressing the *STEP* key, the *REC FREQ STEP* menu appears.

The softkeys are mutually exclusive selection switches. Only one switch can be active at a time.

Control is returned to the *FREQUENCY FREQ* menu via the menu key .

DATA VARIATION - STEP menu





The *STEPSIZE MANUAL* softkey activates the entry window for the input of a fixed step size.

IEC/IEEE bus command `:[SENSe:]FREQuency:CENTer:STEP <num_value>`



The *STEPSIZE = FREQUENC* softkey sets the step size coupling to *MANUAL* and the step size to a value equal to the receiver frequency.
This function is especially useful during measurements of the signal harmonic content, because, when entering the receiver frequency, the receiver frequency of another harmonic is selected with each stroke of the *STEP* key.

IEC/IEEE bus command - -

Level Display and RF Input Configuration – *LEVEL Key Group*

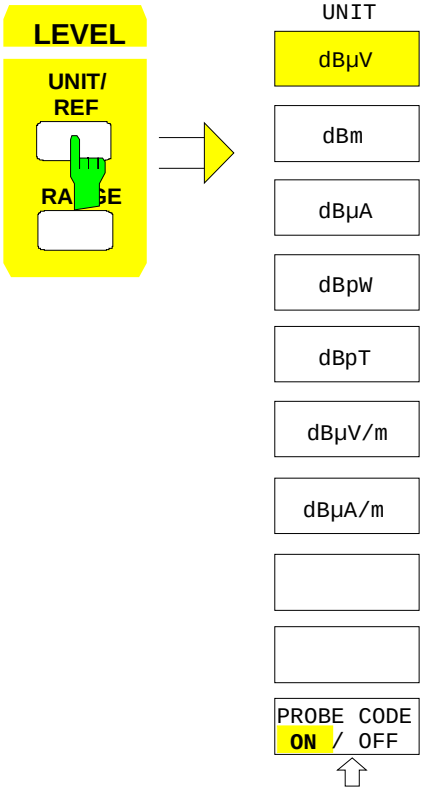
The *REF* and *RANGE* keys are used to set the display units and the display range of the scan diagram. The *INPUT* key sets the characteristics of the RF input (input, input attenuation, and preamplification).

Display Units - *REF* Key

In general, a receiver measures the signal voltage at the RF input. The level display is calibrated in rms values of an unmodulated sinewave signal. In the initial state, the level is displayed in dBµV. Via the known input resistance of 50 Ω a conversion can be made to other units. The units dBm, dBµA, dBpW, and dBpT are directly convertible and can be selected in the *REF* menu.
If the antenna coded connector on the front panel is used, the coded unit there determines the possible display units. Connecting to the coded connector deactivates the settings of the *REF* menu.
By certain codings it is nevertheless possible to select a conversion of the unit in the menu. The dependencies between the unit of the antenna coded connector and the unit which is to be selected for the display are given in the softkey description.

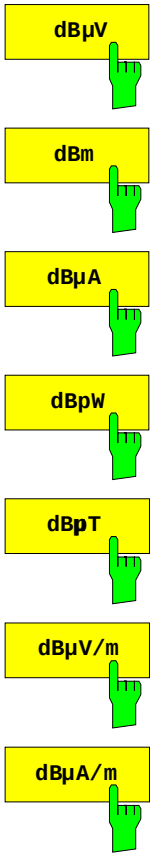
The default coding defined by the connector can be switched off using the *PROBE CODE ON/OFF* softkey. In this case, the unit can be set with the corresponding unit softkeys (dBm, dBµV, ...) even if a coded connector is plugged in. The coded entries in the connector are then ignored.

LEVEL UNIT submenu:



In receiver mode, the *UNIT* key opens a sub-menu in which the desired units for the level axis can be selected and the coding of the antenna coded connector can be switched on and off.

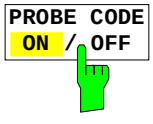
The unit softkeys are mutually exclusive selection switches. Only one of these switches may be active at any one time.



The *dBµV, dBm, dBµA, dBpW, dBpT, dBµV/m, dBµA/m* softkeys set the display units to the corresponding logarithmic units.

The dB*µV* unit is the default unit in receiver mode.

IEC/IEEE bus command `:CALCulate<1|2>:UNIT:POWer DBMV | DBM | DBUA | DBPW | DBPT | DBUV_M | DBUA_M | DBUV_MHZ | DBUA_MHZ | DBMV_MHZ`

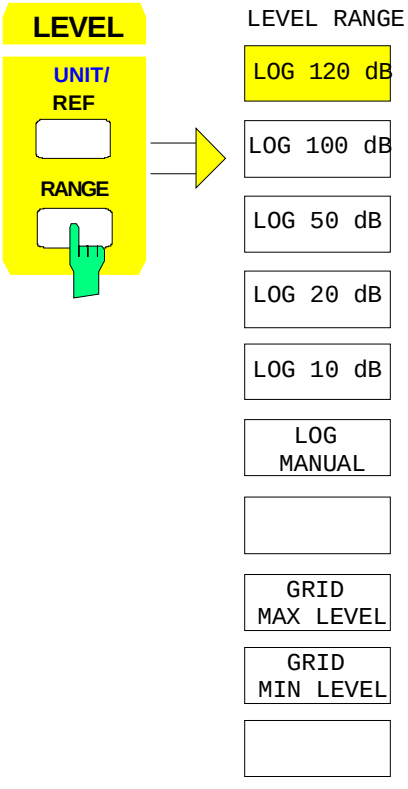


The *PROBE CODE ON/OFF* softkey enables or disables the units defined by the coded connector.

IEC/IEEE bus command `:UNIT:PROBe ON | OFF`

Level Range – *RANGE* Key

LEVEL RANGE menu:



The *RANGE* key calls a menu in which the range for the scan diagram can be selected.

The default setting is 100 dB.

The most often used settings (120 dB, 100 dB, 50 dB, 20 dB and 10 dB) are each directly selectable by a softkey.
All other ranges are chosen with the *LOG MANUAL* softkey.

When the display range is changed, *GRID MAX LEVEL* and *GRID MIN LEVEL* are newly set. *GRID MIN LEVEL* is not changed, however.

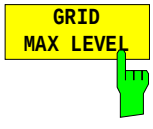
Editing of *GRID MAX LEVEL* and *GRID MIN LEVEL* sets *LOG MANUAL*.



The *LOG MANUAL* softkey activates the entry of the level display range. Display ranges from 10 to 200 dB are allowed in 10-dB steps. Values which are not permissible are rounded to the next valid number.

IEC/IEEE bus commands

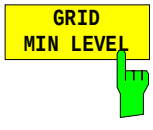
```
:DISPlay[:WINDow<1|2>]:TRACe<1..4>:Y:SPACing LOG
:DISPlay[:WINDow<1|2>]:TRACe<1...4>:Y:SCALe 110DB
```



The *GRID MAX LEVEL* softkey activates the entry of the maximum level of the display range. Values from -83 dBµV to +307 dBµV are allowed.

IEC/IEEE bus commands

```
:DISPlay[:WINDow<1|2>]:TRACe<1..4>:Y:SPACing LOG
:DISP[:WINDow<1|2>]:TRACe<1. 4>:Y[:SCALe]:TOP <num_value>
```



The *GRID MIN LEVEL* softkey activates the entry of the minimum level of the display range. Allowed values are:

GRID MAX LEVEL - 200 ≤ GRID MIN LEVEL ≤ GRID MAX LEVEL - 10

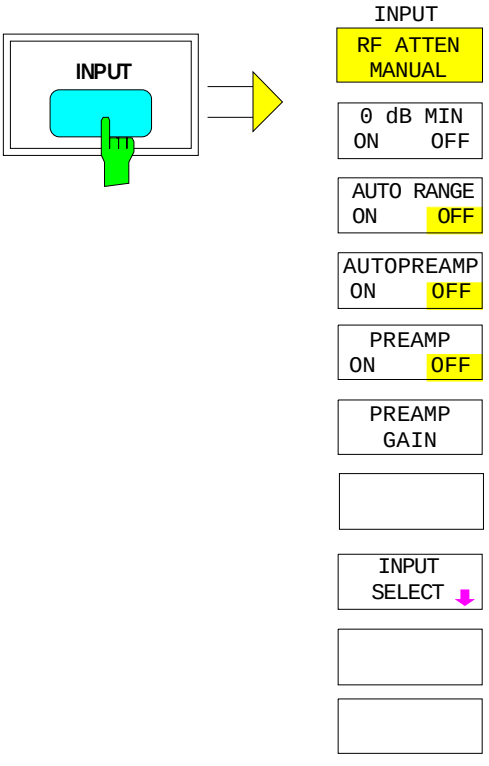
IEC/IEEE bus commands

```
:DISPlay[:WINDow<1|2>]:TRACe<1..4>:Y:SPACing LOG
:DISP[:WIND<1|2>]:TRACe<1. 4>:Y[:SCAL]:BOTTom <num_value>
```

RF Input Configuration – *INPUT* Key

In addition to manual entry of the input attenuation, the FSET provides an option which allows the RF attenuation, dependent on the selected reference level, to be automatically set.

INPUT menu:



The *INPUT* key opens the menu for configuring the RF input. It contains the input attenuator for matching the RF input to the input signal, the auto ranging of the preamplifier, and the selection of the input.



The *RF ATTEN MANUAL* softkey activates the entry of an attenuation factor.

The following attenuation settings are possible depending on the frequency:

During operation with Preselector FSET-Z..:

FSET7:

- 100 Hz to 2 GHz :	0 to 80 dB	in 1-dB steps

FSET22:

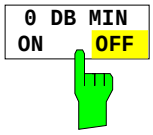
- 100 Hz to 2 GHz :	0 to 80 dB	in 1-dB steps,
- 2 GHz to 22 GHz:	0 to 70 dB	in 10-dB steps

FSET7 and **FSET22** without Preselector FSET-Z..:

- 100 Hz to f_{max}	0 to 70 dB	in 10-dB steps

Other entries are rounded to the next higher integer values.

IEC/IEEE bus command `:INPut<1|2>:ATTenuation 40DB`



The *0 DB MIN* softkey determines whether the 0 dB setting of the attenuator may be used in the manual or automatic setting of the attenuator.

0 DB MIN OFF is the default value, ie an RF attenuation of at least 10 dB is always set on FSET to protect the input mixer.

An attenuation factor of 0 dB cannot be set manually either. This prevents 0 dB being switched on inadvertently.

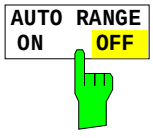
Caution:



If 0 dB RF attenuation is used with autoranging, care must be taken that the permissible signal level at the RF input is not exceeded. Exceeding this level would damage the input mixer.

IEC/IEEE bus command

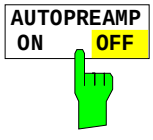
```
:INPut<1|2>:ATTenuation:PROTection ON|OFF
```



The *AUTO RANGE ON/OFF* softkey switches auto ranging on or off.

When the autorange function is active, FSET automatically sets the selected attenuation so that a good S/N ratio is obtained without the receiver stages being overdriven.

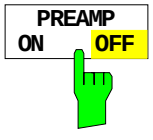
IEC/IEEE bus command `:INPut<1|2>:ATTenuation:AUTO ON | OFF`



The *AUTOPREAMP ON/OFF* softkey switches the autopreamp function on or off.

When the autopreamp function is active, the preamplifier is considered in the autorange procedure. The preamplifier is only switched on when the RF attenuation is reduced to the lowest settable value.
This function can only be controlled when the preamplifier is switched on.

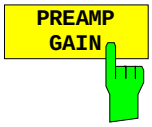
IEC/IEEE bus command `:INPut<1|2>:GAIN:AUTO ON | OFF`



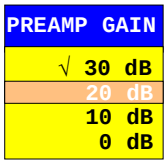
The *PREAMP ON/OFF* softkey switches the preamplifier of option FSET-Z.. on or off.

The softkey is only available, if the measurement has been activated with the preselector and, for FSET22 only, if the 2-GHz frequency range has been selected. In the 22-GHz frequency range, the 20-dB preamplifier gain is always switched on if the preselctor is active.

IEC/IEEE bus command `:INPut<1|2>:GAIN:STATe ON | OFF`



The *PREAMP GAIN* softkey opens a table for selecting the preamplifer gain.



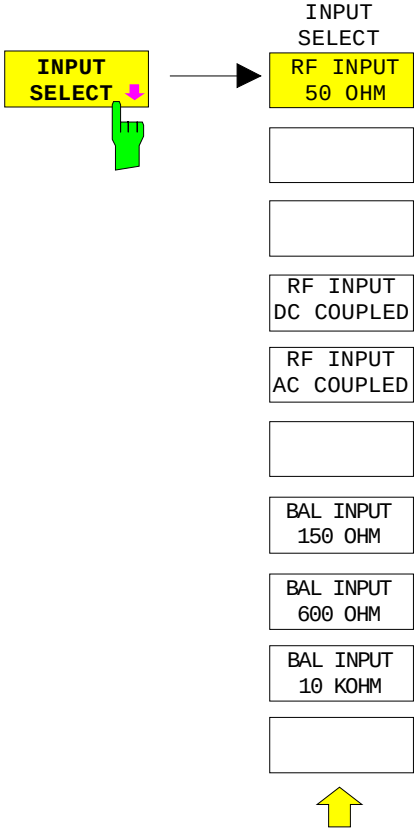
The softkey is only available if the measurement has been activated with the preselector and if the frequency range of 2 GHz has been selected.

Default value is 30 dB.

If the preset reference level cannot be set at the given RF gain, it will be adapted and a corresponding warning will be output.

IEC/IEEE bus command `:INPut<1|2>:GAIN 30 dB`

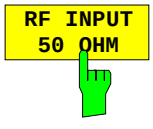
INPUT submenu:



The *INPUT SELECT* softkey opens a submenu for configuration of the RF input. If FSET is operated without Preselector FSET-Z.., the 50-Ohm RF input of the FSET basic unit is always selected (softkey in inverse video). There are no other choices.
During operation with the preselector its input can be *DC COUPLED* or *AC COUPLED*. The default setting is DC coupling.

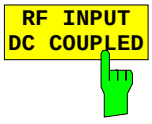
Attention: *AC coupling is only possible up to 2 GHz. For frequencies >2 GHz the RF input of FSET-Z.. is always DC coupled. For DC coupling do not exceed the permissible DC voltage at the RF input as the attenuator or the input mixer might otherwise be damaged.*

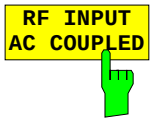
During operation with Preselector FSET-*Z..* it is also possible to use the balanced input. Its frequency range has an upper frequency limit of 50 kHz. The impedance of the balanced input can be switched between 150 Ohm, 600 Ohm and 10 kOhm.



The *RF INPUT 50 OHM* softkey sets the input impedance to 50 Ohm (= default setting).
All level indications are referenced to 50 Ohm. If a different input was selected for FSET previously, the RF input will automatically be switched to.

IEC/IEEE bus command `:INPut<12>:IMPedance 50`





The softkeys *RF INPUT DC COUPLED* and *RF INPUT AC COUPLED* chose DC or AC coupling for the RF input.

The unbalanced input of FSET-*Z..* can be operated with DC or AC coupling. The two softkeys are selector switches. If one function is switched on the other is automatically switched off.

The default setting is *DC COUPLED*. For AC coupling, an isolating capacitor is switched on at the RF input. The bottom frequency limit is 100 Hz.

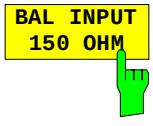
The type of coupling is displayed by enhancement lables next to the measurement value diagram:

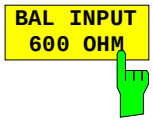
AC: RF input is AC coupled
DC: RF input is DC coupled.

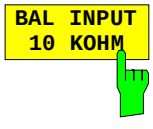
When using the unbalanced input or if FSET is operated without Preselector FSET-*Z..*, only DC coupling is possible. The two softkeys are then not offered for selection.

IEC/IEEE bus command

```
:INPut<1|2>:TYPE RF
:INPut:COUPling AC | DC
```







The *BAL INPUT* softkeys select the balanced input and one of the input impedances 150 Ohm, 600 Ohm or 10 kOhm for Preselector FSET-*Z...* The input impedances are alternative, ie if one is selected the others are switched off. If the RF input has been selected, FSET switches over to the balanced input.

With the balanced input used, the frequency range of FSET is limited to 50 kHz. Higher frequencies cannot be set.
The enhancement label BAL on the right of the measurement value window indicates that the balanced input is being used.

If FSET is operated without Preselector FSET-*Z..* the softkeys are not provided.

IEC/IEEE bus command

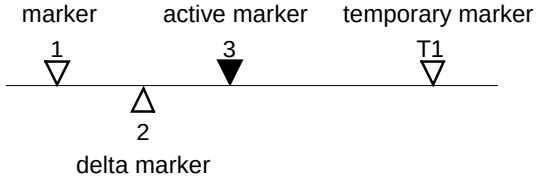
```
:INPut<1|2>:TYPE BALanced
:INPut<1|2>:BIMPedance 150 | 600 | 1000
```

Marker Functions – *MARKER Key Group*

The markers are used for marking points on measurement curves, reading out measurement values and for quickly selecting a display screen segment. Preselected measurement routines can be called by pressing a key in the marker menu. The FSET provides four markers and four delta markers. The currently activated marker can be shifted with the cursor keys, the roll-key or the softkeys.

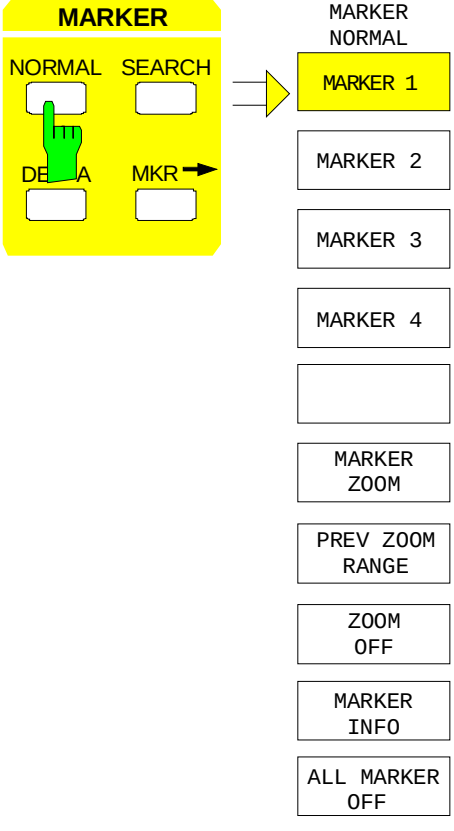
The marker which can be moved by the user is defined as the **active marker**.

Examples:



The measurement values of the active marker (also called **marker values**) are displayed in the marker field. In the **marker info list**, the measurement values from all enabled markers are sorted in ascending order. The marker info list can be switched off with the *MARKER INFO* softkey so that only the values for the active marker are shown.

Main Markers– NORMAL Key



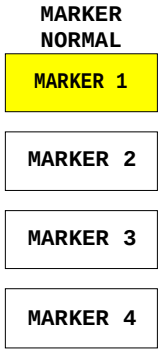
The *NORMAL* key calls a menu which contains all marker standard functions. The current state of the markers is indicated by a colored illumination of the softkeys. If no marker is enabled prior to pressing the *NORMAL* key, *MARKER 1* will be enabled as the reference marker and a peak search on the measurement curve is carried out (assumption: at least one measurement curve is active). Otherwise, the peak search is omitted and the entry window for the reference marker is activated.

The marker field at the upper left of the display screen shows the marker location (here, frequency), the level and the currently selected measurement curve.

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

Measured scan data can be subsequently represented in an expanded form using the zoom function. If the measured values obtained are more than the available pixels, several measured values are combined to one pixel. This compression is performed again for each zoom operation.

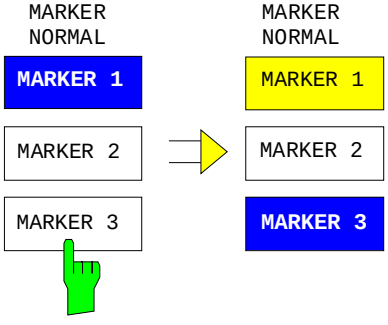
At the same time, the scan start and stop frequencies are set to the new diagram limits. A newly started scan then sweeps only the currently represented frequency range



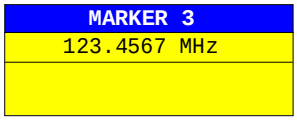
The *MARKER 1* to *MARKER 4* softkeys switch the corresponding marker on/off or activate it as the reference marker. If the marker is activated as a reference marker, an entry field for manually setting the position of the reference marker is opened simultaneously. If the marker is disabled, the softkey is not illuminated. Enabled markers and the reference marker are indicated by illuminating the corresponding softkeys in different colors.(In the instrument default state, the active reference marker is displayed in red and enabled markers are displayed in green.)

Operating example:

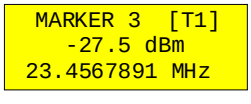
MARKER 1 is shown as the reference marker by the colored background illumination. *MARKER 2* through *MARKER 4* are turned off.

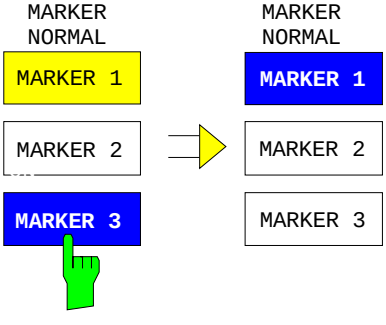


Pressing the *MARKER 3* softkey switches *MARKER 3* on and it becomes the reference maker. The previous reference marker remains enabled and the softkey remains illuminated. However, the entry mode for this marker is not now active. Instead, the entry window for *MARKER 3* is opened and the position of *MARKER 3* can be shifted.



The information in the marker field also changes to describe the new reference marker.





Pressing the current reference marker (*MARKER 3)* softkey again switches *MARKER 3* off. If at least one marker is enabled, the marker with the smallest number will be selected as the new reference marker (in the example, *MARKER 1*). Switching off the last active marker also deletes are delta markers.

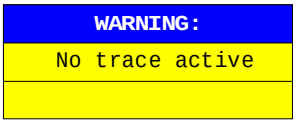
IEC/IEEE bus commands

```
:CALCulate<1|2>:MARKer<1..4>[:STATe]  ON | OFF;
:CALCulate<1|2>:MARKer<1..4>:X  10.7MHz;
:CALCulate<1|2>:MARKer<1..4>:Y?
```

When several measurement curves (traces) are being displayed, the marker is set to the maximum value (peak) of the active curve which has the lowest number (1 to 4). In case a marker is already located there, it will be set to the frequency of the next highest level (next peak).

If a measurement curve is turned off, the corresponding markers and marker functions are also erased. If the curve is switched on again (*VIEW*, *CLR/WRITE*;..), these markers along with coupled functions will be restored to their original positions. A prerequisite for the restoration of the marker positions is that individual markers have not been used on another measurement curve or that the scan data (start/stop frequency) have not been changed.

If a marker (or, delta marker) necessary for a marker function is not available, it will be automatically checked whether or not the enabling of the corresponding marker is possible (see above). If this is not the case, a warning is issued.



The activation of the desired marker function is then not possible.

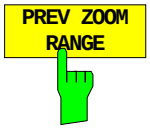
On the other hand, if the marker can be enabled, a peak search is automatically performed. Thereafter, the desired marker function can be executed.

MARKER NORMAL menu:



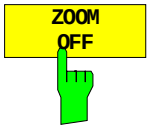
The *MARKER ZOOM* softkey zooms 10% of the diagram around the current marker. It opens at the same time a data entry field which allows to enter any frequency range which is then displayed
Pressing the softkey again expands the diagram such that only 3 measured values are represented.

IEC/IEEE bus command
`:CALCulate<1|2>:MARKer<1...4>:FUNCtion:ZOOM <num_value>`



The *PREVIOUS ZOOM* softkey sets again the previous frequency range

IEC/IEEE bus command `--`



The *ZOOM OFF* softkey switches off the zoomed representation

IEC/IEEE bus command
`:DISPlay[:WINDow<1|2>]:TRACe<1...4>:X[:SCALe]:ZOOM OFF`



The *ALL MARKER OFF* softkey switches off all markers (reference and delta markers). Similarly, it switches off all functions and displays correlated with the markers/delta markers.

IEC/IEEE bus command `:CALCulate<1|2>:MARKer<1...4>:AOFF`



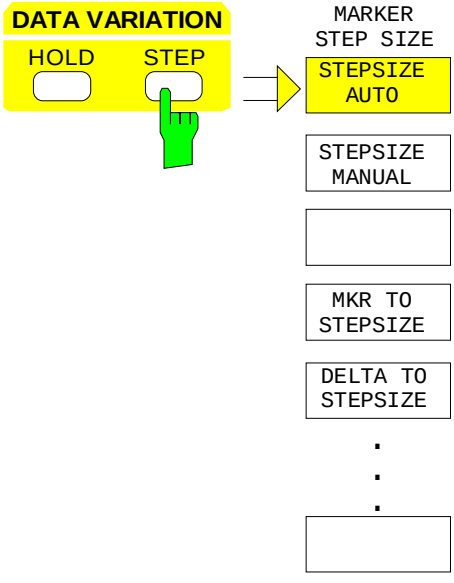
The *MARKER INFO* softkey opens the display of several markers within the grid. In the upper right corner of the grid, a maximum of 4 markers/delta markers with the marker symbols Δ/∇, marker number (1 to 4), position and measurement value are listed. For the output of the marker position, the number or displayed characters will be limited as required.

If the number of lines available is not enough for all the enabled markers and delta markers, first the markers and then the delta markers are entered into the info list

IEC/IEEE bus command `:DISPlay:WINDow<1|2>:MINFo ON | OFF`

Marker Step Size

DATA VARIATION – STEP menu:



The *STEP* key in the *DATA VARIATION* key group opens a menu to match the marker step size to each individual application. In order to change the step size, the marker entry mode must already be active.

Control is returned to the *MARKER NORMAL* menu via the menu key .



The *STEPSIZE AUTO* softkey sets the marker step size to *AUTO*. In this case, the step size is exactly 10% of the grid. A one-raster movement of the roll-key corresponds to one pixel.

STEPSIZE AUTO is the default setting.

IEC/IEEE bus command

```
:CALCulate<1|2>:MARKer<1..4>:STEP:AUTO  ON|OFF
```



The *STEPSIZE MANUAL* softkey activates the entry window for defining a fixed value for the marker step size.

Pressing the step key shifts the marker position by the selected step size. The resolution of the roll-key is always one pixel per raster.

IEC/IEEE bus command

```
:CALCulate<1|2>:MARKer<1..4>:STEP 10KHZ
```



The *MKR TO STEPSIZE* softkey sets the marker step size to the current marker frequency.

This function is well suited to harmonic measurements. The marker is set to the largest signal using the peak search function. After activation of the *MKR TO STEPSIZE* function, the marker is set to the corresponding harmonic of the signal each time the cursor key or is pressed when entering the marker position.

IEC/IEEE bus command

```
:CALCulate<1|2>:MARKer<1..4>:FUNCtion:MSTep
```



The *DELTA TO STEPSIZE* softkey sets the marker step size to the difference between the reference marker and the last active delta marker.

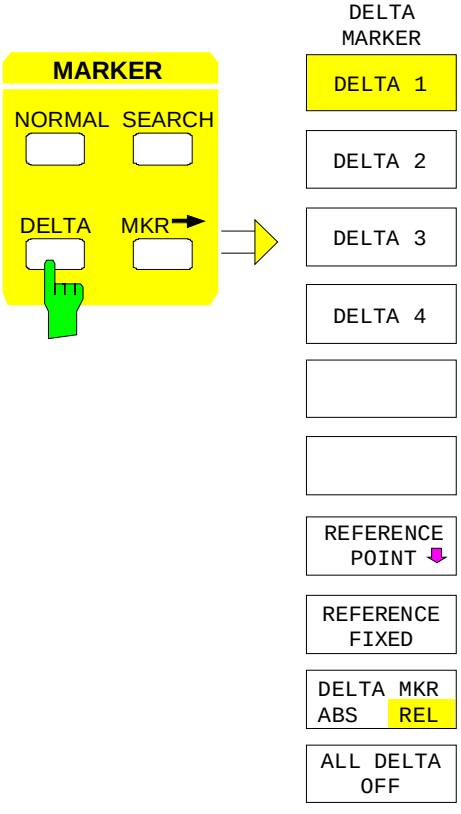
The softkey is only available when at least one delta marker is enabled.

IEC/IEEE bus command --

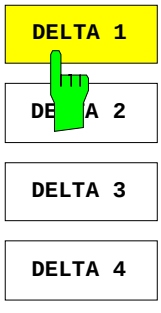
Delta Markers – *DELTA Key*

The delta markers are used to measure a level or frequency referred to a reference marker. They are always referenced to the marker whose position was last changed. A delta marker is displayed as an empty △ symbol. The reference marker is displayed as a filled ▼ symbol.

MARKER DELTA menu:



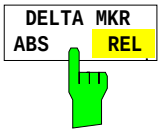
The *DELTA* key switches a delta marker on and calls the menu for its control. If no marker is enabled, *MARKER 1* is automatically activated when the delta marker is switched on. The delta marker activated to entry mode is shown on the display screen as a filled ▲ symbol.



The *DELTA 1 to 4* softkeys are used to enable delta markers 1 to 4. The control of the delta markers corresponds to that of the markers. After a delta marker has been enabled, all entries are now applicable to this marker. The main marker must be activated anew if its position is to be changed.

The delta marker field on the display screen contains the delta marker number, the difference frequency from the delta marker to reference marker and the level difference between the active delta markers and reference markers.

The indicated differences are, in general, referred to the reference marker. If the *REFERENCE FIXED* function are enabled, the reference values under *REFERENCE POINT* are applicable.



The *DELTA ABS REL* softkey switches between relative and absolute entry modes for the delta-marker frequency.

REL The delta marker frequency is entered relative to the reference marker. In this case, the entry mode for the delta-marker frequencies is also relative.

ABS The entry of the delta-marker frequency is in terms of absolute frequency.

The default setting is *REL*.

IEC/IEEE bus commands

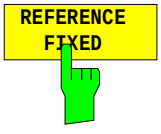
```
:CALCulate<1|2>:DELTamarker<1..4>  ON|OFF
:CALCulate<1|2>:DELTamarker<1..4>:X 10.7MHZ
:CALCulate<1|2>:DELTamarker<1..4>:X:REL?
:CALCulate<1|2>:DELTamarker<1..4>:Y
```



The *ALL DELTA OFF* softkey switches off all active delta markers and any associated functions (e.g. *REFERENCE FIXED*).

IEC/IEEE bus command

```
:CALCulate<1|2>:DELTamarker<1...4>:AOFF
```



The *REFERENCE FIXED* softkey enables/disables relative measurements with respect to a fixed, measurement-curve-independent reference value.

The information in the delta-marker field on the display screen is referenced to this fixed reference value. For the generation of the marker lists using *MARKER INFO* list, the delta markers are also output relative to a fixed reference. In the lists, the *REFERENCE POINT* is tagged by the number of the reference marker (only one enabled)

When *REFERENCE FIXED* is enabled, the current settings of the reference marker become the reference values. If no marker is active, *MARKER 1* (with peak search) is activated. After transferring the reference values, all markers are deleted, and the active delta marker is set to the position of the reference value. Additional delta markers can be switched on.

The reference value can be subsequently changed

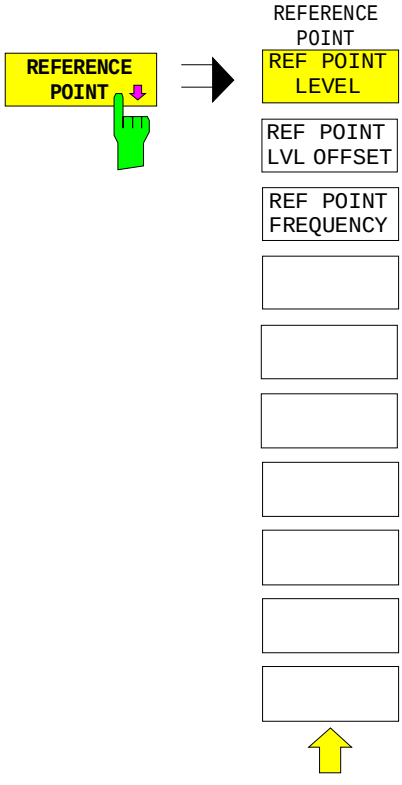
1. by shifting it in the *REFERENCE POINT* sub-menu.

2. by starting a search:
   In the *MARKER NORMAL* menu the *REF POINT* is handled as a reference marker (even though it is not bound to the measurement curve). This means, that it will be shown as enabled and can also be changed in position. The co-ordinates of the *REF POINT* are overwritten by the marker values (they lie, by definition, on the measurement curve). Thus, it is possible, even for an enabled *REFERENCE FIXED*, to define a new reference point function with search functions.

IEC/IEEE bus command

```
:CALCulate<1|2>:DELTamarker<1..4>:FUNCtion:FIXed ON|OFF
```

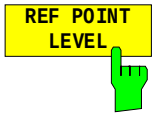
MARKER DELTA- REFERENCE POINT submenu:



The *REFERENCE POINT* softkey opens a sub-menu in which the reference value of the *REFERENCE FIXED* function can be modified.

The position of the reference value is indicated by two additional display lines (horizontal and vertical). In addition, an offset level may be defined which is added to each difference during output.

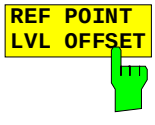
The softkey is only available when the *REFERENCE FIXED* function is switched on.



The *REF POINT LEVEL* softkey activates an entry box for setting the reference level relevant to the *REFERENCE FIXED* function.

IEC/IEEE bus command

```
:CALCulate<1|2>:DELT<1..4>:FUNC:FIXed:RPOint:Y -10DBM
```

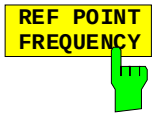


The *REF POINT LVL OFFSET* softkey activates the entry box for the entry of an additional offset level during output when the *REFERENCE FIXED* function are enabled.

The offset level is set to 0 dB when the *REFERENCE FIXED* function are switched on.

IEC/IEEE bus command

```
:CALCulate<1|2>:DELT<1..4>:FUNC:FIX:RPO:Y:OFFSet 10DB
```



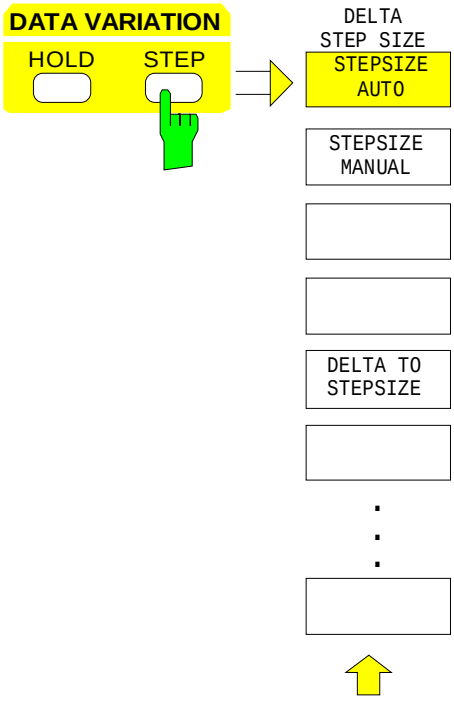
The *REF POINT FREQUENCY* softkey activates the entry box for the input of a reference frequency for the *REFERENCE FIXED* function.

IEC/IEEE bus command

```
:CALCulate<1|2>:DELT<1..4>:FUNC:FIXed:RPOint:X 10.7MHZ
```

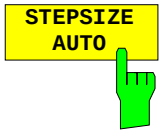
Delta-Marker Step Size - *STEP Key*

STEP-DELTA STEP menu:



The *STEP* key in the *DATA VARIATION* key group opens a menu to match the step size of the individual delta markers to the specific application. In order to change the step size, the entry mode for a delta marker must already be active.

Control is returned to the DELTA MARKER menu via the menu key .



The *STEPSIZE AUTO* softkey sets the delta marker step size to *AUTO*. In this case, the step size of the delta marker is exactly 10% of the grid. The roll-key corresponds to 1/500, i.e., for each rotational pulse, the delta marker is shifted one pixel position.

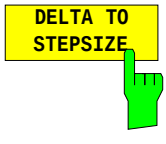
IEC/IEEE bus command
`:CALCulate<1|2>:DELTamarker<1..4>:STEP:AUTO ON | OFF`



The *STEPSIZE MANUAL* softkey permits the entry of a fixed value for the delta marker step size.

Pressing the step-key shifts the marker position by the selected step size. The roll-key resolution, however, always remains constant at 1 pixel.

IEC/IEEE bus command `--`



The *DELTATO STEPSIZE* softkey sets the delta marker step size to a quantity equal to the difference between the delta and reference markers.

The softkey is only presented when at least one delta marker is switched on.

IEC/IEEE bus command `:CALCulate<1|2>:DELT<1..4>:STEP 10HZ`

Search Functions – SEARCH Key

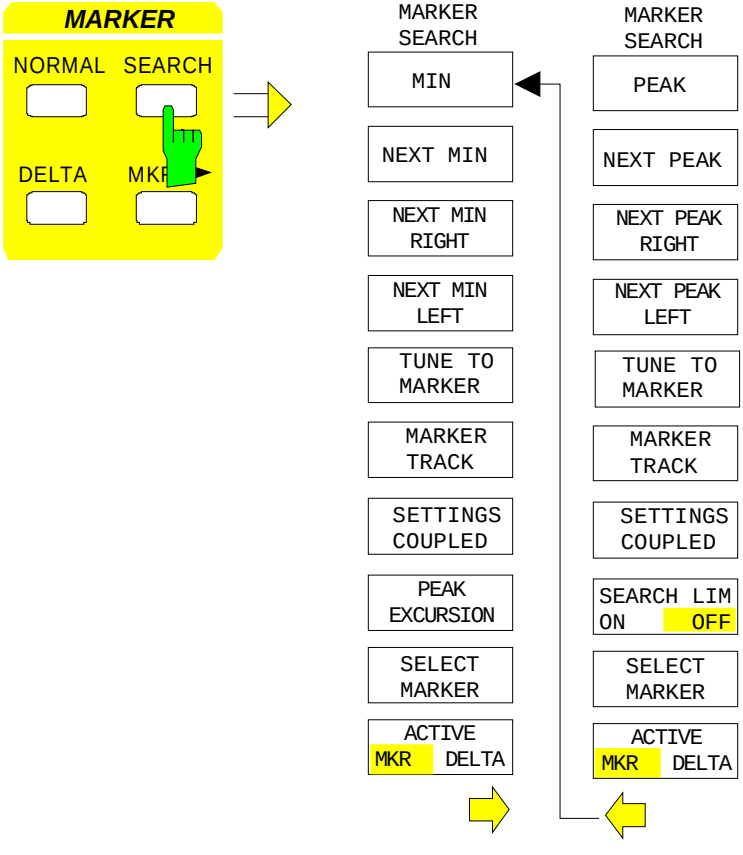
The FSET offers numerous functions useful for peak/min. peak searching. The search functions can be used for marker as well as delta marker functions.

The setups applicable to the available search functions are performed in the *MARKER-SEARCH* menu.

The search functions are always related to the currently active marker. If the *SEARCH* key is pressed while the marker entry mode is active, then all search functions are related to the current reference marker. If the entry mode of a delta marker is active, then the functions will be applied to the corresponding delta marker. For the case where no marker is active, *MARKER* 1 will be automatically enabled (with peak search). The *ACTIVE MKR / DELTA* softkey allows toggling between the active marker and the active delta marker.

If the threshold line is turned on, the peak/min. search functions will only evaluate signals which have a level above/below the selected threshold. In addition, the search range can also be limited (*SEARCH LIM ON/OFF* softkey) by the frequency lines (*FREQUENCY LINE 1/2*).

MARKER SEARCH menu:





The *ACTIVE MKR / DELTA* softkey toggles between the active marker and the active delta marker.

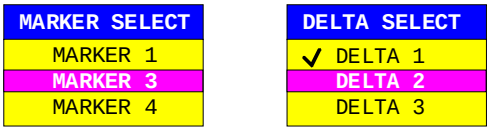
If *DELTA* is illuminated, the following search functions are performed with the active delta marker.

Note: *Switching between marker and delta marker entry modes may also be performed using the NORMAL and DELTA keys.*

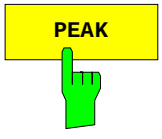
IEC/IEEE bus command - -



The *SELECT MARKER* softkey activates the selection of the marker/delta markers. The selection box lists the currently enabled markers/delta markers.



IEC/IEEE bus command - -



The *PEAK* softkey sets the active marker/delta marker to the maximum displayed value on the corresponding trace.

IEC/IEEE bus commands `:CALCulate<1|2>:MARK<1..4>:MAXimum`
`:CALCulate<1|2>:DELT<1..4>:MAXimum`



The *NEXT PEAK* softkey sets the active marker/delta marker to the next lower peak value on the corresponding curve.

IEC/IEEE bus command `:CALCulate<1|2>:MARKer<1..4>:MAX:NEXT`
`:CALCulate<1|2>:DELT<1..4>:MAX:NEXT`



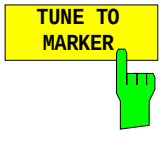
The *NEXT PEAK RIGHT* softkey sets the active marker to the next peak to the right of the current marker position.

IEC/IEEE bus command `:CALCulate<1|2>:MARK<1..4>:MAX:RIGHt`
`:CALCulate<1|2>:DELT<1..4>:MAX:RIGHt`



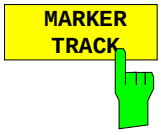
The *NEXT PEAK LEFT* softkey sets the active marker to the next peak to the left of the current marker position.

IEC/IEEE bus command `:CALCulate<1|2>:MARK<1..4>:MAX:LEFT`
`:CALCulate<1|2>:DELT<1..4>:MAX:LEFT`



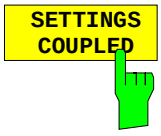
The *TUNE TO MARKER* softkey sets the receiver frequency to the marker frequency.

IEC/IEEE bus command
`:CALCulate<1|2>:MARKer<1..4>:FUNCtion:CENTer`



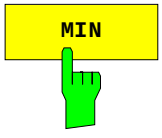
The *MARKER TRACK* softkey sets the coupling of the receiver frequency to the marker frequency.

IEC/IEEE bus command
`:CALCulate<1|2>:MARKer<1..4>:COUPled[:STATe] ON|OFF`



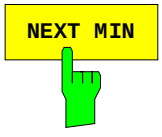
The *SETTINGS COUPLED* softkey sets the coupling of the receiver settings from the concerning subscans to the marker frequency for the functions *TUNE TO MARKER* and *MARKER TRACK*.

IEC/IEEE bus command
`:CALCulate<1|2>:MARKer<1..4>:SCOupled[:STATe] ON|OFF`



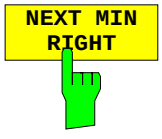
The *MIN* softkey sets the active marker to the lowest displayed peak on the corresponding measurement curve.

IEC/IEEE bus command
`:CALCulate<1|2>:MARKer<1..4>:MIN`
`:CALCulate<1|2>:DELTamarker<1..4>:MIN`



The *NEXT MIN* softkey sets the active marker to the next higher of the low peaks on the corresponding measurement curve.

IEC/IEEE bus command
`:CALCulate<1|2>:MARK<1..4>:MIN:NEXT`
`:CALCulate<1|2>:DELT<1..4>:MIN:NEXT`



The *NEXT MIN RIGHT* softkey sets the active marker to the next low peak to the right of the current marker position.

IEC/IEEE bus command
`:CALCulate<1|2>:MARK<1...4>:MIN:RIGHt`
`:CALCulate<1|2>:DELT<1...4>:MIN:RIGHt`



The *NEXT MIN LEFT* softkey sets the active marker to the next low peak to the left of the current marker position.

IEC/IEEE bus command
`:CALCulate<1|2>:MARK<1...4>:MIN:LEFT`
`:CALCulate<1|2>:DELT<1...4>:MIN:LEFT`



The *PEAK EXCURSION* softkey activates the entry the minimum amount a signal level must decrease/increase before it is recognised by the search functions (except PEAK and MIN) as a maximum or minimum.

Input values from 0 dB to 80 dB are allowed with a resolution of 0.1 dB.

IEC/IEEE bus command
`:CALCulate<1|2>:MARKer<1..4>:PEXCursion 10DB`

The peak excursion is preset to 6 dB. This is completely sufficient for the functions *NEXT PEAK* (or *NEXT MIN*) as always the next smaller (or higher) signal is searched four.

Functions *NEXT PEAK LEFT* and *NEXT PEAK RIGHT* (or *NEXT MIN LEFT and NEXT MIN RIGHT*) search for the next relative maximum (or minimum) independent of the current signal amplitude.

As for wide bandwidths, the set 6-dB level change is already reached by the noise indication of the receiver, the noise values are also identified as peak. 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.

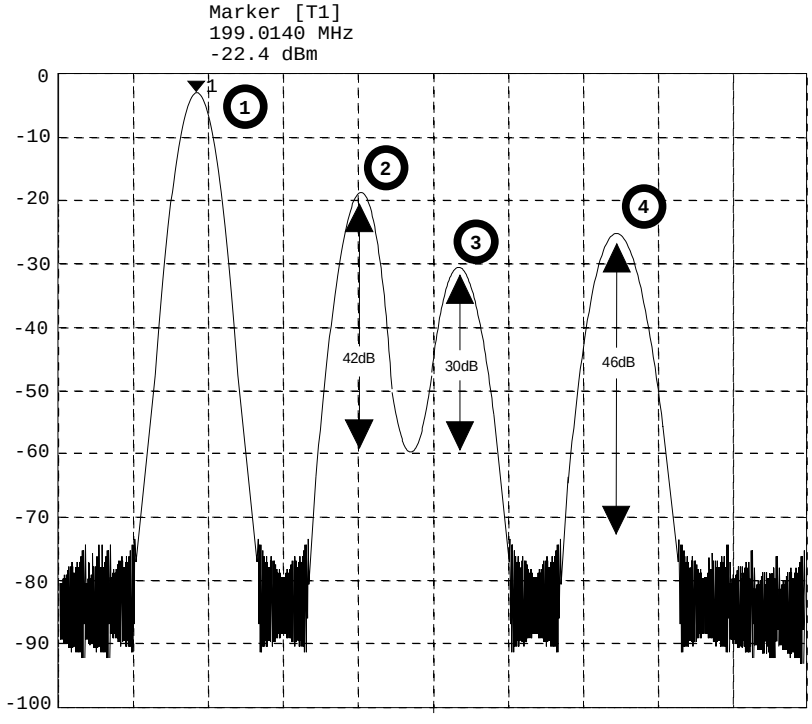


Fig. 4-17 Example for level measurements at different peak excursion settings

Maximum relative level change of the measured signals:

Signal 2:	42dB
Signal 3	30dB
Signal 4:	46dB

Setting **Peak Excursion 40dB** causes signal 2 and 4 to be detected with *NEXT PEAK* or *NEXT PEAK RIGHT*. Signal 3 is not detected since it is only decreased 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

Setting **Peak Excursion 20dB** causes signal 3 to be detected 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

Setting **Peak Excursion 6dB** recognizes 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 *SEARCH LIMIT ON/OFF* softkey switches between a limited (*ON*) and unlimited (*OFF*) search range.

For peak and min. search functions, the search range can also be limited by the frequency lines (FREQUENCY LINE 1, 2). If *SEARCH LIMIT = ON,* the appropriate signal level will only be searched for between the specified frequency lines.

The default setting is *SEARCH LIMIT = OFF*.

When only one line is enabled, frequency line 1 is defined as the lower limit and the upper limit is defined by the stop frequency. If frequency line 2 turned on, then it determines the upper limit.

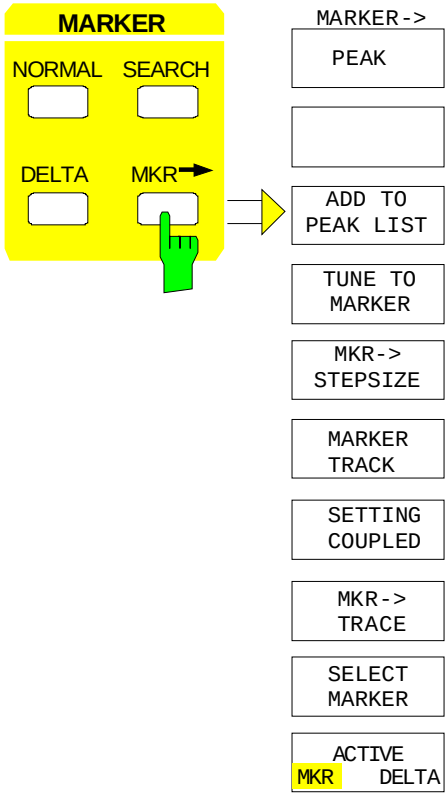
For the case in which no line is active the search range is unlimited.

IEC/IEEE bus command

```
:CALCulate<1|2>:MARKer<1..4>:X:SLIMits ON|OFF
```

Instrument Parameter Changes via Markers – MKR ➔ Key

MARKER MKR → menu:



The *MKR →* menu offers functions through which instrument parameters can be changed with the aid of the currently active marker. Exactly as in the *SEARCH* menu, these functions can also be applied to the delta markers.

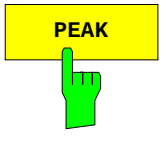
The choice between marker and delta marker is made according to the currently active frequency entry mode for the marker/delta marker. If no entry mode is active, the marker with the lowest number will be activated as the reference marker.



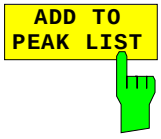
The *ACTIVE MKR /DELTA* softkey toggles between the active marker and the active delta marker.

If *DELTA* is illuminated, the following marker functions are carried out with the active delta marker.

Note: *Switching between marker and delta marker can also be done with the NORMAL and DELTA keys.*

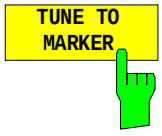


To simplify control, the *PEAK* search function (see section "Search Functions - *SEARCH Key")* is also available in the *MRK→* menu. Thus, the most important functions *MARKER→PEAK*, *TUNE TO MARKER* and *MKR→ STEPSIZE LEVEL* can be selected in one menu.

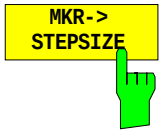


The *ADD TO PEAK LIST* softkey adds the receiver frequency of the current marker to the peak list (see also Section "Data Reduction and Peak List").

IEC/IEEE bus command --



The *TUNE TO MARKER* softkey sets the receiver frequency to that of the current marker.



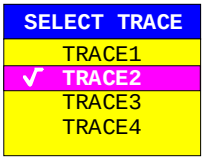
The *MKR→STEPSIZE* softkey sets the step size for the receiver frequency to the current marker frequency.

IEC/IEEE bus command

```
:CALCulate<1|2>:MARKer<1..4>:FUNCtion:CSTep
```



The *MKR→TRACE* softkey opens a selection window through which the marker can be set to a new measurement curve. The traces available for selection appear in the window.

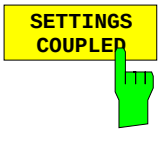


IEC/IEEE bus command

```
:CALCulate<1|2>:MARKer<1..4>:TRACe 2
:CALCulate<1|2>:DELT<1..4>:TRACe 2
```



The *MARKER TRACK* softkey sets the coupling of the receiver frequency to the marker frequency.



The *SETTINGS COUPLED* softkey sets the coupling of the receiver settings from the concerning subscans to the marker frequency for the functions *TUNE TO MARKER* and *MARKER TRACK*.

Setup of Display and Limit Lines – *LINES* Key Field

Display Lines – D LINES Key

Display lines are aids which, similar to markers, make the evaluation of measurement curve data more convenient. The function of display lines is similar to that of a movable scale which can be used to measure absolute and differential values on measurement curves.
In addition, the display lines can also be used to limit the range of search for marker functions.

The FSET provides four different types of display lines:

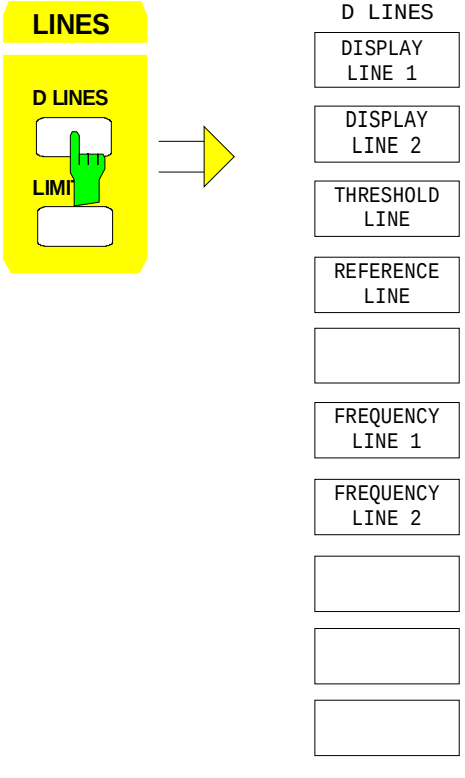
- two horizontal threshold lines for setting levels or for defining level search ranges – Display Line 1/2,
- two vertical frequency lines for indicating frequencies or for determining frequency search ranges – Frequency Line 1/2,
- a threshold line which, for example, sets the search threshold for maximum levels (Peak Search) – Threshold Line
- a reference line which serves as the basis for mathematical correlation between measurement curves – Reference Line

For purposes of clarity, each line is annotated on the right side of the display diagram by the following abbreviations:

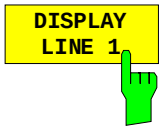
D1	Display Line 1	TH	Threshold Line
D2	Display Line 2	REF	Reference Line
F1	Frequency Line 1		
F2	Frequency Line 2		

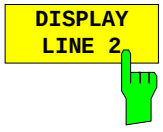
The lines for level, threshold and reference are displayed as continuous, horizontal lines over the full width of the diagram. They are movable in the y-direction.
The lines for frequency are displayed as vertical, continuous lines over the total height of the diagram. They are movable in the x-direction.

Menu *LINES-D-LINES*



The *D LINES* key activates the sub menu for setting of the display lines..



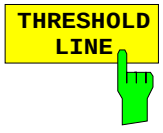


The *DISPLAY LINE 1/2 softkey*s switch the display lines on/off and activate the entry of the line location.

The display lines mark the selected levels in the measurement window.

IEC\IEEE bus commands

```
:CALCulate<1|2>:DLINe<1|2>:STATe ON|OFF;
:CALCulate<1|2>:DLINe<1|2> -20dBm
```

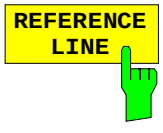


The *THRESHOLD LINE softkey* switches the threshold line on/off and activates the entry of the line location.

The threshold line is a display line which defines a threshold value. This threshold value serves as a lower search limit for maximums/minimums in the marker functions (*MAX PEAK, MIN PEAK, NEXT PEAK* etc.).

IEC\IEEE bus commands

```
:CALCulate<1|2>:THReshold ON | OFF;
:CALCulate<1|2>:THReshold -82dBm
```

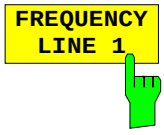


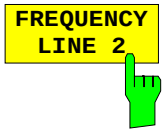
The *REFERENCE LINE softkey* switches the reference line on/off and activates the entry of the line position.

The reference line serves as the basis for mathematical correlation between measurement curve data (see section "Mathematical Operations on Measurement Curves"

IEC\IEEE bus commands

```
:CALCulate<1|2>:RLINe ON | OFF;
:CALCulate<1|2>:RLINe -10dBm
```





The *FREQUENCY LINE 1/2 softkey*s switch the frequency lines 1/2 on/off and activate the entry of the line locations.

The frequency lines mark the selected frequencies in the measurement window or define search ranges (see section "Marker Functions").

IEC\IEEE bus commands

```
:CALCulate<1|2>:FLINe<1|2>:STATe ON | OFF;
:CALCulate<1|2>:FLINe<1|2> 120 MHz
```

Limit Lines – *LIMITS Key*

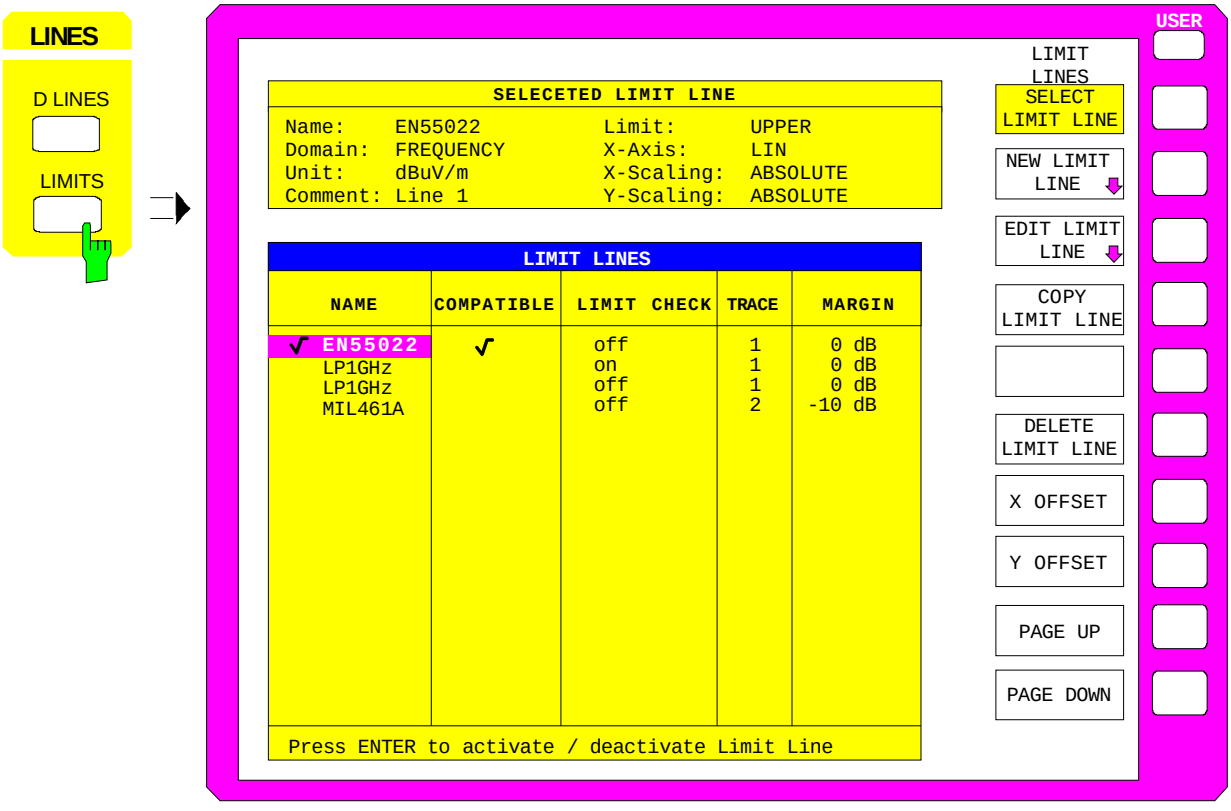
Limit lines are used to define amplitude curves or spectral distribution boundaries on the display screen which are not to be exceeded. They indicate, for example, the upper limits for interference radiation or spurious waves which are permissible from a Unit Under Test (UUT). The lower and upper limits 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 FSET instrument supports up to 300 limit lines, each of which may have a maximum of 50 data points. 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 reference of the interpolation points to the X-axis. In the receiver mode, the limit line is specified for absolute frequencies.
- The reference of the interpolation points to the Y-axis. In the receiver mode, the limit line is selected for absolute levels.
- The type of limit line (upper or lower limit). With this information and the active limit checking function (*LIMIT CHECK*), the FSET 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 FSET, 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, eg, a description of the application.

In the *LINES LIMIT* menu, the compatible limit lines can be enabled in the *LIMIT LINES* table. The *SELECTED LIMIT LINE* display field provides information concerning the characteristics of the marked limit lines. New limit lines can be specified and edited in the *NEW LIMIT LINE and EDIT LIMIT LINE* sub-menus, respectively.

LINES LIMIT menu



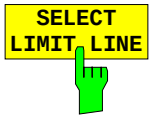
Limit Line Selection

The *SELECTED LIMIT LINES* table provides information about the characteristics of the marked limit line :

Name	name
Domain	frequency domain
Limit	upper/lower limit
X-Axis	linear or logarithmic interpolation
X-Scaling	absolute frequencies
Y-Scaling	absolute Y-units
Unit	vertical scale
Comment	commentary

The characteristics of the limit line are set in the *EDIT LIMIT LINE (=NEW LIMIT LINE)* sub-menu.

Note: *In the receiver mode only frequency domain and absolute scaling of the x and y axis are valid.*



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. 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, ie, only when the horizontal display and vertical scales are ***identical*** to those of the display in the measurement window.

Note: *In the receiver mode, limit lines are only used in the frequency domain with absolute X and Y scales. The limit line cannot be switched on when other parameters are entered (time domain or relative scale).*

Lines with the unit dB are compatible to all dB(..) settings of the Y-axis.
If the trace assigned to a line is not switched on, the line is displayed in the window the trace would be displayed in.

Example:
In split screen mode, trace 2 is assigned measuring window B. A line assigned to trace 2 is always displayed in measurement window B.

If the scale of the y-axis is 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.

***Limit Check* - Activate automatic limit violation check**

These functions are not available in the receiver mode. Entries made in the *Limit Check, Trace* and *Margin* columns are not effective.

***Trace* - Selecting the measurement curve to which the limit line is assigned.**

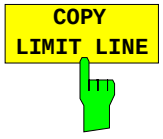
The selection of the measurement curve (trace) takes place in an entry window. Allowed are the integer entries 1, 2, 3 or 4. The default setting is trace 1. If the selected limit line is not compatible with the assigned measurement curve, then the limit line is disabled. (display and limit check).

***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 (ie, no margin).

IEC\IEEE bus commands

```
:CALCulate<1|2>:LIMit<1..8>:NAME <string>;
:CALCulate<1|2>:LIMit<1..8>:STATe ON | OFF
```



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).

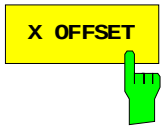
IEC\IEEE bus command

```
:CALCulate<1|2>:LIMit<1..8>:COPY 1..8|<name>
```



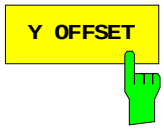
Pressing the *DELETE LIMIT LINE softkey* erases the selected limit line. Before deletion, a message appears requesting confirmation.

IEC\IEEE bus command ---



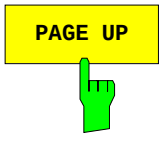
The *X OFFSET softkey* is not used in the receiver mode.

IEC\IEEE bus command ---



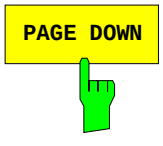
The *Y OFFSET softkey* is not used in the receiver mode.

IEC\IEEE bus command ---



Pressing the *PAGE UP softkey* sets the limit line table to the next page.

IEC\IEEE bus command ---



Pressing the *PAGE DOWN softkey* sets the limit line table to the previous page.

IEC\IEEE bus command ---

Entry and Editing of Limit Lines

A limit line is characterized by

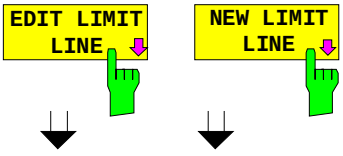
- its name
- the assignment of domain (frequency)
- the scaling in absolute frequencies
- linear or logarithmic interpolation
- the vertical unit
- the vertical scaling
- the definition of the limit line as either upper or lower limit.
- the data points for frequency and level

At the time of entry, the FSET 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 for each data point must be entered in ascending order, however, for any single frequency, two data points may be input (vertical segment of a limit line).

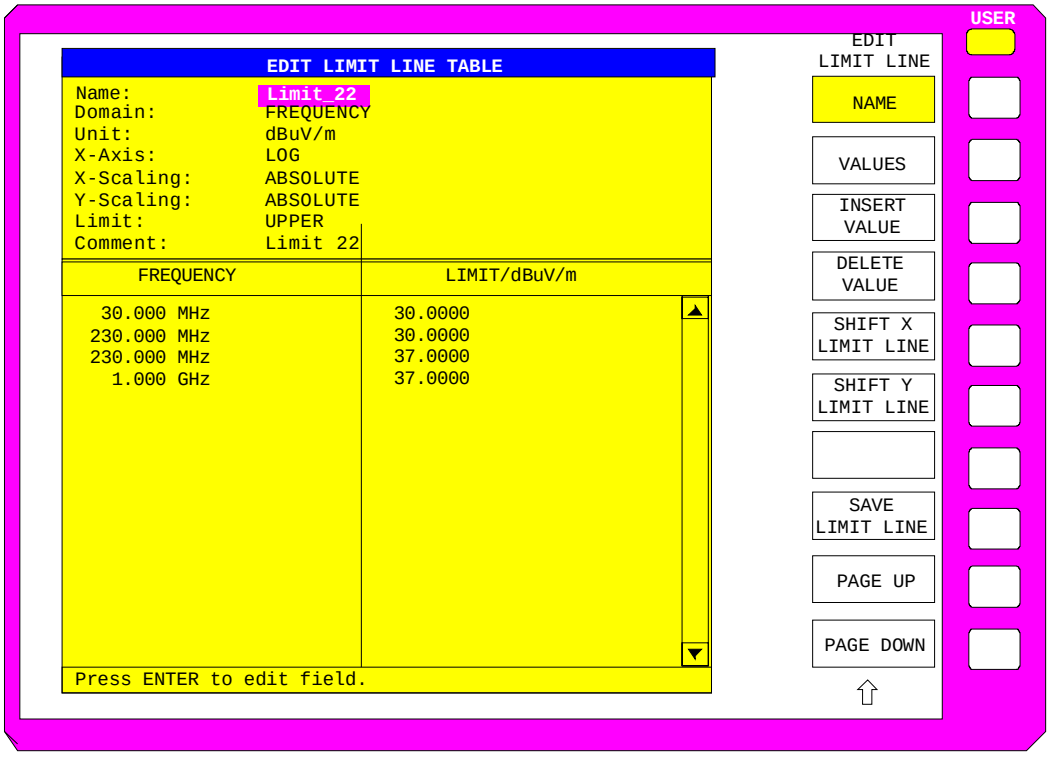
  The data points are allocated in order of ascending frequency. Gaps are not allowed. If gaps are desired, two separate limit lines must be defined and then both enabled.
- The entered frequencies must not necessarily be selectable in FSET. A limit line may also exceed the specified frequency range. The minimum frequency for a data point is 0 Hz, the maximum frequency is 200 GHz.
- 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.

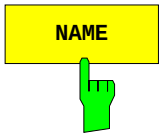
LINES LIMIT-EDIT LIMIT LINE menu



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 and level values are entered in the columns.

Name	Enter name.
Domain	Indication of domain.
Unit	Select units.
X-Axis	Indication of interpolation
X-Scaling	Entry of absolute values for the X-axis
Y-Scaling	Entry of absolute values for the Y-axis
Limit	Select upper/lower limit.
Comment	Enter comments.
Frequency	Enter frequency for the data points.
Limit/dB(..)	Enter magnitudes for the data points.





The *NAME softkey* enables the entry of characteristics in the table heading.

***Name* - Enter name**

A maximum of 8 characters are 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

```
:CALCulate<1|2>:LIMit<1...8>:NAME <string>
```

***Domain* - Indication of frequency domain**

In the receiver mode, only frequency domain is used.

***X-Axis* - Indication of interpolation**

Linear or logarithmic interpolation can be carried out between the frequency reference points of the table. Selection is via the ENTER key which is toggled between LIN and LOG (toggle function).

IEC\IEEE bus command

```
:CALCulate<1|2>:LIMit<1..8>:CONTrol:SPACing LIN | LOG
:CALCulate<1|2>:LIMit<1..8>:UPPer:SPACing LIN | LOG
:CALCulate<1|2>:LIMit<1..8>:LOWer:SPACing LIN | LOG
```

***Scaling* - Indication of scaling**

In the receiver mode, absolute scaling is used..

X-Scaling ABSOLUTE The frequencies are interpreted as absolute physical units.

Y-Scaling ABSOLUTE The limit values refer to absolute levels or voltages.

***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

```
:CALCulate<1|2>:LIMit<1...8>:UNIT
DB| DBM| PCT |DBUV| DBMW | DBUA | DBPW|
DBPT | WATT| VOLT | AMPere | DBUV_MHZ |
DBMV_MHZ| DBUA_MHZ | DBUV_M | DBUV_MMHZ
| DBUA_M | DBUA_MMHZ
```

***Limit* - Select upper/lower limit**

A limit line can be defined as either an upper or lower limit.

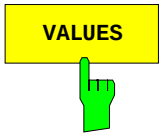
IEC\IEEE bus command --
(defined by the key words :UPPer or :LOWer)

***Comment* - Enter comments**

Comments are arbitrary, however, they must be less than 40 characters long.

IEC\IEEE bus command

```
:CALCulate<1|2>:LIMit<1..8>:COMMent 'string'
```

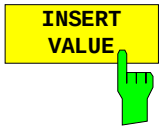


The *VALUES softkey* activates the entry of the data points in the table columns *Frequency* and *Limit/dB(..)*.

The desired frequency data points are entered in ascending order (two repeated frequencies values are permitted).

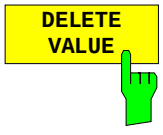
IEC\IEEE bus command

```
: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>..
```



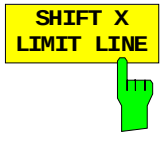
The *INSERT VALUE softkey* creates an empty line above the current cursor position where a new data point may be entered. However, during the entry of new values, it is necessary to observe an ascending order for frequency.

IEC\IEEE bus command `--`



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 `--`



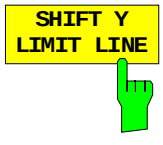
The *SHIFT X LIMIT LINE softkey* calls an entry window where the complete limit line may be shifted parallel in the horizontal direction.

The shift takes place according to the horizontal scale in Hz, kHz, MHz or GHz.

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

```
:CALCulate<1|2>:LIMit<1..8>:CONTrol:SHIFt 50kHz
```



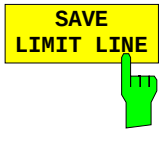
The *SHIFT Y LIMIT LINE softkey* calls an entry window where the complete limit line may be shifted parallel in the vertical direction.

The shift takes place in dB

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

```
:CALCulate<1|2>:LIMit<1..8>:UPPer:SHIFt 20dB
:CALCulate<1|2>:LIMit<1..8>:LOWer:SHIFt 20dB
```



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 `--` (automatically executed during remote control)

Trace Selection and Setup –*TRACE Key Group*

The FSET is capable of displaying up to four separate traces at the same time. A trace consists of a maximum of 500 pixels on the horizontal frequency axis. If there are more measurement values than pixels available, then several measurement values are collected together in one pixel.

The traces are selected using keys 1 to 4 of the *TRACES* key group.

The traces can be individually enabled for a measurement and, after the measurement is completed, held fixed. Traces which are not enabled remain dark.

For each trace, the type of display is selectable. The traces can be overwritten (CLEAR/WRITE mode) at each measurement, or a maximum/ minimum value from several measurements can be determined and displayed.

Individual detectors are selectable for the various traces. The peak detector displays maximum values within a pixel. The rms detector displays the power (rms value) of the measured values within a pixel, the average detector the linear average value (see also Section "Selecting the Detector").

The number of the traces which are switched on, influences the possible number of the measured values per trace.

Number of traces	**Measured values /trace**
1	250.000
2	150.000
3	100.000
4	80.000

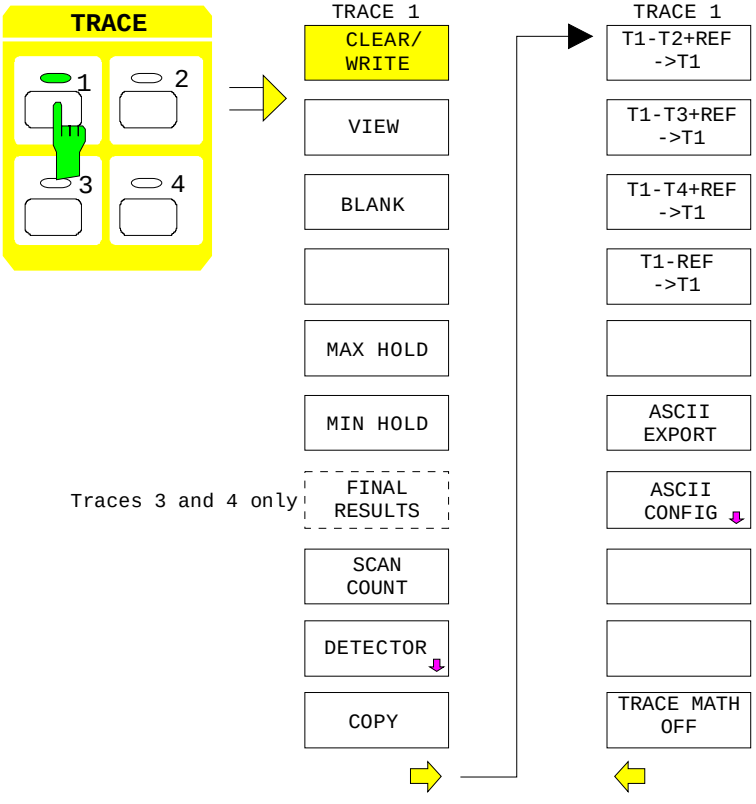
If a trace is turned to VIEW, the number of the measured values will be fixed for other scans. Other traces can only be activated, if the condition above is kept.

Measurement Function Selection - *TRACE 1 to 4* key

The trace functions are partitioned as follows:

- type of trace display (CLEAR/WRITE, VIEW and BLANK)
- evaluation of the trace as a whole (MAX HOLD and MIN HOLD)
- detector of a trace (PEAK, RMS, AC VIDEO and AVERAGE)

TRACE 1 menu



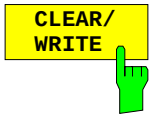
The *TRACE* keys 1...4 call a menu which presents the options for the selected trace.

In this menu, the method to be used for compressing the measurement data to the 500 representable points of the display is determined. At the beginning of the measurement, each trace can be displayed either completely new or based on previous measurement results.

Traces can be displayed, blanked and copied. By applying mathematical functions, the traces can also be corrected. The measurement detector for each of the display types may be chosen directly by the FSET.

All activated traces are marked with a LED at the corresponding key (here, *TRACE 1)*. The default setting is *TRACE 1* with *CLEAR / WRITE* and the *PEAK* detector selected, *TRACE2* with *CLEAR / WRITE* and the *AVERAGE* detector selected . The remaining traces 3 to 4 are switched off (*BLANK*).

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



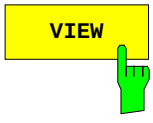
The *CLEAR/WRITE* softkey activates the clear/write display mode.

The trace is displayed without additional trace evaluation. The trace memory is overwritten by each scan. If more than one data point falls within a pixel, the trace is displayed in bar form with the maximum and minimum values in a pixel connected. In the clear/write display mode, all the available detectors are selectable.

After each *CLEAR/WRITE* softkey action, the FSET clears the selected trace memory and starts the measurement anew.

IEC\IEEE bus command

```
:DISPlay[:WINDow<1|2>]:TRACe<1..4>:MODE WRITe
```

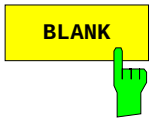


The *VIEW* softkey freezes the current contents of the trace memory and displays them on the display screen.

If *LEVEL RANGE* is changed in the *VIEW* display mode, the FSET adjusts the measurement data to the changed display range. Thus, an amplitude zoom can be performed after the measurement so that details of the trace can be seen better.

IEC\IEEE bus command

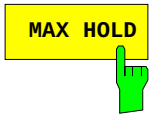
```
:DISPlay[:WINDow<1|2>]:TRACe<1..4>:MODE VIEW
```



The *BLANK* softkey removes the trace from the display screen. However, the trace data remain stored in memory and can be displayed again by *VIEW*. The markers for the blanked trace are also erased. If the trace is activated again (with *VIEW, CLEAR / WRITE, MAX HOLD, MIN HOLD*) the markers will be restored to their original positions.

IEC\IEEE bus command

```
:DISPlay[:WINDow<1|2>]:TRACe<1..4> OFF
```



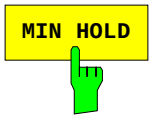
The *MAX HOLD* softkey activates the max hold mode.

In this display mode, the FSET saves for each scan the largest of the previously stored/currently measured values in the trace memory. In this way, the maximum value of a signal can be determined over several scans.

This is especially useful in the measurement of modulated or pulsed signals. The signal spectrum is filled at each scan until all signal components have been captured.

IEC\IEEE bus command

```
:DISPlay[:WINDow<1|2>]:TRACe<1..4>:MODE MAXH
```



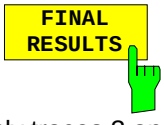
The *MIN HOLD* softkey activates the min hold mode.

In this display mode, the FSET saves for each scan the smallest of the previously stored/currently measured values in the trace memory. In this way, the minimum value of a signal can be determined over several scans.

This function is, e.g., useful in making an unmodulated carrier in a mix of signals visible. Noise, interference signals or modulated signals are suppressed by the *MIN HOLD* function while a CW signal maintains a constant level.

IEC\IEEE bus command

```
:DISPlay[:WINDow<1|2>]:TRACe<1..4>:MODE MINH
```



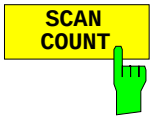
(only traces 3 and 4)

The *FINAL RESULTS* softkey activates the display of final measurement values. Trace 3 represents the allocated final measurement values referring to trace 1 with the symbol "x" and trace 4 the final measurement values for trace 2 with "+" (see section "Selection of Detectors for Final Measurement").

IEC/IEEE-bus command

```
:DISPlay[:WINDow<1|2>]:TRACe<1..4>:MODE FRESults
```

In *SINGLE SCAN* mode, *RUN SCAN* initiates n single scans. The scans are stopped as soon as the selected number of scans is reached.

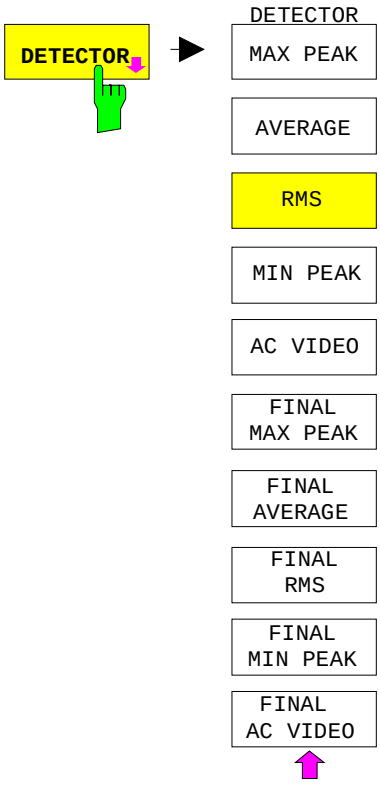


The *SCAN COUNT* softkey activates the entry of the number of scans for *SINGLE SCAN*.

The permitted range for *SCAN COUNT* is 1 through 32767.

The default setting is 1 scan.

IEC\IEEE bus command `:[SENSe<1|2>:]SWEep:COUNt 10`



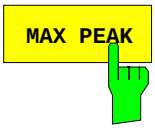
The *DETECTOR* softkey opens a submenu to select the detector.

The detector type may be indepently selected for each trace.

Multiple detection is activated by switching on up to three single detectors.

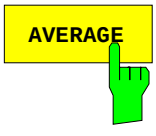
For description of detector types see Section "Detector Selection" in Analyzer Mode.

The detectors for the final measurement are marked by "FINAL".



The *MAX PEAK* softkey activates the max peak detector.

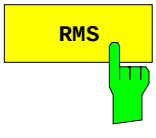
IEC\IEEE bus command
`:[SENSe:]DETector[:FUNCtion] POSitive`



The *AVERAGE* softkey activates the average detector.

The average detector supplies the straight average of the signal during the measurement time.

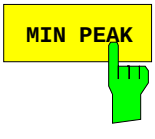
IEC\IEEE bus command
`:[SENSe:]DETector[:FUNCtion] AVERage`



The *RMS* softkey activates the rms detector.

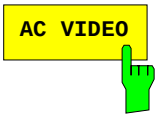
The rms detector supplies the rms value of the signal. The mean of squares of all sampled values is formed during the measurement time.

IEC\IEEE bus command
`:[SENSe:]DETector[:FUNCtion] RMS`



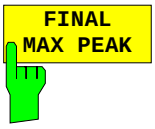
The *MIN PEAK* softkey activates the min peak detector.

IEC\IEEE bus command
`:[SENSe:]DETector[:FUNCtion] NEGative`



The *AC VIDEO* softkey activates the *AC VIDEO* detector.

IEC\IEEE bus command
`:[SENSe:]DETector[:FUNCtion] ACVideo`



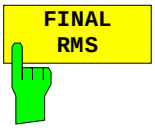
The *FINAL MAX PEAK* selects the max peak detector for the final measurement.

IEC\IEEE bus command
`:[SENSe:]DETector:FMEasurement POSitive`



The *FINAL AVERAGE* selects the average detector for the final measurement.

IEC\IEEE bus command
`:[SENSe:]DETector:FMEasurement AVERage`



The *FINAL RMS* selects the rms detector for the final measurement.

IEC\IEEE bus command
`:[SENSe:]DETector:FMEasurement RMS`



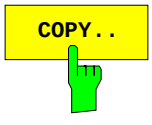
The *FINAL MIN PEAK* selects the min peak detector for the final measurement.

IEC\IEEE bus command
`:[SENSe:]DETector:FMEasurement NEGative`

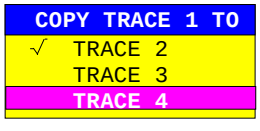


The *FINAL AC VIDEIO* selects the AC video detector for the final measurement.

IEC\IEEE bus command
`:[SENSe:]DETector:FMEasurement ACVideo`



The *COPY* softkey copies the contents of the display screen for the current trace to another trace memory. A table appears in which the desired copy procedure can be selected.

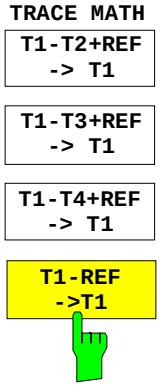


After copying, the contents of the destination memory are lost. The destination memory now changes automatically to view mode with the new data.

IEC\IEEE bus command
```
:TRACe:COPY
      TRACE1| TRACE2| TRACE3|
TRACE4,
      TRACE1| TRACE2| TRACE3| TRACE4
```

Mathematical Functions for Traces

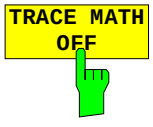
TRACE 1- menu:



The *T1-T2+REF, T1-T3+REF*, *T1-T3+REF* and *T1-REF* softkeys subtract the corresponding traces and add the set level to the difference. If the reference line is switched on (see key D LINES), the level value of the reference line is added to the difference. Thus, the differential curve can be positioned anywhere on the screen by shifting the reference line. The difference of the two traces with respect to the reference line is displayed.

The *T1-REF* softkey subtracts the level of the reference line from the trace level.

To indicate that the trace has been obtained by a differential curve, a corresponding enhancement label is displayed at the right margin of the measurement value diagram (1-2, 1-3, 1-4, 1-R). In *TRACE 1* main menu, the *TRACE MATH* softkey is on a coloured background to show that the function is being used.



The *TRACE MATH OFF* softkey switches the enabled differential curve off. The softkey is only available when a conversion function is enabled.

IEC/IEEE-bus command - -

Trace Export

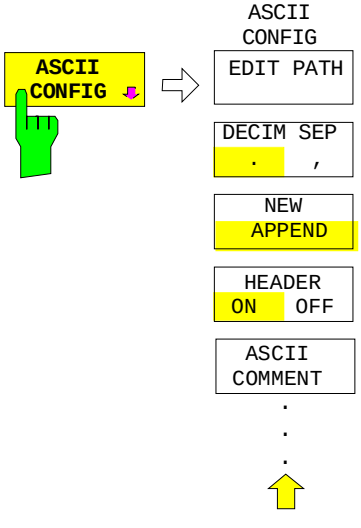
TRACE 1 menu:



The *ASCII EXPORT* softkey stores the corresponding trace in a file with ASCII format.
Upon pressing the *ASCII EXPORT* softkey, a file name can be entered. The default name is TRACE.DAT. Then the measured data of the trace are stored.
The function can be configured in the *ASCII CONFIG* submenu.

IEC/IEEE-bus command `:MMEMory:STORe:TRACe 1..4,<path>`

TRACE 1 menu:

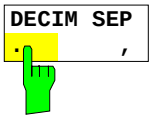


The *ASCII CONFIG* softkey calls a submenu for various settings for the *TRACE ASCII EXPORT* function.



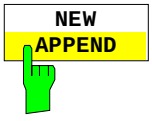
The *EDIT PATH* softkey defines the directory in which the file is to be stored.

IEC/IEEE-bus command --



The *DECIM SEP* softkey selects the separator for the ASCII file: '.' (decimal point) or ',' (comma).
Different language versions of analysis programs may require different notations of the decimal point. .

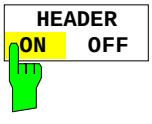
IEC/IEEE-bus command
`:FORMat:DEXPort:DSEParator POINt|COMMA`



The *APPEND NEW* softkey defines whether output data are to be written to an existing file or a new file.

- With *APPEND,* the data are added to an existing file.
- With *NEW,* either a new file is generated or an existing file is overwritten by storage of the data.

IEC/IEEE-bus command `:FORMat:DEXPort:APPend ON | OFF`



The *HEADER ON/OFF* softkey defines whether important instrument settings should be stored at the beginning of the file.

IEC/IEEE-bus command `:FORMat:DEXPort:HEADer ON | OFF`



The *ASCII COMMENT* softkey activates the entry of commentary concerning the current ASCII data set. A total of 60 characters are available for this purpose.

IEC\IEEE bus command
`:FORMat:DEXPort:COMMent 'string'`

Structure of the ASCII file:

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.

	Content of file	Description
File header	Type;FSET;	Instrument model
	Version;2.07;	Firmware version
	Date;01.Jan 2000;	Date of data set storage
	Mode;Receiver;	Instrument mode
	Comment;Test	Comment
	Start;10000;Hz Stop;100000;Hz	Start/stop of the display range. Unit: Hz
	x-Axis;LIN;	Scaling of x-axis linear (LIN) or logarithmic (LOG)
	Detector;AVERAGE;	Selected detector MAX PEAK,MIN PEAK,RMS,AVERAGE, QUASI PEAK,AC VIDEO
	Scan Count;1;	Scan count
	Transducer;TRD1;	Transducer name (if switched on)
	Scan 1:	Loop over all defined scan ranges (1-10)
	Start;150000;Hz	Range - start frequency in Hz
	Stop;1000000;Hz	Range – stop frequency in Hz
	Step;4000;Hz	Range - step width in Hz for linear step width or in % (1-100) for logarithmic step width
	RBW;100000;Hz	Range - resolution bandwidth
	Meas Time;0.01;s	Range - measurement time
	Auto Ranging;ON;	Auto ranging on - or off for current range
	RF Att;20;dB	Range - input attenuation
	Auto Preamp;OFF;	Auto Preamp on or off for current range
	Preamp;0;dB	Range - preamplifier on (20dB) or off (0dB)
	Input;RF;	Range - input (1 or 2)
Data section of the file	Trace 1:	Selected trace
	Trace Mode;AVERAGE;	Trace mode: CLR/WRITE,AVERAGE,MAX HOLD,MIN HOLD, VIEW, BLANK
	x-Unit;Hz;	Unit of x values:
	y-Unit;dBuV;	Unit of y values:
	Values;31714;	Number of test points
		Measured values:
	150000.000000;11.459816;	<x value>, <y value>;
	154000.000000;13.225037;	
	158000.000000;12.387199;	
	162000.000000;13.124626;	
	166000.000000;13.615486;	
	...;...;	

Example for exported scan data:

```
Type;FSET ;
Version;2.07;
Date;01.Jan 2000;
Mode;Receiver;
Comment; test
Start;150000.000000;Hz
Stop;1000000000.000000;Hz
x-Axis;LOG;
Detector;MAX PEAK;
Scan Count;1;
Transducer;;
Scan 1:
Start;150000.000000;Hz
Stop;30000000.000000;Hz
Step;4000.000000;Hz
RBW;9000.000000;Hz
Meas Time;0.001000;s
Auto Ranging;OFF;
RF Att;10.000000;dB
Auto Preamp;OFF;
Preamp;0.000000;dB
Input;RF;
Scan 2:
Start;30000000.000000;Hz
Stop;1000000000.000000;Hz
Step;40000.000000;Hz
RBW;120000.000000;Hz
Meas Time;0.000100;s
Auto Ranging;OFF;
RF Att;10.000000;dB
Auto Preamp;OFF;
Preamp;0.000000;dB
Input;RF;
TRACE 1:
Trace Mode;CLR/WRITE;
x-Unit;Hz;
y-Unit;dBuV;
Values;31714;
150000.000000;11.459816;
154000.000000;13.225037;
158000.000000;12.387199;
162000.000000;13.124626;
166000.000000;13.615486;
.....
999880000.000000;24.259178;
999920000.000000;25.103134;
999960000.000000;28.462601;
1000000000.000000;28.185074;
.....
```

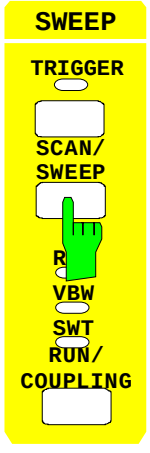
If all traces are to be stored in one file with the header information stored only once, the following procedure is recommended:

[TRACE 1] [MENU ⇒][ASCII CONFIG]	
[ASCII CONFIG] [NEW]	Generate new file
[ASCII CONFIG] [HEADER ON]	with header
[TRACE 1] [MENU ⇒][ASCII EXPORT]	Store trace 1 with header
[TRACE 2] [MENU ⇒][ASCII CONFIG]	
[ASCII CONFIG] [APPEND]	Append to end of file
[ASCII CONFIG] [HEADER OFF]	without header
[TRACE 2] [MENU ⇒][ASCII EXPORT]	Write trace 2 to file
[TRACE 3] [MENU ⇒][ASCII EXPORT]	Write trace 3 to file
[TRACE 4] [MENU ⇒][ASCII EXPORT]	Write trace 4 to file

Scan Control – *SWEEP Key Group*

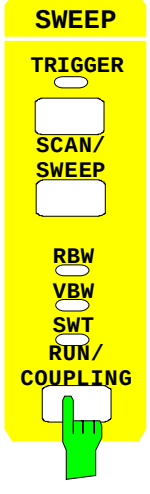
Using the *SWEEP* key group, the parameters are entered which determine the scan characteristics. These are the scan range (*SWEEP* key), the trigger used for starting the scan (*TRIGGER* key) and the starting of the scan (*COUPLING* key).

Entry of Scan Data – *SWEEP* Key



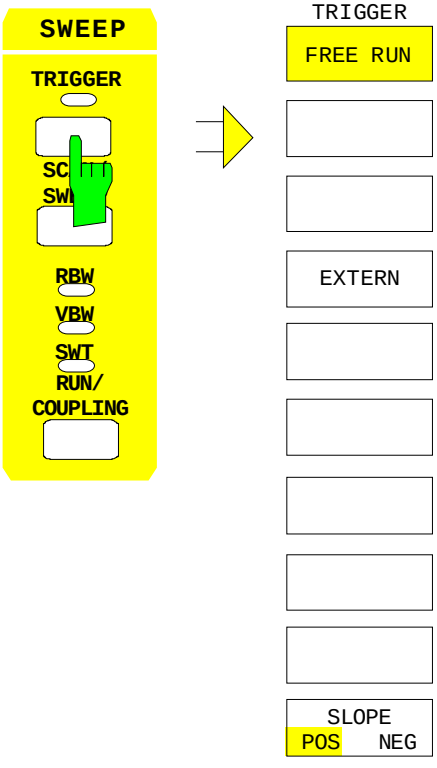
The *SCAN/SWEEP* key opens a submenu where existing scan tables can be edited or new ones created. Tables with the current scan settings are displayed (see Section "Entry of Scan Data").

Start of Frequency Sweep – *COUPLING* Key



The RUN/*COUPLING key* starts the frequency scan with the selected settings (see Section "Running a Scan").

Triggering a Level Measurement – *TRIGGER* Key

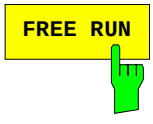


The *TRIGGER* key opens a menu for selection of the various trigger sources and the trigger polarity. The active trigger mode is indicated by illumination of the corresponding softkey.

The *FREE RUN* and *EXTERN* softkeys are selection switches. Only one key can be enabled at any one time (illuminated).

If triggering has taken place, the trigger LED is turned on and then turned off at the end of level measurement.

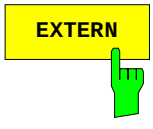
To indicate that the FSET is set for triggering (= not free run), the enhancement label **TRG** is shown on the display.



The *FREE RUN* softkey activates the free-run level measurement (default setting).
With free-run level measurement selected, triggering of a measurement doe not take place. A new measurement is immediately started when a measurement is completed.

IEC\IEEE bus command

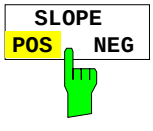
```
:TRIGger<1|2>[:SEQuence]:SOURce  IMMediate
```



The *EXTERN* softkey activates triggering via an external voltage (-5V to +5V) at the input connector *EXT TRIGGER/GATE* on the rear panel. The trigger threshold can be set in an entry window within this range.

IEC\IEEE bus command

```
:TRIGger<1|2>[:SEQuence]:SOURce EXTernal
:TRIGger<1|2>[:SEQuence]:LEVel 2.5V
```



The *SLOPE POS/NEG* softkey selects the trigger slope.

The measurement starts after a positive or negative edge of the trigger signal. The selected setting is illuminated. The selection is valid for all trigger modes with the exception of *FREE RUN*.

The default mode is *SLOPE POS.*

IEC\IEEE bus command

```
:TRIGger<1|2>[:SEQuence]:SLOPe POS |NEG
```

Operating Mode AF Demodulation

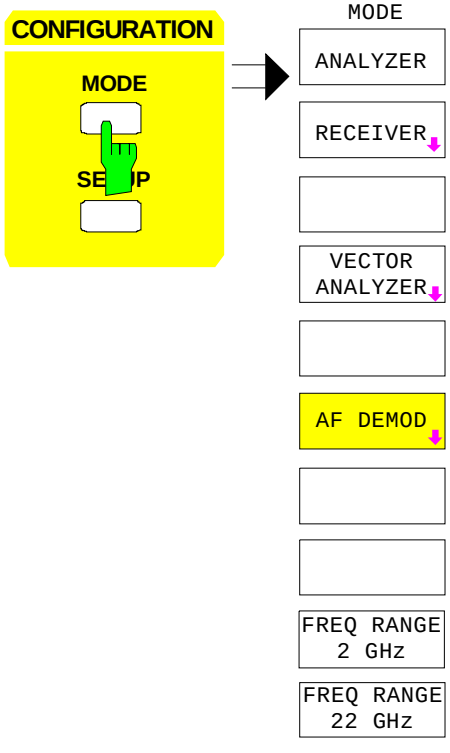
In addition to displaying the signal spectrum FSET can also demodulate modulated signals. The demodulated signal can be monitored via the internal adjustable loudspeaker or a headphone and is available as an analog voltage at the rear for further processing or displayed at the screen.

Digitally modulated signals are demodulated in the operating mode vector analysis which is described in a separate manual.

Time-continuous demodulation is performed in operating mode *AF DEMOD*. Different demodulations are available:

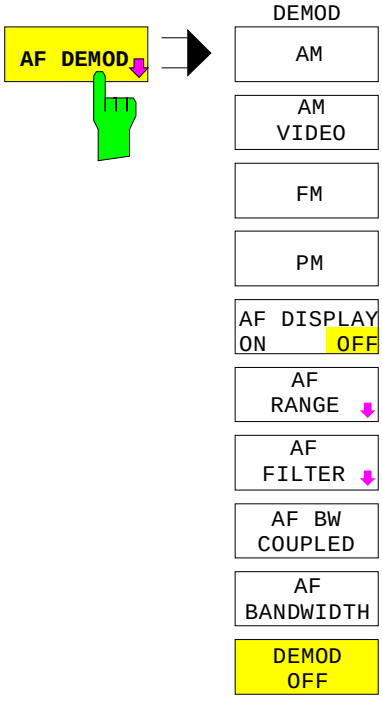
- An AM demodulator for bandwidths up to 100 kHz. Demodulation is performed by means of digital signal processors which are also used for digital demodulators.
- An FM demodulator, which, like the AM demodulator, is fully digital up to bandwidths of 100 kHz and is implemented by an analog broadband demodulator of high linearity for bandwidths between 200 kHz and 10 MHz.
- A phase demodulator operating up to bandwidths of 100 kHz.

CONFIGURATION - MODE menu



The *MODE* key in the key group *CONFIGURATION* opens the menu for selecting the operating mode (see also section "Selecting the Operating Mode").

The *AF DEMOD* softkey opens a submenu for selecting of the type of demodulation.
The AF demodulation is switched on irrespective of the other settings, ie even if FSET sweeps, demodulation is switched on continuously.



The *AF DEMOD* softkey opens a submenu for selecting the type of modulation.

Amplitude demodulation (*AM* or *AM VIDEO*), frequency demodulation (*FM*) and phase demodulation (*PM*) can be selected. AF demodulation is switched off by means of the *DEMOD OFF* softkey.
These softkeys are selection switches of which only one can be active.

The *AF DISPLAY ON/OFF* softkey sets the display of the AF voltage

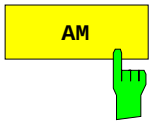
The *AF RANGE* submenu determines the scale of the Y axis for the measurement value diagram.

The filters for AF-band limitation are selected in the *AF FILTER* submenu.

The *AF BW COUPLED* softkey switches the coupling between receiver bandwidth and audio bandwidth on and off.

The *AF BANDWIDTH* softkey activates the entry of the audio bandwidth.

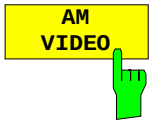
The volume for the loudspeaker and the headphones is controlled by the volume control knob on the front panel of FSET.



The *AM* softkey switches the AM demodulation on.

For AM demodulation, resolution bandwidths from 2 to 100 kHz are available. If the resolution bandwidth is outside this range upon switch-on, it is set to the next possible value for demodulation.

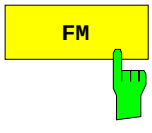
IEC/IEEE-bus command `:[SENSe<1|2>:]DEMod AM`



The *AM VIDEO* softkey switches the unregulated AM video signal into the AF path of FSET.

The bandwidth for AM video is only limited at AF.

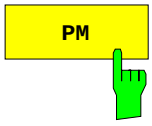
IEC/IEEE-bus command `:[SENSe<1|2>:]DEMod AMVideo`



The *FM* softkey switches the FM demodulation on .

For FM demodulation, resolution bandwidths (RBW) from 2 kHz to 10 MHz are available. If the resolution bandwidth is outside this range upon switch-on, it is set to the next possible value for demodulation.
The demodulated signal is always available DC or AC coupled at the AM/FM output (rear panel) (settable with *AF FILTER*).
For the display, irrespective of the above, the DC component can be separated by *AC VIDEO COUPLING*. This is recommended if a frequency sweep is carried out by means of the FM demodulator to suppress unmodulated carriers and to display only modulated signals.

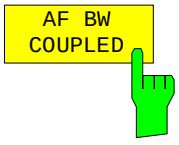
IEC/IEEE-bus command `:[SENSe<1|2>:]DEMod FM`



The *PM* softkey switches the phase demodulation on.

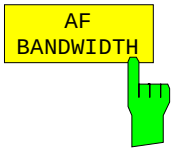
For phase demodulation, resolution bandwidths from 2 to 100 kHz are available. If the resolution bandwidth is outside this range upon switch-on, it is set to the next possible value for demodulation.

IEC/IEEE-bus command `:[SENSe<1|2>:]DEMod PM`



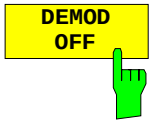
The *AF BW COUPLED* softkey switches the coupling between receiver bandwidth and audio bandwidth on and off.

IEC/IEEE-bus command
`:[SENSe<1|2>:]BWIDth:DEMod:COUPling ON | OFF`



The *AF BANDWIDTH* softkey activates the entry of the audio bandwidth. Entries for audio bandwidth can always be made, however they influence the RBW only if *AF BW COUPLED* is active.

IEC/IEEE-bus command `:[SENSe<1|2>:]BWIDth:DEMod 100 kHz`



The *DEMOD OFF* softkey switches the AF demodulation off.

This is the default setting of FSET.

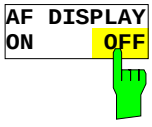
IEC/IEEE-bus command `:[SENSe<1|2>:]DEMod OFF`

Display of Modulation Results

FSET can display the demodulated AF signal. To this effect, the demodulated signal of the selected demodulator is digitized instead of the video signal of the measurement path and displayed after video filtering and processing by the detector, ie the settings for the video bandwidth, the detector and the traces are also valid for the display of the demodulated signal.

The display of the demodulated signal is possible both in the time domain (span = 0 Hz) and in the frequency range, ie in the sweep mode.

CONFIGURATION - MODE - AF DEMOD submenu



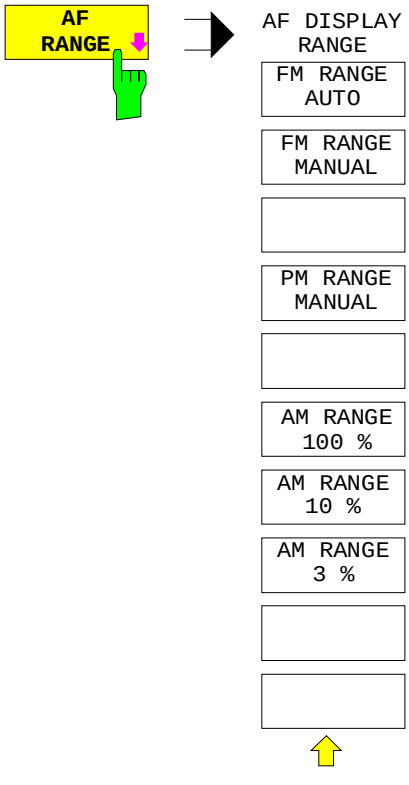
The *AF DISPLAY* softkey *ON* displays the demodulated AF signal instead of the spectrum.

This is not valid for the setting *AM VIDEO*. As the unregulated video signal is looped into the AF path for *AM VIDEO*, the AM video signal is identical with the display of the spectrum, ie *AF DISPLAY ON* for *AM VIDEO* does not affect the display of measurement results.

IEC/IEEE-bus command

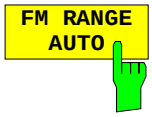
```
:DISPlay[:WINDow<1|2>]:FEED 'AF' | 'VIDeo'
```

CONFIGURATION - MODE - AF DEMOD - AF RANGE submenu



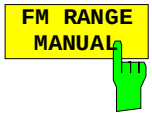
The *AF RANGE* softkey opens the submenu for setting the scale of the Y axis for the measurement value diagram.

For FM demodulation, this corresponds to the maximum frequency deviation display range. For phase demodulation, this corresponds to the maximum phase deviation range and for AM demodulation, the maximum modulation depth range.



The *FM RANGE AUTO* softkey adapts the deviation range to the selected bandwidth.
The deviation is set to half the bandwidth, ie at 10-MHz bandwidth the display range of the Y axis is ± 5 MHz.

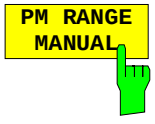
IEC/IEEE-bus command `:[SENSe<1|2>:]DEMOD:FM:RANGe:AUTO ON`



The *FM RANGE MANUAL* softkey activates the manual entry of the displayed deviation range.

The setting range for the FM display range is coupled to the selected resolution bandwidth. For bandwidths < 100 kHz, the range can be set between ±50 Hz and ±50 kHz, for bandwidths ≥ 100 kHz between ±50 kHz and ±5 MHz.

IEC/IEEE-bus command
`:[SENSe<1|2>:]DEMOD:FM[:DEViation]:RANGe:UPPer 300 kHz`

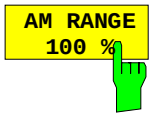


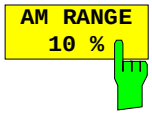
The *PM RANGE MANUAL* softkey activates the manual entry of the displayed deviation range.

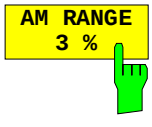
For phase demodulation, the setting range is 0.01 rad to 10 rad, irrespective of the resolution bandwidth (RBW). The steps for the setting are 1, 3, 10, ie ±0.01 rad, ±0.03 rad, ±0.1 rad, ±0.3 rad, ...

IEC/IEEE-bus command
`:[SENSe<1|2>:]DEMOD:PM[:DEViation]:RANGe:UPPer 4`

Note: *PM Range Auto is not possible as each frequency deviation can have any phase deviation.*







The *AM RANGE 100%, 10% and 3%* Softkeys directly select the display of the audio signal in % modulation depth.

The ranges 100%, 10% and 3% modulation depth can be selected. For the display range of 100%, the display ranges from -100% to +100%.

For *AM VIDEO,* the display is identical to the analyzer mode, ie as spectrum in the frequency range and as unregulated envelope signal in the time domain.

IEC/IEEE-bus command
`:[SENSe<1|2>:]DEMOD:AM:RANGe:UPPer 100 | 10 | 3`

Selection of AF Filter

To improve the S/N ratio at AF, lowpass filters for the screen display and the AM/FM output at the rear of the unit are provided.

The video filters which are available in the analyzer mode can also be used for screen display, ie lowpass filters between 1 Hz and 10 MHz can be switched. Operation is the same as that for spectrum display using the *COUPLING* key and the *VIDEO BW* softkeys.

In the default setting the AF lowpass filters are coupled to the selected resolution bandwidth (RBW).

The following audio filters are available:

Broadband FM demodulator:

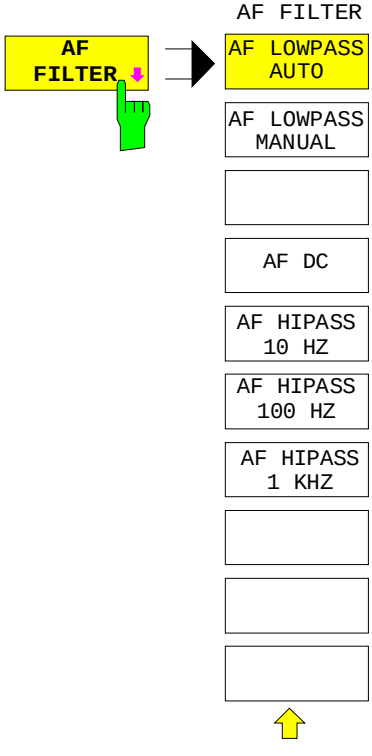
Lowpass filter	Coupled to bandwidths
30 kHz	can only be set manually
100 kHz	200 / 500 kHz
300 kHz	1 MHz
1 MHz	2 / 5 MHz
5 MHz	10 MHz

Narrowband AM/FM demodulator:

Lowpass filter	Coupled to bandwidths
3 kHz	<10 kHz
10 kHz	20 / 50 kHz
30 kHz	≥100 kHz

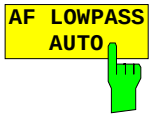
Note: *The AF filters are located directly after the demodulators and also influence the bandwidth when the demodulated signal is displayed on the screen. This means that the maximum bandwidth is determined by the AF filters. Additional band limitation is provided for the AF signal when the video filter is selected. For larger bandwidths, the AF bandwidth is limited by the set AF filter.*

CONFIGURATION MODE - AF DEMOD - AF FILTER submenu



The *AF FILTER* softkey opens the submenu for selecting the filter for the band limitation at AF.

The default setting is *AF LOWPASS AUTO* in which the AF bandwidth is coupled to the selected IF bandwidth according to the list above.

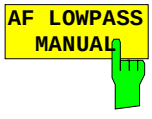


The *AF LOWPASS AUTO* softkey couples the AF bandwidth to the selected IF bandwidth according to the list above.

AF LOWPASS AUTO is the default setting.

IEC/IEEE-bus command

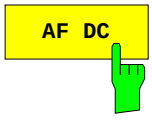
```
:[SENSe<1|2>:]DEMod:FILTer[:LPASs]:AUTO ON
```



The *AF LOWPASS MANUAL* softkey activates the manual entry of the desired AF bandwidth. Entries different from the set of filters offered are set to the next smaller value.

IEC/IEEE-bus command

```
:[SENSe<1|2>:]DEMod:FILTer[:LPASs]:FREQuency 300 kHz
```

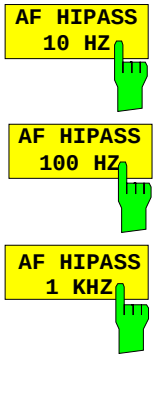


The *AF DC* softkey activates the DC coupling of the AM/FM output. DC coupling is only possible for FM.

With DC coupling of the AM/FM output (*AF DC*) the screen display can only be switched to AC coupling. In this case, activate the function *AC VIDEO COUPLING* (with the COUPLING key in the menu on the right).

IEC/IEEE-bus command

```
:[SENSe<1|2>:]DEMod:FILTer:HPASs:FREQuency 0
```



The *AF HIPASS* softkeys switch on a highpass filter with the given limit frequency to separate the DC component.

1 kHz has to be selected if a short transient time is required. The highpass filters affect the AM/FM output and the display in case of *AF DISPLAY ON*.

IEC/IEEE-bus command

```
:[SENSe<1|2>:]DEMod:FILTer:HPASs:FREQuency 10| 100| 1000
```

Vector Analyzer Mode

The Vector Signal Analyzer in the FSET allows the analysis of digital modulations. For this purpose, the FSET samples the IF signal which is band-limited by the resolution bandwidth (RBW) and mixes it into the complex baseband. The real and imaginary section of the signal is then digitally filtered and further processed in digital signal processors. The complex baseband contains the whole signal information which can be evaluated according to the different criteria.

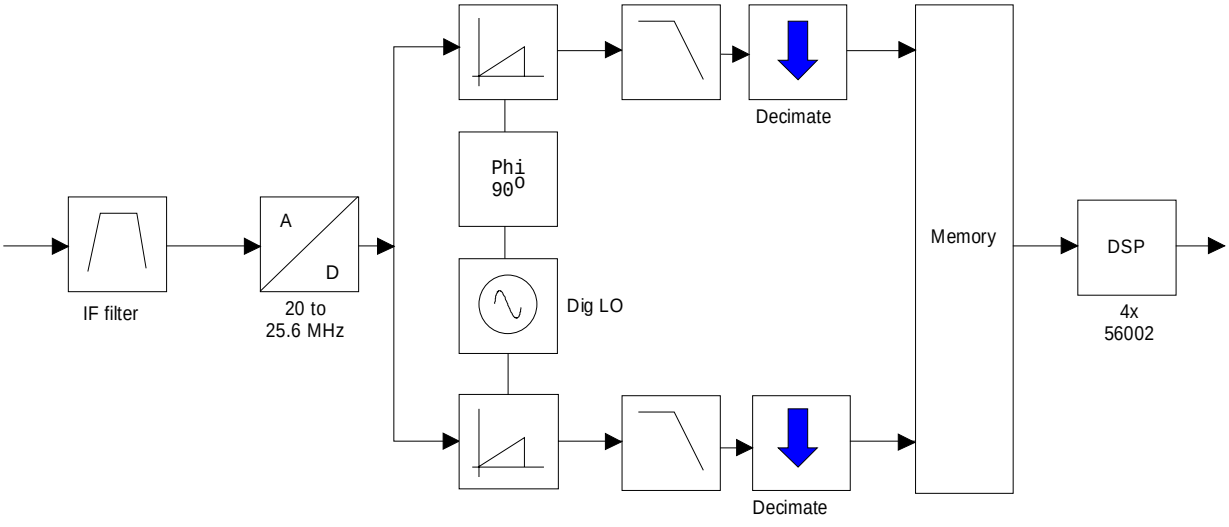


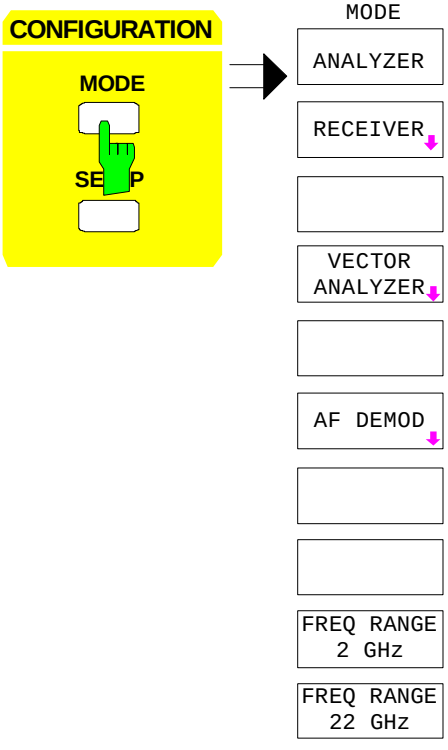
Fig. 4-18 Block diagram of FSET vector signal analyzer

Two types of analysis are distinguished in the vector signal analyzer:

- For digitally modulated signals, the most commonly used demodulators are available to evaluate the modulation parameters.
- Also, the magnitude of the non-demodulated signal can be displayed (MAGNITUDE CAP BUFFER).

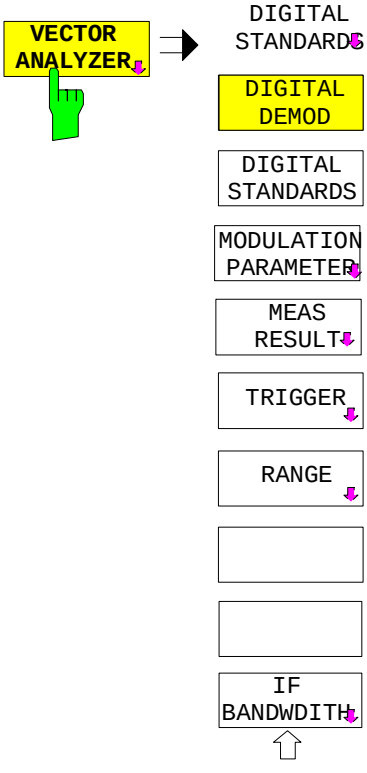
The vector analyzer mode is activated in the *CONFIGURATION MODE* menu
(See section: "Selecting the Operating Mode" - *MODE* key)

Selecting the Operating Mode



The *MODE* key calls up the menu for selecting the operating mode.

The type of analysis is selected in the *VECTOR ANALYZER* sub menu.



The *VECTOR ANALYZER* softkey calls up a submenu. The specific settings for the vector analyzer are entered into this submenu.

The menus for the test parameter settings lying below these keys (*FREQUENCY*, *LEVEL*, *MARKER*, *TRACE*, *COUPLING*, *TRIGGER*) are adapted to the specific capabilities of the vector signal analyzer.

The *DIGITAL STANDARDS* and *DIGITAL DEMOD* softkeys are selectors with which the required type of analysis is set.

The *MODULATION PARAMETER* softkey sets the required modulation parameters for the demodulation of digitally modulated signals.

The *MEAS RESULT* softkey calls up a submenu in which the required evaluation of the selected type of analysis is set. For digital demodulation, this is the evaluation of the signal itself or the reference signal, I/Q or vector errors etc.

The *TRIGGER* softkey calls up a menu equal to the *SWEEP TRIGGER* menu.

The *RANGE* softkey calls up the same menu called by the *RANGE* key in the *LEVEL* key group.

The *IF BANDWIDTH* softkey calls up a submenu in which the analog IF Bandwidth is set.

IEC\IEEE-bus command `:INSTrument<1|2> DDEMod`

Note: *If two displays (screen A and screen B) are opened after switch-on of the vector signal analysis, the vector 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. Storage and display of measured values is sequential: first in the upper and then in the lower display.*

The configuration of the vector analysis is performed in four steps:

1. Setting the type of analysis: General demodulation of digitally modulated signals (*DIGITAL DEMOD)* or setting as required by a specific transmission mode (*DIGITAL STANDARDS,* in this case, step no. 2 can be skipped).
2. Selecting the modulation parameters (*MODULATION PARAMETER*).
3. Selecting the required measurement results (*MEAS RESULT)*.
4. Selecting the output format for measurement results (*RESULT DISPLAY*).

Digital Demodulation Methods

Diagram for signal processing

In modern mobile radio networks digital transmission methods are used to avoid the disadvantages of a transmission channel in mobile communication and to be able to serve more subscribers in the available frequency spectrum. The FSET offers all commonly used demodulators for digitally modulated signals. All modulation parameters for standard transmission methods can be loaded as required by the user. The FSET determines all relevant modulation parameters such as frequency, phase, amplitude and vector errors, etc. Measurements are carried out on continuous as well as pulsed signals such as TDMA signals. Bit patterns can be defined to be able to trigger to known bit sequences like preambles or midambles. The demodulator requires neither a coherent carrier nor a symbol clock for demodulation. It comprises matched filters and synchronizes automatically to the carrier and to the symbol clock. Furthermore, the demodulator can generate the ideal I/Q signal from the demodulated bit stream and thus determine the errors of the analyzed signal.
For a correct demodulation of digital signals, a number of modulation parameters in addition to the modulation mode has to be specified for the signal to be analyzed. The most important are the symbol rate and the input filter. And in addition, the frequency of the FSET (approx. 2% of the symbol rate) has to be tuned exactly to the frequency of the signal to be analyzed.

The bandwidth for demodulation is a function of the symbol rate and the selected oversampling method (*POINTS PER SYMBOL*). At least 4-fold oversampling is performed. If the number set under *POINTS PER SYMBOL* is reduced, fewer points are used in the display. The demodulation bandwidth for 1, 2 and 4 points per symbol is 3.125 times the symbol rate, with 8 points per symbol 6.5 times and for 16 points per symbol 13 times. It should be ensured that no modulation spectrum of adjacent signals is within the displayed range during demodulation, as this may introduce errors in the measurement of modulation parameters. If required, check for correct settings in the analyzer mode. The block diagram below shows the digital demodulator and its measurement capabilities:

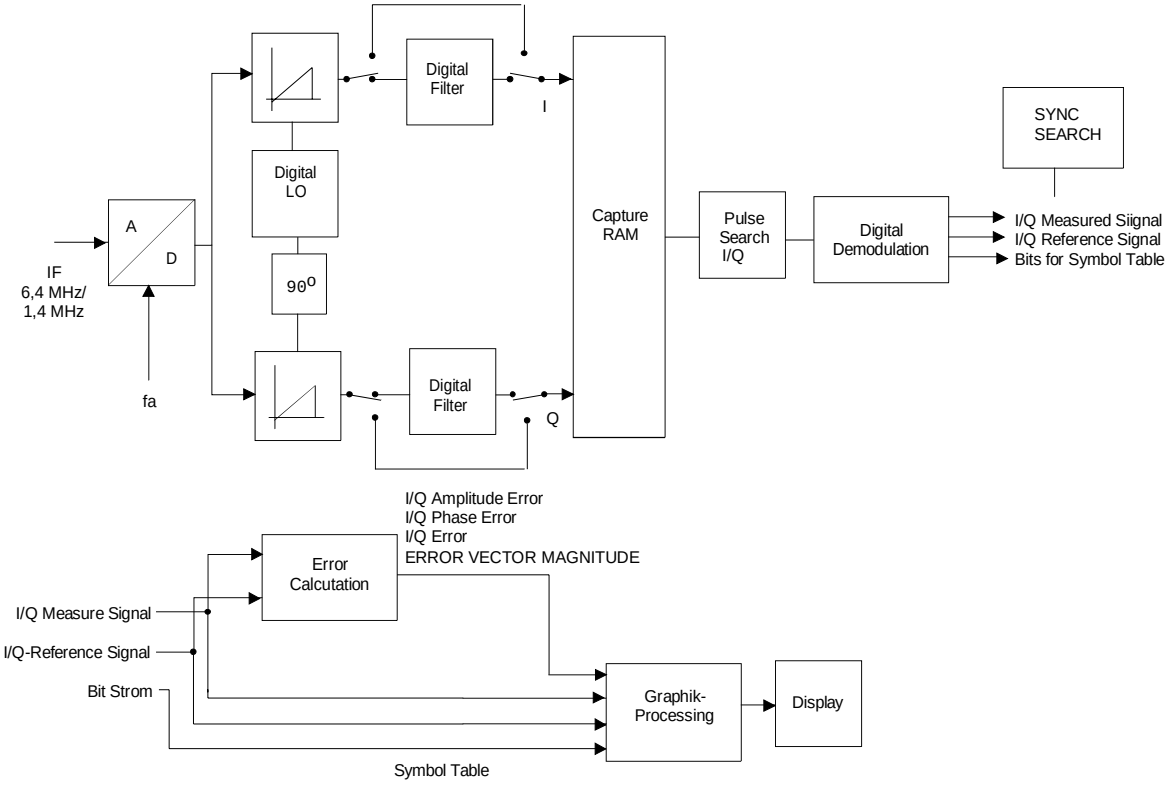
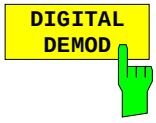


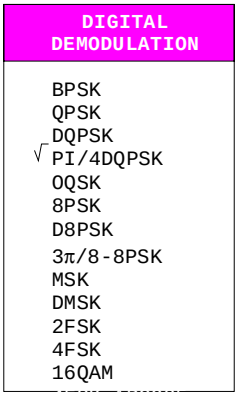
Fig. 4-19 Block diagram for signal processing during digital demodulation

Selecting the Digital Demodulators

Submenu: *CONFIGURATION MODE - VECTOR ANALYZER*



The *DIGITAL DEMOD* softkey opens a list of all available demodulators.



Demodulators are provided for the two-, four- and eight-level PSK modulation modes BPSK, QPSK and 8PSK. For QPSK and 8PSK demodulation, the demodulators for differential signals DQPSK and D8PSK can be selected additionally.

Demodulators are also availabe for the special versions of QPSK modulation, such as differential QPSK with π/4 phase offset (π/4-DQPSK) and offset QPSK (OQPSK).

QPSK is used, for instance, by the IS95- CDMA for modulating signals from the base station to the mobile, OQPSK for signals from the mobile to the base station. The American TDMA system NADC (IS54) uses π/4-DQPSK for digital signal transmissions.

For higher-level modulation modes the demodulator for 16QAM is available. MSK (minimum shift keying) demodulators pertain to the group of continuous-phase demodulators. MSK with Gaussian filters (GMSK = Gaussian minimum shift keying) is used for the European mobile radio systems GSM and DCS1800 or PCS1900 in the USA. For correct bit detection for GSM, DCS 1800 and PCS 1900 and 1800 the MSK demodulator with additional differential decoding (DMSK) should be activated.

For FSK (frequency shift keying modulation, two-level (2FSK) and four-level (4FSK) demodulators can be selected.

2FSK modulation methods are used for instance for the digital cordless telephone to DECT standard, 4FSK for the paging system to ERMES standard.

IEC/IEEE-bus commands

```
:INSTrument[:SELect]  DDEMod
:[SENSe<1|2>:]DDEMod:FORMat QPSK|PSK|MSK|QAM|FSK
:[SENSe<1|2>:]DDEMod:QPSK:FORMat
               NORMal | DIFFerential | OFFSet | DPI4
:[SENSe<1|2>:]DDEMod:PSK:NSTate 2 | 8
:[SENSe<1|2>:]DDEMod:PSK:FORMat NORMal |DIFF |N3Pi8
:[SENSe<1|2>:]DDEMod:MSK:FORMat
               TYPE1 | TYPE2 | NORMal | DIFFerential
:[SENSe<1|2>:]DDEMod:QAM:NSTate 16
:[SENSe<1|2>:]DDEMod:FSK:NSTate 2 | 4
:CALCulate<1|2>:MARKer<1|2>:FUNCtion:DDEMod:RESult?
               MERM| MEPK| MEPS| PERM| PEPK| PEPS|
               EVRM| EVPK| EVPS| IQOF| IQIM| ADR|
               FERR| DEV| FSRM| FSPK| FSPS| RHO| FEPK
```

Standard Settings

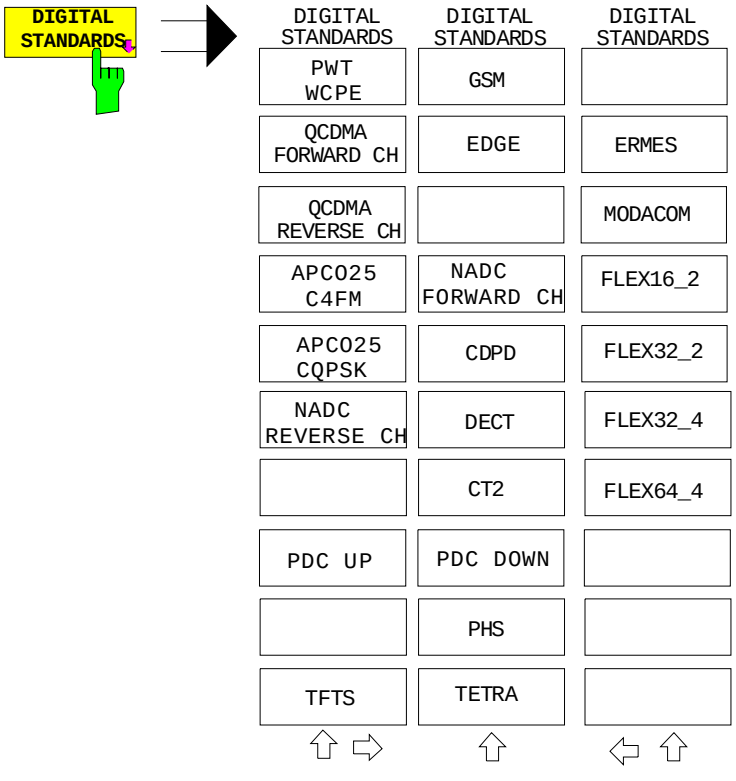
To simplify the selection of parameters when standard transmission methods are used, standard setups are available in the FSET. All modulation parameters and the width of the display range are set automatically..
The following table shows available standards and respective settings.
For the GSM, DCS1800 and PCS 1900 standards the sync pattern GSM_BTS0 with the associated synchronization offset of 61 symbols is preset in addition. When selecting the NADC standard, the instrument is set to the burst of the base station with a slot length of 162 symbols. When selecting the NADC FORWARD CH standard, the instrument is set to the non-burst signal of the base station with a slot length of 162 symbols. For the burst of the mobile station, the standard length NADC REVERSE CH must be set.
For the DECT standard the sync pattern of the fixed part DECT_FP is preset, the sync offset is set to 0. When selecting the TETRA standard, the sync pattern Tetra_1 is preset, the sync offet is preset to 122.

Sync pattern and sync offset become active be switching *FIND SYNC* (menu *SWEEP TRIGGER*) on.

Note: *The pager standards ERMES and FLEX (2FSK and 4FSK modulation) feature modulation filters with increased bandwidth (B*T> 1). This means that with normal oversampling (4 points per symbol) there is an intolerable bandwidth restriction which causes a distinctly higher demodulation error probability. Therefore the number of points per symbol is preset to 8 when the ERMES standard is selected and to 16 when the FLEX standard is selected.*

Attention: *In case of departures from the preset value (which may happen automatically when increasing the frame length or result length) there is a higher system error probability.*

Submenu: *CONFIGURATION MODE - VECTOR ANALYZER*



The *DIGITAL STANDARDS* softkey calls up a submenu of available standard setups.

If one of the following modulation parameters is modified, any digital standard that may be selected is switched off automatically:

- Symbol rate
- Measurement filter
- Reference filter
- α/BT

IEC/IEEE-bus command

```
:[SENSe<1|2>:]DDEMod:PRESet
PWT| F95Cdma| R95Cdma|
APCO25C4FM| APCO25CQPSK|
FNADc| RNADc| PDCup|
PDCDown| TFTS| EDGe| GSM|
DCS1800| PCS1900| CT2|
CDPD| PHS| TETRa| ERMes|
MODacom| F16| F322| F324|
F64
```

Table 4-4 Standard settings

Modulation/ Standard	Symbol rate	Measurement filter	Reference filter	Alpha BT	Synchro-nization	Sync Pattern	Sync offset	Points/ symbol
GSM, (DCS1800, PCS 1900) MSK	270.833 kHz	NONE	GAUSSIAN	0,3	BURST SEARCH	GSM_BTS0	61	4
EDGE 3π/8-8PSK	270.833 kHz	EDGE_MES	EDGE_REF	--	BURST SEARCH	EDGE_BT0	61	4
NADC FORWARD CH*) π/4 DQPSK	24.3 kHz	ROOT RAISED COS	RAISED COS	0,35	BURST SEARCH	NADC_S1	0	4
NADC REVERSE CH π/4 DQPSK	24.3 kHz	ROOT RAISED COS	RAISED COS	0,35	BURST SEARCH	NADC_S1	8	4
PDC DOWN π/4 DQPSK	21 kHz	ROOT RAISED COS	RAISED COS	0,5	SYNC SEARCH	PDC_S1	57	4
PDC UP π/4 DQPSK	21 kHz	ROOT RAISED COS	RAISED COS	0,5	BURST SEARCH	PDC_S1	57	4
PHS π/4 DQPSK	192 kHz	ROOT RAISED COS	RAISED COS	0,5	BURST SEARCH	PHS_DO1	32	4
CDPD MSK	19,2 kHz	NONE	GAUSSIAN	0,5	--	--	--	4
DECT 2-FSK	1152 kHz	NONE	GAUSSIAN	0,5	VIDEO TRIGGER + BURST SEARCH	DECT_FP	0	4
TETRA π/4-DQPSK	18 kHz	ROOT RAISED COS	RAISED COS	0,35	BURST SEARCH	TETRA_1	122	4
CT2 2-FSK	72 kHz	NONE	GAUSSIAN	0,5	BURST SEARCH	CT2_CFP	0	4
ERMES 4-FSK	3.125 kHz	NONE	BESSEL 1_25		--	--	--	8
MODACOM 4-FSK	4.8 kHz	ROOT RAISED COS	RAISED COS	0,2	--	--	--	4
FLEX 16_2 (FLEX 1600) 2-FSK	1.6 kHz	NONE	BESSEL 2_44	--	--	--	--	16
FLEX 32_2 (FLEX 3200) 2-FSK	3.2 kHz	NONE	BESSEL 1_22	--	--	--	--	16
FLEX 32_4 (FLEX 3200 4-FSK	1.6 kHz	NONE	BESSEL 2_44	--	--	--	--	16
FLEX 64_4 (FLEX 6400) 4-FSK	3.2 kHz	NONE	BESSEL 1_22		--	--	--	16
PWT WCPE π/4 DQPSK	562.5 kHz	ROOT RAISED COS	RAISED COS	0,5	BURST SEARCH	WCPE_FP1	0	4
IS95-CDMA FORWARD CH QPSK	1.2288 MHz	IS95_FM	IS95_FR	--	--	--		
IS95-CDMA REVERSE CH OQPSK	1.2288 MHz	IS95_RM	IS95_RR	--	--	--		
TFTSπ/4 DQPSK**)	22.1 kHz	NONE	RAISED COS	0,4	BURST SEARCH	TFTS_G1	0	
APCO25 C4FM	4.8 kHz	NONE	RAISED COS	0.2	--		--	8
APCO25 CQPSK	4.8 kHz	APCO25FM	RAISED COS	0.2	--		--	4

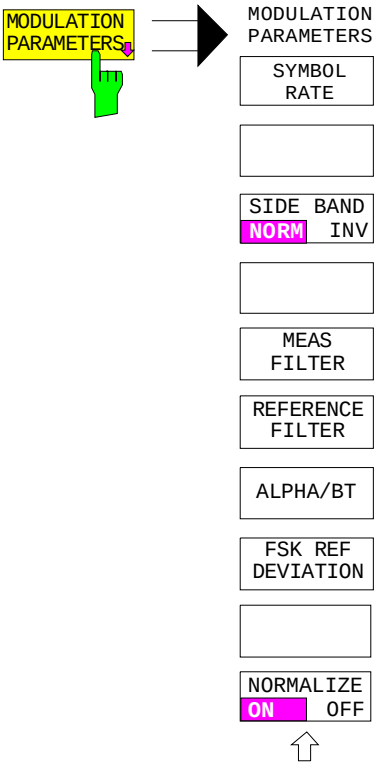
*) The standard setting is matched to the slot of the NADC base station. As the base station doesn't burst, the FIND BURST function is disabled.

**) When selecting the TFTS standard, the special bit decoding is made according to the TFTS standard.

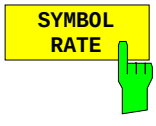
The standard settings are called up by means of the DIGITAL STANDARD softkey.

Selecting Modulation Parameters for Digital Demodulation

Submenu: *CONFIGURATION MODE - VECTOR ANALYZER*



The *MODULATION PARAMETERS* softkey calls up a submenu for setting of the modulation parameters.



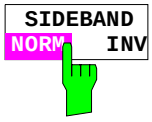
The *SYMBOL RATE* softkey opens a window for entering the symbol rate of the digitally modulated signal to be measured.

The symbol rate is a function of the bit rate determined via the modulation level and corresponds to the baud rate. With QPSK, for instance, the symbol rate corresponds to half the bit rate (= 2 bits per symbol). Symbols are only valid while the signal is evaluated by the receiver. The time of demodulation is the point of decision. The demodulator of the FSET uses the set symbol rate to find the points of decision.

To be able to select the correct symbols, the symbol rate has to be entered exactly. The more complex (high-level) the modulation method, the more critical the exact definition of the symbol rate. An inaccurately defined symbol rate causes demodulation errors. The settings below should also be observed for selecting the symbol rate:

- Maximum possible symbol rate is 2.133 MHz.
- The number of points per symbol is limited to 8 for symbol rates >200 kHz and to 4 for symbol rates >400 kHz.

IEC/IEEE-bus command `:[SENSe<1|2>:]DDEMod:SRATe 18kHz`



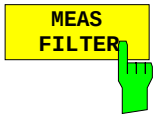
The *SIDE BAND NORM / INV (INVERTED)* demodulates and inverts the signal received.

Thus, with FSK demodulation, the frequency states are inverted, and, with non-FSK modulation, the I and Q signal are inverted.

Default status is *SIDEBAND NORM* (normal).

IEC/IEEE-bus command

```
:[SENSe<1|2>:]DDEMod:SBANd NORMal|INVerse
```



The *MEAS FILTER* softkey selects the input filter for the signal to be measured. The required filter is selected in a table:

MEAS FILTER

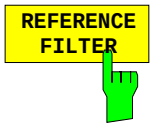
- None
- √ Raised Cos
- Root Raised Cos
- Gaussian

- apco25fm
- edge_mes
- edge_ref
- bess1_22
- bess1_25
- bess2_44
- is95_fm
- is95_fr
- is95_rm
- is95_rr

Further information is given in the description of the *REFERENCE FILTER* softkey.

IEC/IEEE-bus command

```
:[SENSe<1|2>:]DDEMod:FILTer:MEASurement
  OFF| RCOSine| RRCosine| GAUSsian| B22|
  B25| B44| QFM|FM95 | QFR|FR95 | QRM|RM95|
  QRR|RR95 | A25Fm | EMES | EREF
```



The *REFERENCE FILTER* softkey selects the filter for the ideal reference signal for detecting modulation errors at the baseband level. The required filter is selected in a table:

REFERENCE FILTER

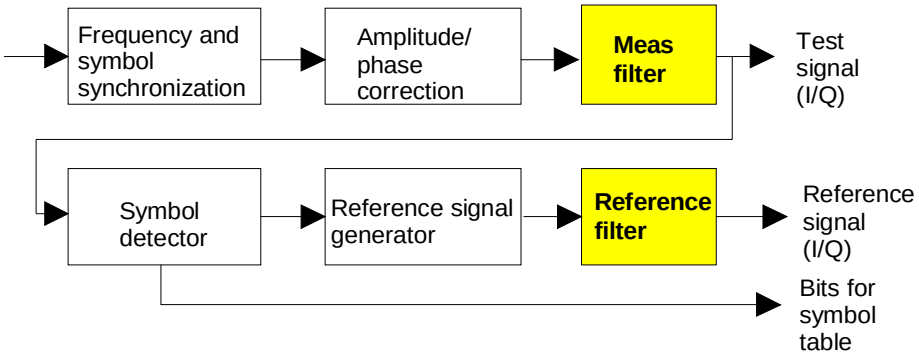
- √ Raised Cos
- Root Raised Cos
- Gaussian

- apco25fm
- edge_mes
- edge_ref
- bess1_22
- bess1_25
- bess2_44
- IS95_fm
- IS95_fr
- IS95_rm
- IS95_rr

Predefined filters are the squarewave filter (only for setting *MEAS FILTER:NONE*), the raised cosine filter, the root raised cosine filter and the Gaussian filter. Cosine filters are generally used for PSK modulation, Gaussian filters by MSK and FSK modulators.

The filter parameters are set via *ALPHA/BT*.

The digital demodulator of FSET generates two signals at the I/Q level, the signal to be measured (*MEAS SIGNAL*) and the reference signal (*REFERENCE SIGNAL*).



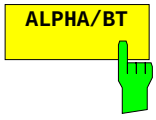
The signal to be measured is present at the RF input after demodulation. The reference signal is the signal that would be obtained in the case of an ideal RF signal. A separate filter is provided for the signal and the reference signal. For digital transmissions, filtering can be carried out at the transmitter or receiver end or be split up between both. The filter at the receiver is the measurement filter. The reference filter is used for the total system. Depending on the configuration of filters, the following combinations can be used:

Filters of transmission system		**Filters to be selected**	
Transmitter	**Receiver**	**MEAS FILTER**	**REFERENCE FILTER**
Root-raised cos	Root-raised cos	Root-raised cos	Raised cos
Raised Cos	none	none	Raised cos
Gaussian	none	none	Gaussian

If no modulation filter is provided in the transmitter, it may also be useful to employ a RAISED COS or GAUSSIAN filter as measurement filter.

However, the non-existing band limiting at the FSET input may cause unwanted aliasing products in the vector analyzer mode, which might impair the measurement. A measurement without reference filter is not possible!

IEC/IEEE-bus command
```
:[SENSe<1|2>:]DDEMod:FILTer:REFerence
    RCOSine| RRCosine| GAUSsian| B22|
    B25| B44| QFM|FM95 | QFR|FR95 |
    QRM|RM95 | QRR|RR95 | A25Fm |
    EMES | EREF
```



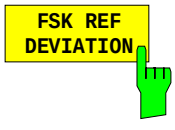
The A*LPHA/BT* softkey opens a window where the roll-off factor (*ALPHA*) for the cosine filters or the bandwidth/symbol period product *BT* for the Gaussian filters is entered.

If an input filter is used for demodulation or a filter for generating the reference signal, the filter characteristic has to be determined by means of *ALPHA/BT*. With Nyquist filters *ALPHA* has to be specified, with Gaussian filters the product of the symbol period T and bandwidth B (*BT*).

All filters are computed up to a length of 16 symbols. Permissible input values are 0.2 to 1 in steps of 0.05. The value for *ALPHA/BT* applies to the measurement and to the reference filter. Values for *ALPHA* or *BT* are determined by the digital transmission system. These values should be used for measurements with FSET as higher demodulation errors could otherwise occur.

ALPHA describes the transmission characteristic of a Nyquist filter (cosine filter). It is also designated as roll-off factor or bandwidth factor. The greater ALPHA, the greater is the bandwidth occupied by the digitally modulated signal relatives to the theoretical minimum. In digital transmission systems typical bandwidth factors of 0.25 to 0.5 are used, ie the occupied bandwidth is 25% to 50% larger than the theoretical minimum. The bandwidth/time product *BT* describes the characteristic or the bandwidth factor of Gaussian filters.

IEC/IEEE-bus command `:[SENSe<1|2>:]DDEMod:FILTer:ALPHa 0.5`



The *FSK REF DEVIATION* softkey opens a window for entering the reference deviation for FSK demodulation.

FSK deviation is defined as the (unilateral) deviation from the center frequency occurring in the case of modulation with constant 0 or 1 sequences, ie the stationary value.

For 4FSK, the modulation deviation is the deviation from the center frequency for the bit sequences causing maximum frequency deviation.
The reference deviation is used for computing the deviation error in *NORMALIZE ON* mode

IEC/IEEE-bus command
`:CALCulate<1|2>:FSK:DEViation:REF 20kHz`

NORMALIZE	
ON	OFF

The *NORMALIZE ON/OFF* softkey has the following effect:
The measurement result in the vector and constellation diagram is always normalized to a circle, the radius of which corresponds to the mean distance between the center of the circle and the mid-points (of all groups of sampling values).
This circle is defined as a unit circle with the radius 1.

Softkey *NORMALIZE ON* shifts the center of the unit circle by the I/Q offset to the center for the group mid-points.

NORMALIZE ON is the default state:

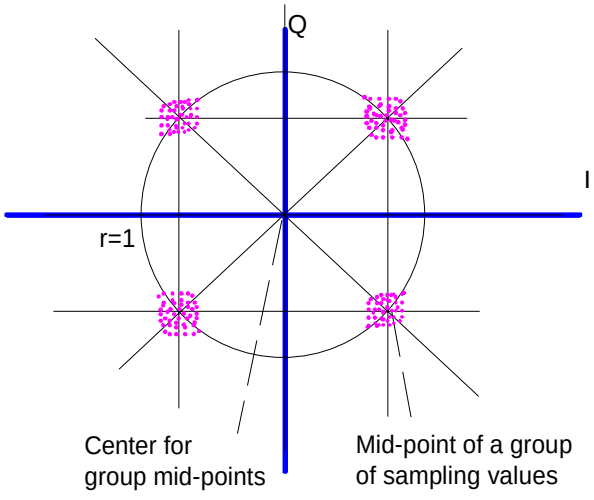
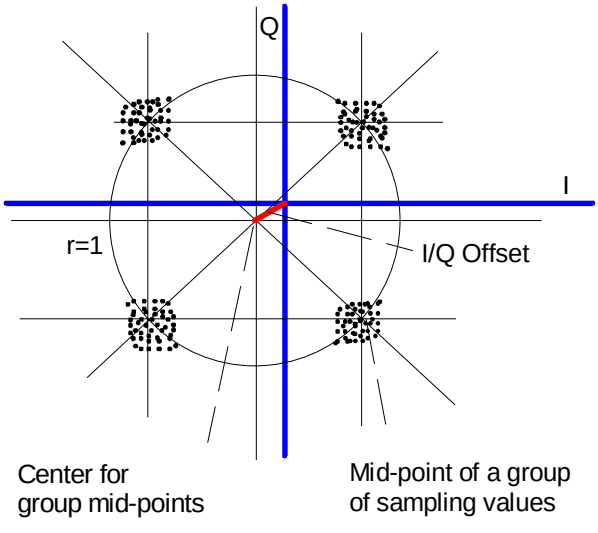


Diagram in the case of *NORMALIZE OFF*:

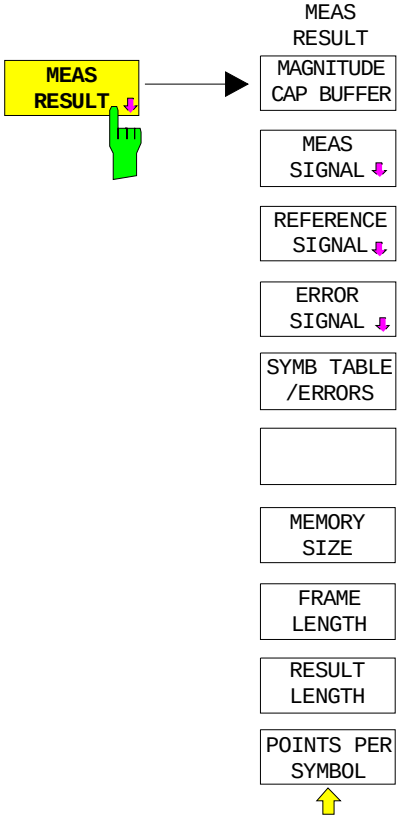


IEC/IEEE-bus command `:[SENSe<1|2>:]DDEMod:NORMalize ON|OFF`

Selecting Measurement Results for Digital Demodulation

After entering all modulation parameters the required measurement is selected using the *MEAS RESULT* softkey. The contents of the trace memory (magnitude), the demodulated measurement signal, the reference signal, i.e. the ideal signal derived from the measurement signal, or the error signal can be displayed as the measurement result. The I/Q error and the vector error are the two possible error signals. A table is available listing all errors together with the demodulated bits.

Submenu: *CONFIGURATION MODE - VECTOR ANALYZER*



The *MEAS RESULT* softkey opens a submenu in which the different displays for the measured signal can be selected.

The *MAGNITUDE CAP BUFFER*, *MEAS SIGNAL*, *REFERENCE SIGNAL*, *ERROR SIGNAL* and *SYMB TABLE/ERRORS* softkeys are selection switches, i.e. only one of the measurement results offered can be selected per screen. If two screens are available, (split-screen mode) a different measurement result can be displayed in each screen.

When the measurement signal, the reference signal and the error signal are displayed, submenus are called up by the corresponding softkeys and the associated parameter can be set.

Moreover, softkeys are available for setting the memory size, the number of bits to be demodulated and displayed.

IEC\IEEE-bus commands for result display

```
:CALC<1|2>:MARKer<1|2>:FUNCtion:DDEMod:RESult?
MERM| MEPK| MEPS| PERM| PEPK| PEPS| EVRM| EVPK|
EVPS| IQOF| IQIM| ADR| FERR| DEV| FSRM| FSPK|
FSPS| RHO| FEPK
```

or

```
:CALCulate<1|2>:MARKer<1|2>:Y?
```

or

```
TRACe:DATA? TRACE1
```

Magnitude of Capture Buffer

The capture buffer is the memory comprising the samples that are entered during the storage of measured values. These samples are used for demodulation but are retained over the complete measurement. A reason for this is the loss in the dynamic range during the synchronization and demodulation of the signal. For synchronization, an interpolation between the samples is necessary, for example, for determining the symbol decision point accurately. Interpolation is always synonymous with a loss in the amplitude dynamic range. In case of synchronization, the signal has to be normalized. The normalization is also linked with a loss in the dynamic range.
When measuring the power ramping of a TDMA burst, a maximum dynamic range is required. This dynamic range is obtained when using the capture buffer for samples.

Submenu: *CONFIGURATION MODE - VECTOR ANALYZER - MEAS RESULT*



The *MAGNITUDE CAP BUFFER* softkey indicates the magnitude of the signal in the capture buffer in the time domain.

The *MAGNITUDE CAP BUFFER* mode is therefore recommended in all cases where power ramping of TDMA bursts should be measured with a wide dynamic range. Timing will be accurate to less than or equal to half a clock period of the sampling unit

Example:
A signal is sampled with 8 values per symbol. The maximum timing error of the TDMA burst synchronized to a bit sequence is 1/16, i.e. 6.25% of the symbol period.

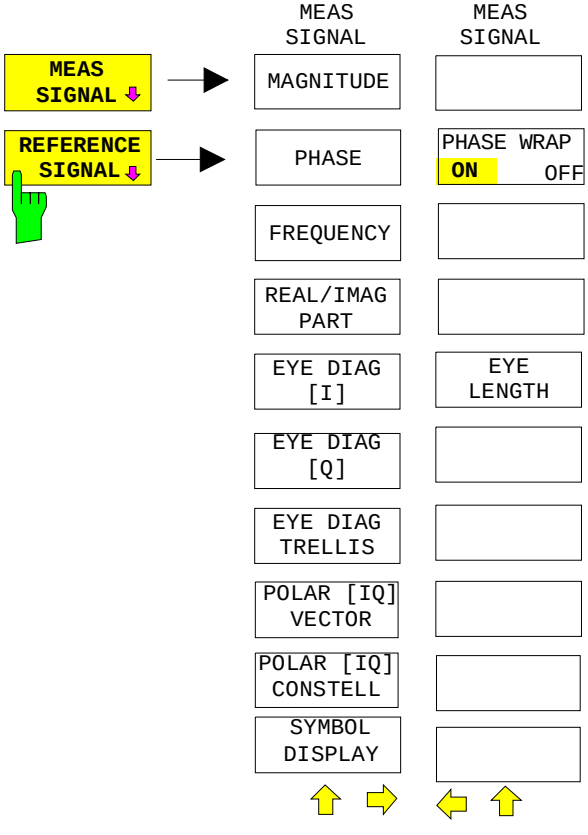
IEC\IEEE-bus command `:CALCulate<1|2>:FEED 'TCAP'`

Measurement Signal or Reference Signal

The FSET can display both the waveform of the measurement signal, which is derived from the samples in the baseband, and that of the reference signal. To this effect, the measurement signal is filtered and synchronized to the carrier and the symbol clock. The I/Q offset and the amplitude reduction of the signal is compensated prior to the display. The reference signal is generated from the demodulated bits by modulation down to the baseband. It is identical to the measurement signal freed of modulation errors and noise.
The output formats for the measurement signal and the reference signal are identical. The output formats are different for FSK demodulation and thel other demodulation modes.

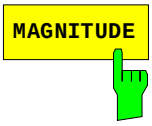
Output formats for non-FSK demodulation:

Submenu: *CONFIGURATION MODE - VECTOR ANALYZER - MEAS RESULT*



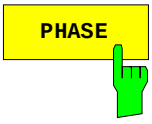
The *MEAS SIGNAL* and *REFERENCE SIGNAL* softkeys call up identical submenus. The output formats of the two signals can be selected there.

IEC\IEEE-bus commands
`:CALC<1|2>:FEED 'XTIM:DDEM:MEAS'`
`:CALC<1|2>:FEED 'XTIM:DDEM:REF'`



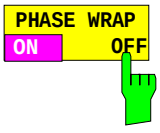
The *MAGNITUDE* softkey displays the magnitude of the demodulated measurement or reference signal, which is normalized to 1, as a function of time and symbol.

IEC\IEEE-bus command `:CALCulate<1|2>:FORMat MAGNitude`



The *PHASE* softkey displays the phase of the measurement or reference signal.

IEC\IEEE-bus command `:CALCulate<1|2>:FORMat PHASe`



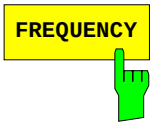
The *PHASE WRAP ON/OFF* softkey activates/deactivates a phase shift.

The phase of a signal can have very high values due to the modulation. Therefore, scaling should be very coarse to display the phase over many bits. FSET therefore offers the phase to be shifted by means of the *PHASE WRAP ON/OFF* softkey.

ON The FSET displays the phase in the range of ±180°. If the phase exceeds +180°, for example, 360° is subtracted from the phase value so that >-180° is indicated. This avoids very high phase values to be displayed which would impair the reading accuracy.

OFF The phase is not shifted. It is displayed within the range of the Y axis. Phase values above or below this range are cut off at the diagram edges.

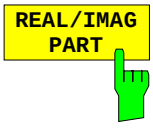
IEC\IEEE-bus command `:CALCulate<1|2>:FORMat PHASe|UPHase`



The *FREQUENCY* softkey displays the time or symbol-dependent frequency response of the signal, i.e., the frequency-demodulated signal. The softkey is only available for MSK demodulation.

The frequency display is suitable for measuring the frequency deviation by using the markers.

IEC\IEEE-bus command `:CALCulate<1|2>:FORMat FREQuency`



The *REAL*/IMAG *PART* softkey calls up the display of the real and imaginary parts of the measurement or reference signal in separate diagrams.
To this effect, the diagram is split up. The real part is displayed in the upper half whereas the imaginary part is displayed in the bottom half. The X axis (which is scaled in time units or symbols) is identical for the two diagrams.

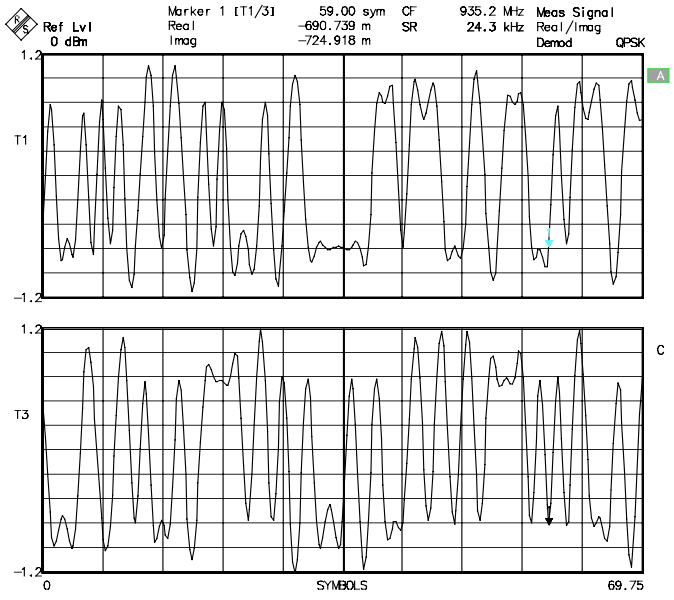


Fig. 4-20 Simultaneous display of inphase and quadrature component in a single diagram (here: screen A in split-screen display)

IEC\IEEE-bus commands `:CALCulate<1|2>:FORMat RIMag`

EYE DIAG [I]

EYE DIAG [Q]

EYE DIAG TRELLIS

The *EYE DIAG [I]*, *EYE DIAG [Q]* and *EYE DIAG TRELLIS* softkeys select the various eye diagrams:

- eye diagram for the inphase signal,
- eye diagram for the quadrature signal and
- trellis diagram.

The eye diagram is the representation of inphase and quadrature signal (*EYE DIAG [I] or EYE DIAG [Q]*) as a function of time. It is triggered by the symbol clock at the points of decision. The display range of the eye diagram (number of states on the time axis) is determined by softkey *EYE LENGTH*.

The individual traces of the eye diagram are superimposed on each other until the number of symbols specified with *RESULT LENGTH* is attained. The successive traces are the continuation of the trace written last, i.e. the total trace is displayed in a folded form. To obtain a complete eye diagram, all the states of a signal have to be traced at least once. The number of eyes vertically corresponds to the number of modulation states less 1. The eye aperture is a measure for differentiating between two decision levels. A small eye apertures indicate a high, large eye apertures a small bit error rate.

The trellis diagram is used for representing the states of continuous-phase modulation methods (e.g. MSK). It indicates the phase versus time and permits also phases above ±180° to be displayed. The trellis diagram is similar to the eye diagram in that measured traces are superimposed onto each other in the display until the number of symbols defined by *RESULT LENGTH* is attained.

For the FSET, the trellis diagram is particularly useful for testing MSK and GMSK modulation. The symbols are spaced by 90°. A phase shift of +90° corresponds to logic 1, a shift of -90° to logic 0. A rising phase edge therefore indicates a logic 1, a falling edge a logic 0. Same as with the eye diagram, the width of the trellis diagram is defined by *EYE LENGTH*. To obtain a clear display, a minimum of 5 symbols should be selected as display width.

The number of P*OINTS PER SYMBOL* should be as high as possible to obtain a continuous trace in the eye diagram. 8 to 16 points are recommended.

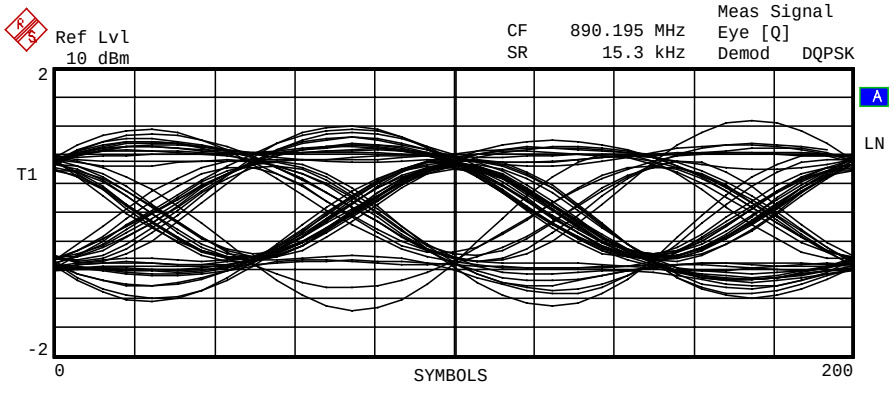


Fig. 4-21 Eye diagram over 200 symbols of a DQPSK-modulated signal. Display range is five symbols.

IEC\IEEE-bus command

```
:CALCulate<1|2>:FORMat IEYE | QEYE | TEYE
```

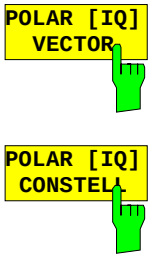
EYE LENGTH

The *EYE LENGTH* softkey determines the display width of the eye diagram in symbols. The number of symbols is entered in the field.

At least one symbol length or two states are required for a complete eye. To be able to detect the errors particularly at the zero crossings, two to five symbols are recommended. The number of symbols is limited with *RESULT LENGTH*. In the case of *EYE LENGTH = RESULT LENGTH*, however, the signal versus time is displayed, the eyes are no longer visible.

IEC\IEEE-bus command

```
:DISPlay[:WINDow<1|2>]:TRACe<1..4>:EYE:COUNt 5
```



The *POLAR [IQ] VECTOR and POLAR [IQ] CONSTELL* softkey display the trace in the form of a polar diagram. In the vector diagram, all the points are marked. In the constellation diagram only those at the points of decision.

In the I/Q diagram, the FSET displays the inphase component of the signal on the X axis, the quadrature component on the Y axis. Each trace represents a vector. The magnitude of the vector is the distance to the zero point, the phase is the angle between the positive X axis and the vector measured counterclockwise.

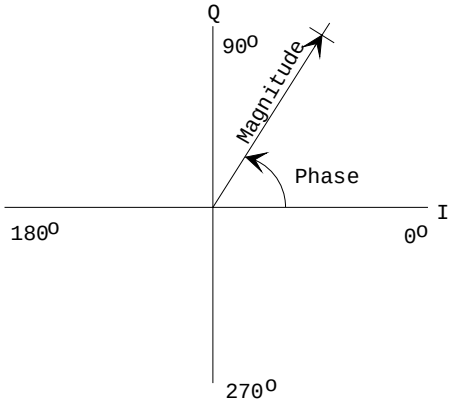


Fig. 4-22 Vector in the I/Q diagram

In the vector diagram the number of points between the points of decision is determined with *POINTS PER SYMBOL*. For instance, if 5 points per symbol have been selected, every 5th point is a symbol at the point of decision. The other four points are intermediate values. The points of decision can be marked by selecting *DOTS* under *SYMBOL DISPLAY*.
The constellation diagram displays only the measurement values at the points of decision.

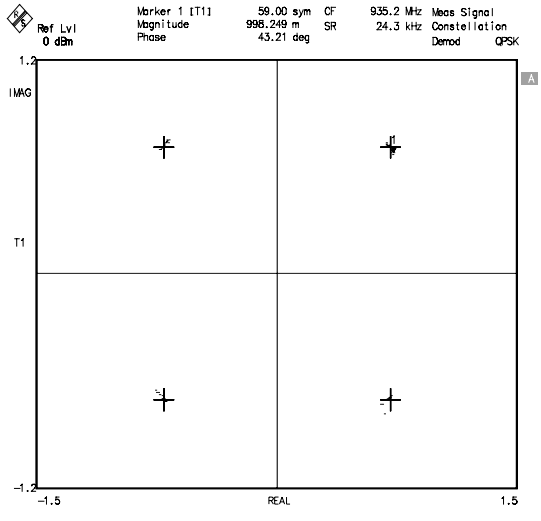
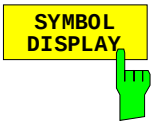


Fig. 4-23 Constellation diagram (example QPSK)

IEC\IEEE-bus commands `:CALCulate<1|2>:FORMat COMP | CONS`



The *SYMBOL DISPLAY* softkey marks the symbol decision points in the displayed trace. The desired form of highlighting can be selected from the table. Points of decision can be marked by vertical lines or by means of dots.

SYMBOL DISPLAY
off
Dots
√ Lines

With *off* selected, the points of decision are not marked. When *Dots* are selected, points are drawn on the trace and for *Lines*, (except for vector and constellation diagrams) vertical lines are drawn between the X axis and the trace.

For vector and constellation diagrams dots are inserted with *Dots* **and** *Lines*.

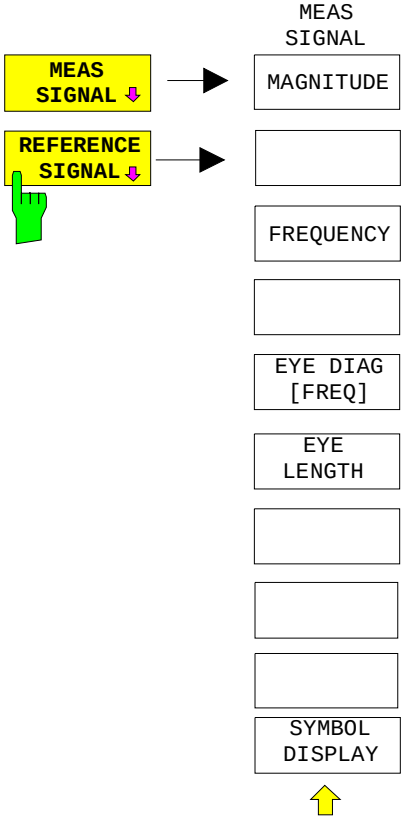
For the constellation diagram dots are also displayed even in the *off* mode.

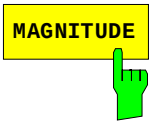
This function is used for displaying the time characteristic of measurement results, e.g. as an I/Q characteristic or error signal.

IEC\IEEE-bus command
`:DISPlay[:WINDow<1|2>]:TRACe<1..4>:SYMBol DOTS|BARS|OFF`

Output formats with FSK demodulation:

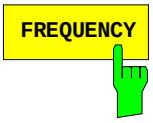
Submenu: *CONFIGURATION MODE - VECTOR ANALYZER - MEAS RESULTS*





The *MAGNITUDE* softkey displays the magnitude of the demodulated measurement or reference signal as a function of time and symbol.

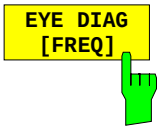
IEC\IEEE-bus command `:CALCulate<1|2>:FORMat MAGNitude`



The *FREQUENCY* softkey displays the time- or symbol-dependent frequency response of the signal, i.e., the frequency-demodulated signal.

The frequency display is for instance suitable for measuring the frequency deviation by using the markers.

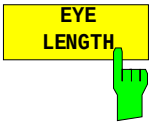
IEC\IEEE-bus command `:CALCulate<1|2>:FORMat FREQuency`



The *EYE DIAG [FREQ]* softkey displays the frequency-demodulated signal as a function of time. This signal is triggered by the symbol clock at the points of decision. The display range of the eye diagram (number of states on the time axis) is determined by *EYE LENGTH*.

The individual traces of the eye diagram are superimposed on each other until the number of symbols specified with *RESULT LENGTH* is attained. The successive traces are the continuation of the trace written last, i.e. the total trace is displayed in a folded form. To obtain a complete eye diagram, all the states of a signal have to be traced at least once. The number of eyes corresponds to the number of modulation states less 1. The eye aperture is a measure for differentiating between two decision levels. A small eye apertures indicate a high, large eye apertures a small bit error rate.

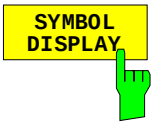
IEC\IEEE-bus command `:CALCulate<1|2>:FORMat FEYE`



The *EYE LENGTH* softkey determines the display width of the eye diagram in symbols. The number of symbols is entered in the field.

At least one symbol length or two states are required for a complete eye. Two to five symbols are recommended however to detect the errors particularly at the zero crossings. The number of symbols is limited by *RESULT LENGTH*. In the case of *EYE LENGTH* = *RESULT LENGTH*, however, the signal versus time is displayed, the eyes are no longer visible.

IEC\IEEE-bus command
`:DISPlay[:WINDow<1|2>]:TRACe<1..4>:EYE:COUNt 5`



The *SYMBOL DISPLAY* softkey marks the symbol decision points in the displayed trace. The desired form of highlighting can be selected from the table. Points of decision can be marked by vertical lines or by dots..

SYMBOL DISPLAY
off
Dots
√ Lines

With *off* selected, the points of decision are not highlighted. When *Dots* are selected, points are drawn on the trace and with *Lines* selected (except for vector and constellation diagrams), vertical lines are drawn between the X axis and the trace.

IEC\IEEE-bus command
`:DISPlay[:WINDow<1|2>]:TRACe<1..4>:SYMBol DOTS|BARS|OFF`

Measurement of Modulation Errors

The FSET evaluates the modulation errors by comparing the measurement signal with the internally generated ideal reference signal.The different output formats of the error are selected by means of the *ERROR SIGNAL* softkey. The output formats differ depending on whether FSK demodulation is selected or not.

Non-FSK demodulation:

The modulation error of the measurement signal can be displayed separately, i.e. according to magnitude and phase, as I and Q error, error vector magnitude or, in polar diagrams, as vector or constellation diagram.

The magnitude and phase error are determined according to the following equations:

Error signal magnitude = $\sqrt{I^2 + Q^2}$ - $\sqrt{I_{ref}^2 + Q_{ref}^2}$ and

Error signal phase = $\arctan\frac{Q}{I} - \arctan\frac{Q_{ref}}{I_{ref}}$, where

the real and imaginary part of the error signal are given as follows

Error signal real part = $(I - I_{ref})$ x 100% and

Error signal imag part = $(Q - Q_{ref})$ x 100%

The magnitude of the error vector (error vector magnitude) is

$$EVM = \sqrt{(I - I_{ref})^2 + (Q - Q_{ref})^2}$$

I, Q = measured I/Q component
I_{ref}, Q_{ref} = I/Q components ideally calculated from the bit sequence.

The following vector diagram indicates the different types of errors resulting from the measurement signal and the reference signal:

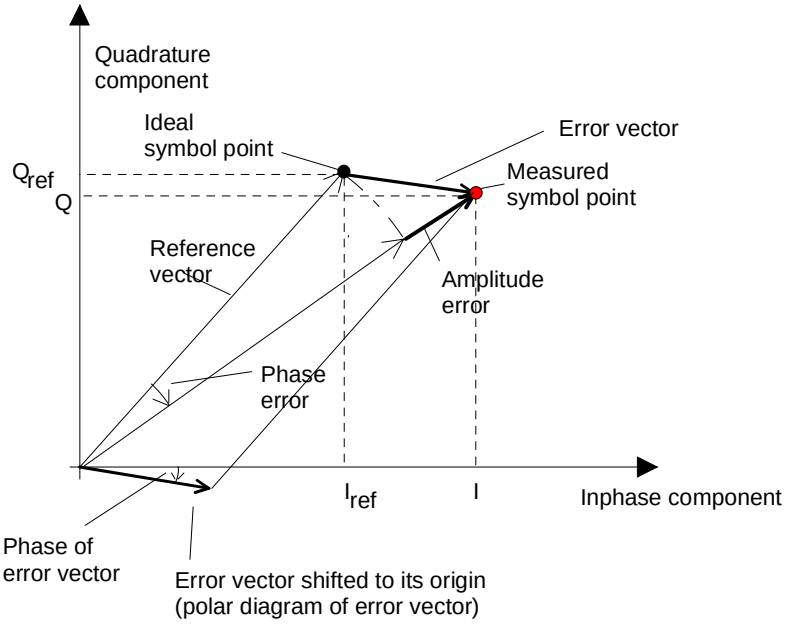
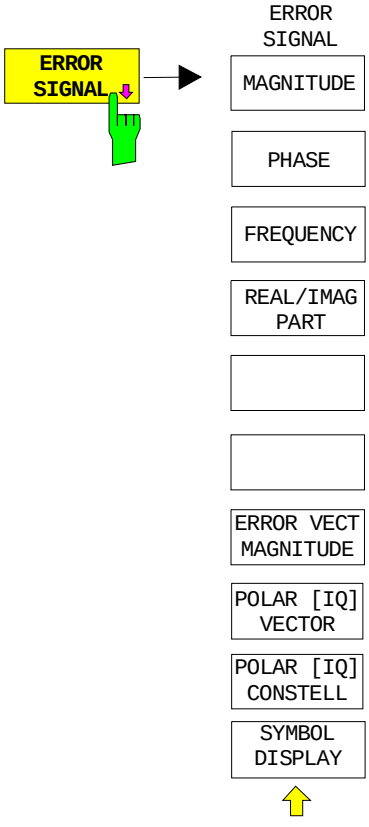


Fig. 4-24 Graphic display of modulation errors by means of a point of decision

Submenu: *CONFIGURATION MODE - VECTOR ANALYZER - MEAS RESULT*



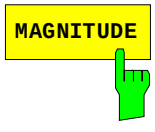
The *ERROR SIGNAL* softkey opens the submenu for selecting the type of error to be displayed.

The following types of error representation are available

- amplitude error (MAGNITUDE)
- phase error (PHASE)
- frequency error (FREQUENCY)
- error if the real part (REAL/IMAG PART) and
- error of the imaginary part (REAL/IMAG PART)
- magnitude error (ERROR VECTOR MAGNITUDE)

For error representation the FSET compares all the points of the measurement and reference signal and displays them in the error diagram (except for *POLAR [IQ] CONSTELL*). Thus, the number of measurement results depends on the number of points per symbol. If only the errors are to be evaluated at the points of decision, the number of points per symbol has to be set to one.

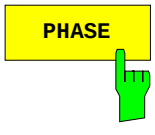
To maintain the correct error for discontinuous transmission, e.g. for TDMA methods, make sure that only valid symbols are displayed. The result length and the trigger condition have to be set appropriately.



The *MAGNITUDE* softkey starts the point by point comparison of the magnitude of the measurement signal with the magnitude of the ideal signal. The difference of the two magnitudes is displayed.

IEC\IEEE-bus commands

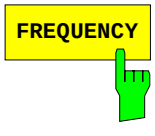
```
:CALCulate<1|2>:FEED  'XTIM:DDEM:ERR:MPH'
:CALCulate<1|2>:FORMat MAGNitude
```



The *PHASE* softkey starts the point by point comparison of the phase of the measurement signal with the phase of the ideal signal. The difference of the two phases is displayed as phase error.

IEC\IEEE-bus commands

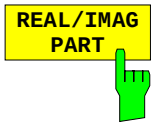
```
:CALCulate<1|2>:FEED  'XTIM:DDEM:ERR:MPH'
:CALCulate<1|2>:FORMat PHASe
```



The *FREQUENCY* softkey displays the frequency error. The frequency response of the measurement signal is compared with that of the ideal reference signal and the difference between the two responses is displayed as a function of time and symbol. The softkey is only available for MSK demodulation.

IEC\IEEE-bus commands

```
:CALCulate<1|2>:FEED  'XTIM:DDEM:ERR:MPH'
:CALCulate<1|2>:FORMat FREQuency
```



The *REAL/IMAG PART* softkey displays the error of the real and imaginary part in separate diagrams. To this effect, the measurement diagram is split up. The real part is displayed in the top half and the imaginary part in the bottom half. The X axis (time or symbols) is identical for the two diagrams.

IEC\IEEE-bus commands

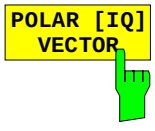
```
:CALC<1|2>:FEED  'XTIM:DDEM:ERR:MPH'
:CALCulate<1|2>:FORMat RIMag
```

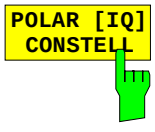


The *ERROR VECT MAGNITUDE* softkey displays the magnitude of the error vector versus time or symbols.

IEC\IEEE-bus commands

```
:CALCulate<1|2>:FEED  'XTIM:DDEM:ERR:VECT'
:CALCulate<1|2>:FORMat MAGNitude
```





The *POLAR [IQ] VECTOR* and *POLAR [IQ] CONSTELL* softkeys display the error vector in the polar diagram. The error vector diagram and the error constellation diagram.

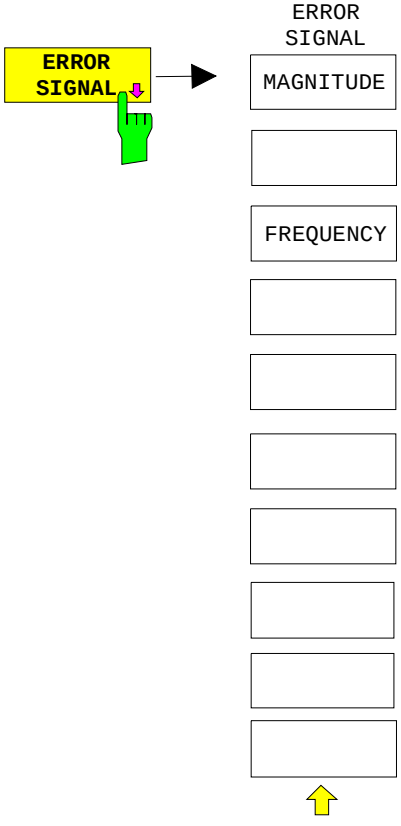
With these forms of representation, the points of decision are all shifted back to the origin and are laid on top of each other. The errors at the points of decision can thus be seen at a glance.

IEC\IEEE-bus commands

```
:CALCulate<1|2>:FEED  'XTIM:DDEM:ERR:VECT'
:CALCulate<1|2>:FORMat COMP | CONS
```

FSK demodulation:

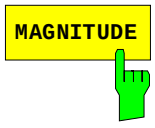
Submenu: *CONFIGURATION MODE - VECTOR ANALYZER - MEAS RESULT*



The *ERROR SIGNAL* softkey opens the submenu for selecting the type of error to be displayed.

The following quantities can be displayed:

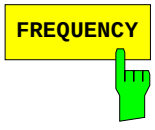
- Magnitude error (MAGNITUDE)
- Frequency error (FREQUENCY)



The *MAGNITUDE* softkey starts the point by point comparison of the measurement signal with the magnitude of the ideal signal. The difference of the two magnitudes is displayed.

IEC\IEEE-bus commands

```
:CALCulate<1|2>:FEED  'XTIM:DDEM:ERR:MPH'
:CALCulate<1|2>:FORMat MAGNitude
```



The *FREQUENCY* softkey displays the frequency error.
The frequency response of the measurement signal is compared with that of the ideal reference signal and the difference between the two responses is displayed as a function of time and symbol.

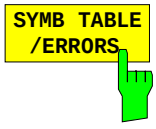
IEC\IEEE-bus commands

```
:CALCulate<1|2>:FEED  'XTIM:DDEM:ERR:MPH'
:CALCulate<1|2>:FORMat FREQuency
```

Symbol Table and Table of Modulation Errors

The symbol table and the table with modulation errors are indicated in the same display. In this case, the two tables are assigned to a trace. Similar to the trace display, the corresponding trace can be frozen (*VIEW*) or faded out (*BLANK*).
The range for the error calculation can be limited by means of the time lines (TIME LINES 1/2; *MARKER SEARCH* menu, *SEARCH LIM ON/OFF* menu).
If only one window is displayed, the symbol table is assigned to trace 1 and the error table to trace 2.

Submenu: *CONFIGURATION MODE - VECTOR ANALYZER - MEAS RESULT*



The *SYMB TABLE / ERRORS* softkey displays a table of demodulated bits and a table of modulation errors of the measured signal.

IEC\IEEE-bus command `:CALCulate<1|2>:FEED 'XTIM:DDEM:SYMB'`

The symbol table shows the demodulated bits of the signal. The number of bits is defined under *RESULT LENGTH* in the same menu. Bits can be related to the traces (in split screen mode) by means of the marker coupling. The marker on the trace and the associated symbol are marked at the same time.

The indicated modulation errors differ depending on whether FSK signals are demodulated or one of the other digital demodulators is active.

The following parameters are indicated as sum errors of the modulation (except with FSK demodulation):

- Frequency error
- Magnitude error
- Phase error
- Error vector magnitude
- I/Q offset
- I/Q imbalance and
- Amplitude droop
- Rho factor.

The FSET evaluates these errors within the result length or in a range limited by the vertical lines within the result length.

With FSK demodulation, the following parameters are indicated as sum errors of the modulation:

- Frequency error
- Magnitude error
- FSK deviation
- FSK deviation error

The entered reference deviation is indicated in addition (*FSK REF DEVIATION*).

Non-FSK demodulations:

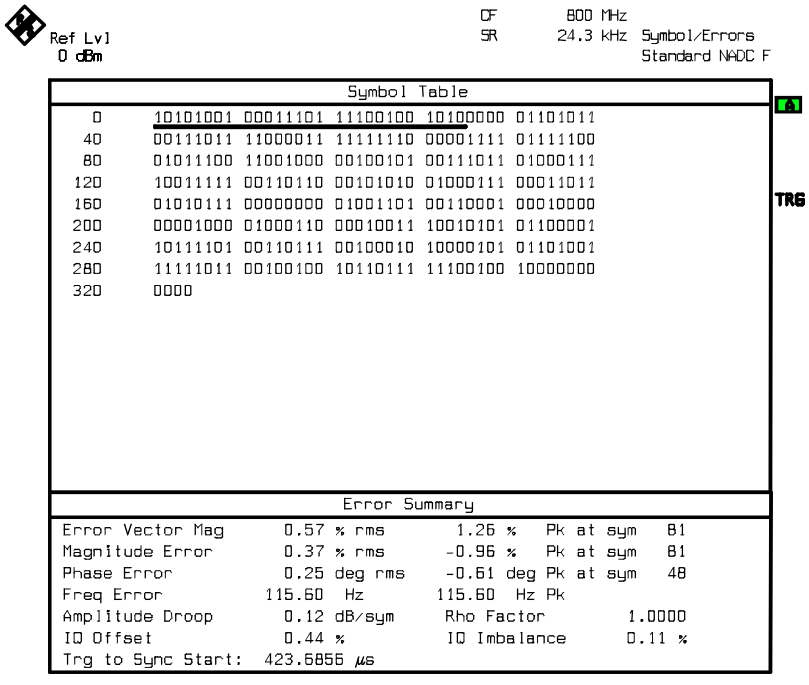


Fig. 4-25 Symbol table and table of sum errors (not FSK demodulation)

Description of errors as follows **(not FSK signals):**

Magnitude error: The magnitude error is the amplitude difference of the I/Q components of measurement signal and reference signal at the points of decision. For MSK modulations, all the points are considered in the calculation. It is a measure for the quality of the amplitude component of the modulated signal.

Phase error: The phase error is the phase difference of the I/Q components of measurement signal and reference signal at the points of decision. For MSK modulations, all the points are considered in the calculation.

Vector error: The error vector magnitude is the magnitude of the error vector which links the measured I and Q value in the complex plane to the ideal I and Q value at the points of decision. The error is calculated according to the following equation:

Error vector magnitude (EVM) = $\sqrt{I_{err}^2 + Q_{err}^2}$, where

I_{err} = error of the inphase signal and Q_{err} = error of the quadrature signal

Frequency error : The frequency error is the deviation of the FSET center frequency from the measured carrier frequency. It is derived from the frequency shift to be effected for synchronization to the carrier. The reference error of the FSET is also part of the frequency error.

Amplitude droop: The amplitude droop indicates the amplitude variation of the signal between the two symbols at the points of decision in dB. This parameter is very important for TDMA signals and is a measure for the quality of pulse modulation.

I/Q offset: The I/Q offset is a measure for the LO feedthrough with analog I/Q modulators. It can be seen through a shift of the zero point in the constellation diagram. Without LO feedthrough (LO 100 % suppressed), the I/Q offset is zero. It is measured at the points of decision.

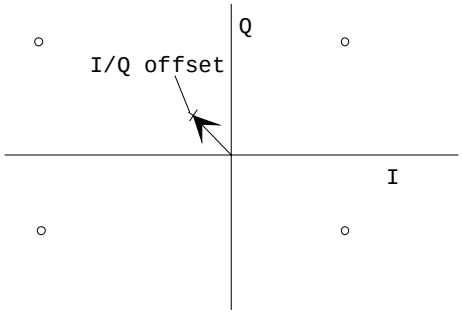


Fig. 4-26 Constellation diagram with I/Q offset

Amplitude and vector errors are given in %, phase errors in degrees (deg) or radian (rad). Prior to calculation, the measurement result is normalized in the vector or constellation diagram to a circle around the center of the group mid-points, the radius corresponding to the mean distance of all group mid-points to the center. This circle is defined as a unit circle with the radius 1 (see *NORMALIZE* function in the *MODULATION PARAMETER menu*)
Then, the errors at the points of decision are determined and the rms of the individual error values is calculated. Since the constellation diagram is normalized, the result is the rms value of the error in %.

I/Q imbalance: The I/Q imbalance is a measure for the symmetry of the I/Q modulator to be measured. The I/Q gain error is the result of unequal gain factors in the I and Q path of the transmitter. The I/Q imbalance is calculated from the square root of the quotient of the vector magnitude for the wanted and interfering signals averaged over all points of decision:

$$\mathrm{I/Q\ imbalance} = 100 * \sqrt{\sum_{i=1}^{n} \frac{|\mathrm{Interferencevector}|^2}{|\mathrm{Signal\ vector}|^2}} \quad [\%]$$

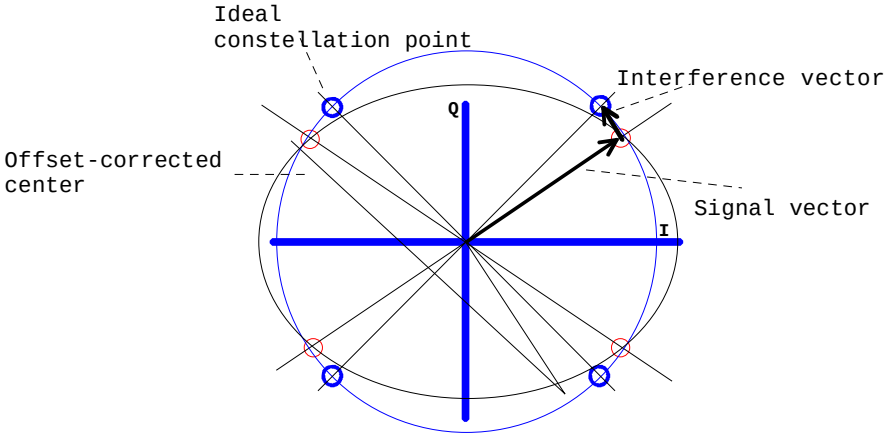


Fig. 4-27 Constellation diagram with I/Q imbalance

Rho factor: Similar to the error vector magnitude, the Rho factor is a measure for the quality of digital modulation. It is determined by measurement of the normalized correlated power between the measured signal and reference signal (IS95-CDMA to US standard IS-98) and is designated as waveform quality factor.
The Rho factor can assume a maximum value of 1.0 (measured signal and reference signal are a 100% identical).

FSK demodulation:

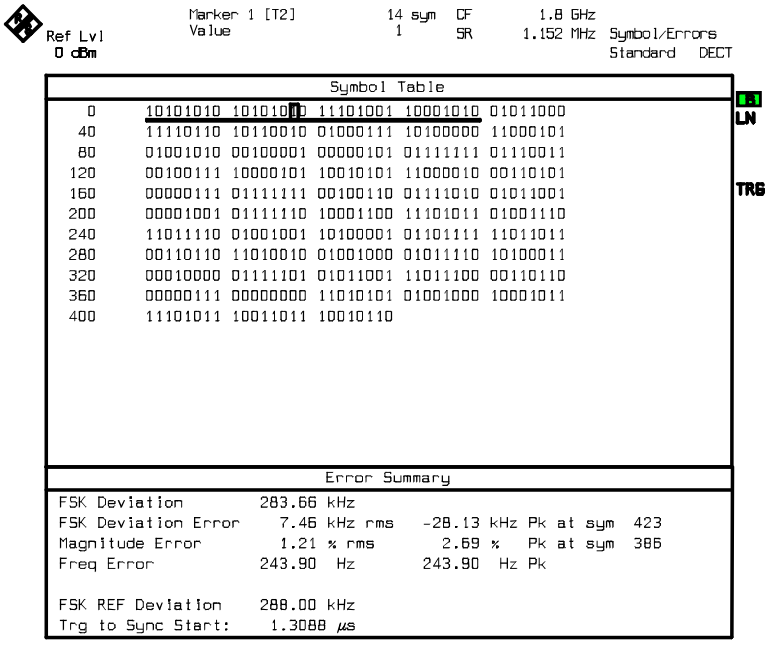


Fig. 4-29 Symbol table and table of sum errors (FSK demodulation)

The various errors and measured values have the following meaning (**FSK signals**):

FSK deviation: The FSK deviation is determined by the square difference between measurement and reference signal being minimized. The reference signal is based is formed on the basis of the known demodulated bits and modulation parameters. The frequency offset is determined separately and indicated under Freq Error. The frequency error is not considered in the indicated FSK deviation.

FSK deviation error: The FSK deviation error is the deviation difference between the measured signal and the reference signal, measured as an rms and peak value over all symbols. Frequency errors (frequency offset) are part of the indicated FSK deviation error.

Normalize ON The entered FSK reference deviation is used for scaling of the reference signal.

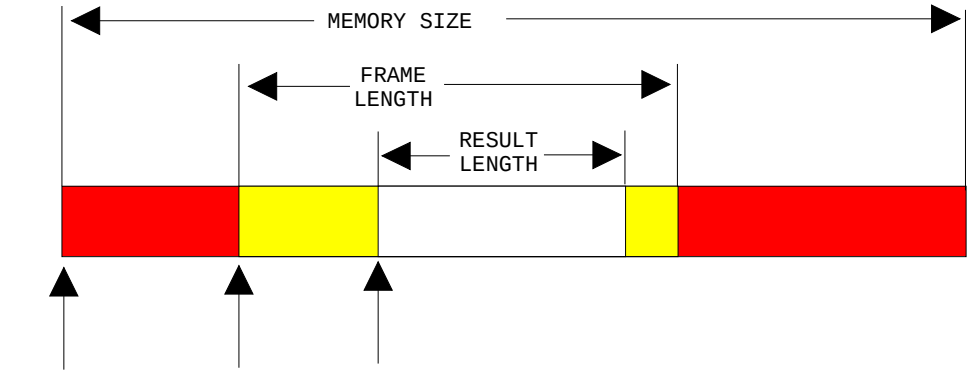
Normalize OFF The reference signal is automatically derived from the measurement signal on the basis of the known demodulated symbols and modulation parameters so as to ensure maximum agreement between measurement and reference signal.

Magnitude error: With FSK, the magnitude error is the deviation of the individual amplitudes of the AM envelope from the mean (rms) carrier amplitude, measured as an rms value over all symbols displayed and as a peak value normalized to the rms amplitude in %.

Frequency error: The frequency error is the deviation of the FSET center frequency from the measured carrier frequency. It is derived from the frequency shift to be effected for synchronization to the carrier. The reference error of the FSET is also part of the frequency error.

Selecting Memory Size, Demodulation Length and Display Range

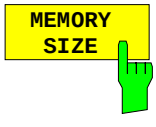
The size of the capture buffer containing the stored samples, the frame length to be demodulated and displayed and the number of points per symbol can be set to allow an adaptation to the measurement or to optimize the measurement speed.
At the beginning of a measurement, the FSET stores the samples into the capture buffer which can be selected between 1 and 16-k symbols. It then tries to find the suitable frame length for further processing according to the trigger condition (*FIND BURST*). The frame length to be displayed or used for error calculation is defined with *RESULT LENGTH*. It can be positioned within the frame length by synchronization sequence triggering (*FIND SYNC*).



Finally, the number of points per symbol can be set. This number defines the maximum number of symbols that can be processed in the *FRAME LENGTH.*

The settings are performed in the *MEAS RESULT* submenu.

Submenu *CONFIGURATION MODE - VECTOR ANALYZER - MEAS RESULT*



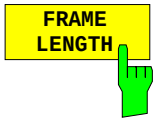
The *MEMORY SIZE* softkey calls up a table in which the number of samples saved in the capture buffer per measurement is determined. Within the memory size a burst, e.g. in the case of a TDMA signal, can be searched for (*FIND BURST* function).

Only the symbols entered under *FRAME LENGTH* are used for demodulation.

For symbol rates > 1 MHz the data are stored in the memory without prior filtering and reduction. The maximum memory size is therefore reduced to 4096 points.

IEC\IEEE-bus command

```
:[SENSe<1|2>:]TCAPture:LENGth 1024|2048|4096|8192|16384
```



The *FRAME LENGTH* softkey calls up a table in which the number of symbols to be demodulated or evaluated is defined.

With up to 4 points per symbol a maximum of 1600 symbols can be demodulated per measurement and their modulation parameters measured. With 8 points per symbol up to 800 symbols, and with 16 points per symbol up to 400 symbols can be handled.

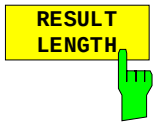
With symbol rates >1 MHz to ≤1.28 MHz a maximum of 600 symbols can be handled. This is due to the fact that the data are stored in the memory without prior reduction. The subsequent reduction limits the FRAME LENGTH in the specified frequency range.

The frame length markedly influences the time required for evaluating a measurement signal. It is therefore recommended to choose the frame length as short as possible. 400 symbols, for example, are sufficient for determining the phase error of a GSM burst as only 147 symbols are to be evaluated. The FSET automatically searches for the correct time domain by trigger functions *FIND BURST* and *FIND SYNC* .

The choice of the frame length influences the maximum number of points per symbol. With up to 400 symbols a maximum of 16 points, with >400 up to 800 symbols a maximum of 8 points and with >800 symbols a maximum of 4 points per symbol is possible.

With symbol rates >1MHz to ≤1.28 MHz, the maximum number of symbols is 600!

IEC\IEEE-bus command :[SENSe<1|2>:]DDEMod:SEARch:TIME 400

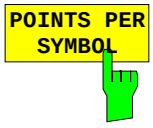


The *RESULT LENGTH* softkey opens a window for defining the number of symbols for display on the screen.

The maximum result length is identical to the frame length.

With the *FIND SYNC* function activated (synchronization to bit sequences in the signal), the maximum result length can be reduced (or the frame length increased).

IEC\IEEE-bus command `....:[SENSe<1|2>:]DDEMod:TIME 80`



The *POINTS PER SYMBOL* softkey opens a window for entering the number of points per symbol.

1, 2, 4, 8 and 16 points per symbol can be selected. With one point per symbol, each point in the display corresponds to a symbol sampled at the time of decision. With n points per symbol, each n-th value is a point of decision. With 1 and 2 points per symbol, the FSET demodulates with 4 points per symbol for reasons of accuracy. Only one or two samples are output, however.
For up to 4 points per symbol, a frame length of max. 1600 symbols is possible, with 8 points per symbol a frame length of max. 800 symbols and with 16 points per symbol of max. 400 symbols.

In the case of MSK demodulation, the number of points per symbol influences the result of the error measurement as all the points are considered in the calculation. With all other demodulators, only the values measured at the points of decision are taken into account. For GSM (DCS1800 and PCS1900) less than 4 points per symbol should not be used.

The number of points per symbol largely influences the measurement speed attained during the evaluation of the signal. If high measurement rates are to be attained for automatic tests, for example, a low number of points per symbol is recommended.

IEC\IEEE-bus command

```
:[SENSe<1|2>:]DDEMod:PRATe 1| 2| 4| 8| 16
```

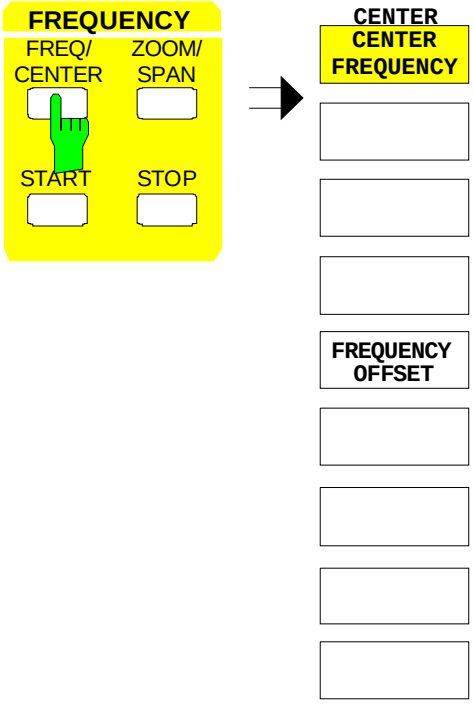
Frequency Settings- FREQUENCY Key Group

Setting the Frequency - CENTER Key

In vector signal analysis, FSET is always set to a fixed frequency. The RF signal is analyzed by converting the signal into the complex baseband.

The frequency of FSET is set in the same way as in the spectrum analysis mode, i.e. with the *CENTER* key in the *FREQUENCY* key group.

FREQUENCY CENTER menu

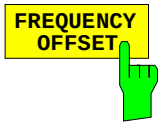


The *CENTER* key calls up the entry window for the center frequency .

For the demodulation of digitally modulated signals, the FSET frequency has to be accurately set to the frequency (carrier) of the signal to be measured so that synchronization to the carrier is possible. The required setting accuracy depends on the symbol rate and must not exceed 2% of the symbol rate.

IEC\IEEE-bus command

```
:[SENSe<1|2>:]FREQuency:CENTer 100MHz
```



The *FREQUENCY OFFSET* softkey activates the input of a frequency offset which can be added to the frequency-axis labeling. The displayed frequency is shifted by the frequency offset. The range of values for the offset is -100 GHz to +100 GHz.

IEC\IEEE-bus command `:[SENSe<1|2>:]FREQuency:OFFSet 1GHz`

Setting the Frequency Span - START, STOP, and SPAN Key

The *SPAN*, *START* and *STOP* keys are not assigned in vector signal analysis for the demodulation of digitally modulated signals since FSET is always set to a fixed frequency and the measurement results are displayed in the time domain. The analysis bandwidth by which the demodulation is performed is predefined by the symbol rate and the number of sampling points.

Setting the Level Display and Configuring the RF Input

Setting the Reference Level

With spectrum analysis (ANALYZER mode) of the FSET, the level applied to the RF input is always indicated on the display so that one can see the relationship between the setting of the reference level and the measurement results on the display.

With vector signal analysis, this only applies to operating mode *DIGITAL DEMODULATION*, *MAG CAP BUFFER* In operating mode *DIGITAL DEMODULATION* with activated demodulation , e.g. when the demodulated signal is displayed this relationship is not obvious. That is why a strict distinction has to be made between setting the **reference value** which is an important reference point for the measured-value display and the **reference level** relating to the RF input.

To obtain a maximum dynamic range it is important for the signal level at the A/D converter to be close to the maximum level of the converter. The maximum level of the converter corresponds to the reference level (*REF LEVEL*) in the spectrum analysis mode. This means that a signal whose amplitude attains the reference level in the spectrum analysis mode is ideal for the vector analyzer mode. An important factor is the **sum level** within the IF bandwidth (=*ANALOG BANDWIDTH* in vector signal analysis mode) of the analyzer.

The reference level can be manually set by checking the signal level in the spectrum analysis mode against the set frequency (at the same IF bandwidth!) and by operating the vector analyzer with the same setting.
The FSET can perform this in vector signal analysis but also by a single automatic setting of the reference level.

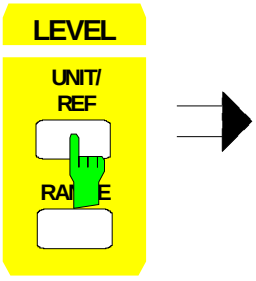
Certain settings of the spectrum analysis mode such as center frequency, reference level and attenuation are taken over by the vector signal analysis. Parameters that are not affected are span (in vector signal analysis, the frequency span has a different meaning: it corresponds to the analysis bandwidth and is thus independent in the two operating modes), resolution bandwidth, ref. level offset as well as trace and trigger settings

The **reference value** (*REF VALUE*) of the vector signal analysis is the reference point for scaling the measured value. Apart from *DIGITAL DEMODULATION-RESULT DISPLAY-MAGNITUDE CAP BUFFER* it is decoupled from the setting of the reference level, i.e. a direct relationship cannot be determined.

With the ***REF*** key, the **reference level** can be set like in the spectrum analysis mode.

The ***RANGE*** key calls up a menu comprising all the settings required for scaling the measured value such as auto scaling (*AUTO SCALE*), scaling (Y per Div), reference values in the X and Y direction (X/Y_REF VALUE) and the relative position of the reference value on the diagram (*REF VALUE POSITION*).

LEVEL REF Menu

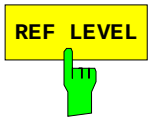


REF LEVEL
RF LEVEL OFFSET
RF ATTEN MANUAL
ATTEN AUTO NORMAL
ATTEN AUTO LOW NOISE
ATTEN AUTO LOW DIST
MIXER LEVEL

The REF key calls up the menu for setting the reference level and at the same time activates the level entry field.

Operation and softkey functions identical to analyzer mode:

ATTEN STEP 1dB/10dB
RF ATTEN MANUAL
ATTEN AUTO NORMAL
ATTEN AUTO LOW NOISE
ATTEN AUTO LOW DIST
MIXER LEVEL



The *REF LEVEL* softkey activates entry of the manual gain of the FSET. For a maximum dynamic range, it has to be ensured that the A/D converter is driven to its full range but not overdriven.

In the vector analyzer mode, this is indicated by the messages *IF OVLD* (overload) and *UNLD* (underrange) which inform on the dynamic range when measured data are read in.
When *IF OVLD* is displayed, the instrument or the A/D converter is overdriven during data read-in and entered data are invalid.
With *UNLD* displayed, the A/D converter is not sufficiently driven during data read-in (level <-6 dB of full range). Indicated values may have a reduced dynamic range, i.e. have a greater error.

For a correct level setting in the case of *IF OVLD*, reduce the REF LEVEL (continuous sweep mode) in sufficiently small steps (e.g. 2 dB) until the message disappears.
Proceed analogously for increasing the REF LEVEL when *UNLD* is displayed until the message disappears.
The maximum dynamic range is attained approx. 1 dB below the *OVLD* level.

The reference level can also be set to the test signal in the spectrum analysis mode at the same IF bandwidth as in the vector signal analysis mode (with *COUPLED: ANALOG BW AUTO* also 10 kHz) and vector signal analysis can then be selected again.

IEC\IEEE-bus command

```
:DISPlay[:WINDow<1|2>]:TRACe:Y:RLEVel -60dBm
```



The *REF LEVEL OFFSET* softkey activates the entry of a level offset.
It is added to the measured level, irrespective of the unit used. The scaling of the Y axis is changed accordingly.
This function is used to take into account the effect of an external attenuator on the displayed values.
The setting range is ± 200 dB in 0.1 dB steps.

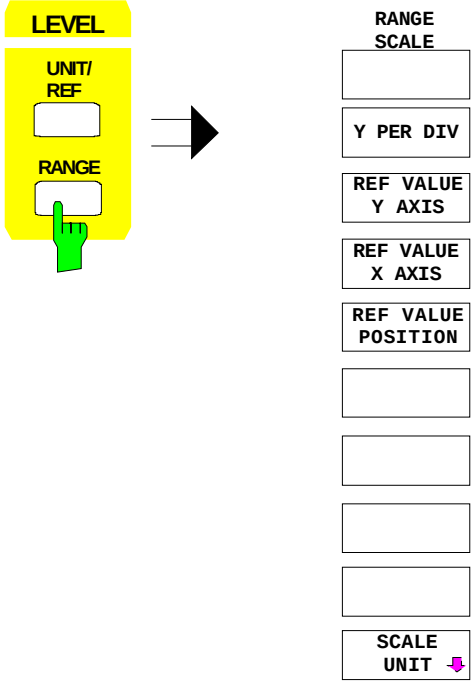
IEC\IEEE-bus command

```
:DISPlay[:WINDow<1|2>]:TRACe:Y:RLEVel:OFFSet -10dBm
```

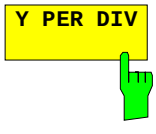
Setting the Display Range and Scaling - RANGE Key

The menu for setting the display range is different from that of the spectrum analysis mode.

LEVEL RANGE menu



The *RANGE* key calls up a menu comprising all the important display parameters such as reference value, scaling etc.



The *Y PER DIV* softkey calls for the entry of the vertical scaling in the current unit.

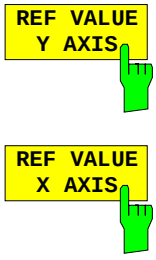
For vector or constellation diagrams, the corresponding X scaling is linked with Y scaling:

X PER DIV =5/4 *(Y PER DIV)

Reason: The diagram has 400 x 500 points. In case of a free X scaling circles would be reproduced as ellipses.

IEC/IEEE-bus command

```
:DISPlay[:WINDow<1|2>]:TRACe:Y:PDIVision 10DEG
```



The *REF VALUE Y AXIS* and *REF VALUE X AXIS* softkeys call for the entry of the reference value for the Y or X axis of the measurement diagram. The *REF VALUE X AXIS* softkey is only displayed if a polar diagram has been selected for the trace.

The reference value is entered in the corresponding unit of the diagram (See *UNIT*).

IEC/IEEE-bus command
```
:DISP[:WINDow<1|2>]:TRACe:Y:RVALue 1.2
:DISP[:WINDow<1|2>]:TRACe:X:RVALue 20SYM
```

Example 1: Constellation diagram: y reference value: +1.20; x reference value: - 0,35 (reference position: 50%)

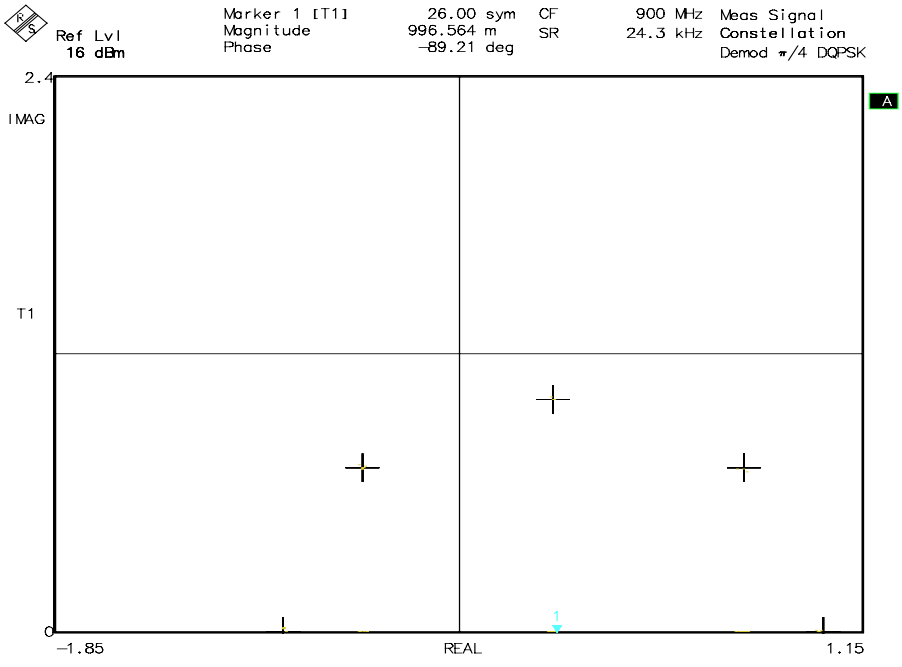


Fig. 4-29 Representation of the reference values in the constellation diagram

Example 2: Display of I and Q signals: Y reference value: -0.2 REF position: 50%

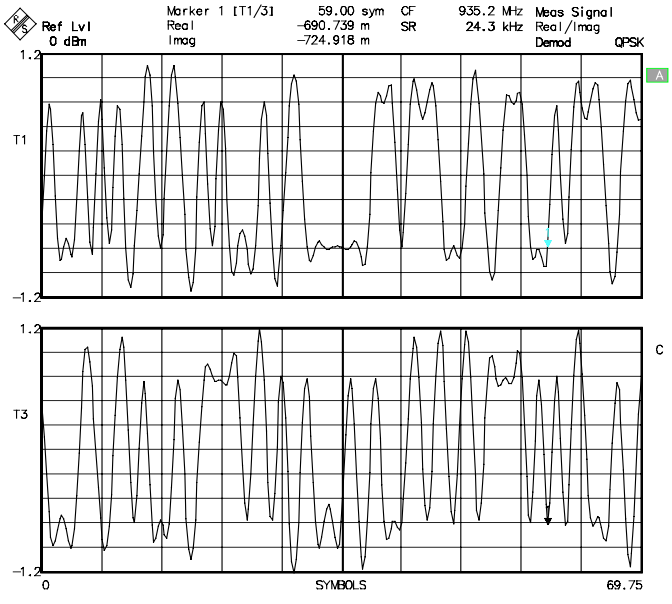
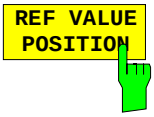


Fig. 4-30 Display of I and Q signals



The *REF VALUE POSITION* softkey opens a window for setting the reference positions diverging from the basic setting.

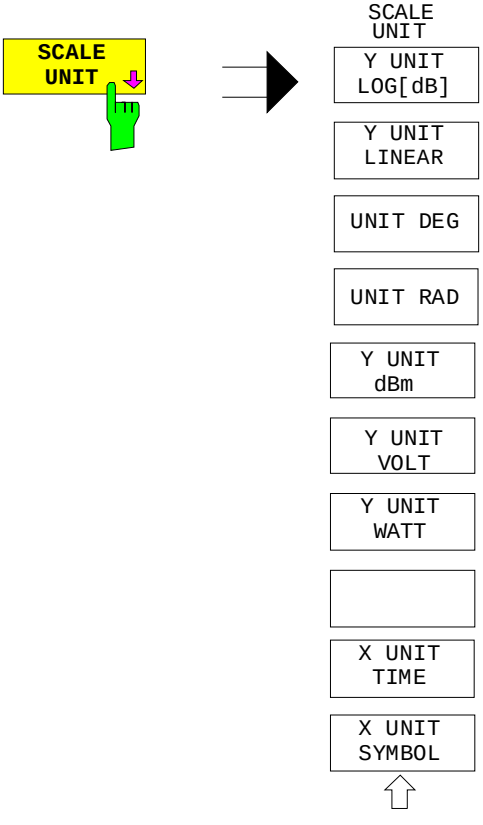
REF VALUE POSITION defines the position of the reference value. It normally lies at 100%, i.e. the maximum displayable Y value is also the reference value. It is best to use this setting for displaying the magnitude which is then the basic setting.

When, for example, the timing of I/Q signals or the phase spectrum is displayed it might be desirable to set the reference value to the center. The basic setting is thus 50% (also for polar diagrams).

IEC/IEEE-bus command

```
:DISPlay[:WINDow<1|2>]:TRACe:Y:RPOSition 50PCT
```

Submenu: *LEVEL RANGE*



The *SCALE UNIT* softkey calls up a submenu in which the unit of the Y axis and the X axis are set.

The units offered depend on the setting of *RESULT DISPLAY* and *MEAS RESULT*.

The logarithmic unit dB (*Y UNIT [dB]*) or dimensionless linear units (*Y UNIT LINEAR*) are permissible for the Y axis.

ERROR and *MAGNITUDE* are displayed in the following units:

Y UNIT LOG [dB]: dB

Y UNIT LINEAR : %.

Errors of *REAL/IMAG PART* are always displayed in %.

Phase errors are displayed in DEG or RAD, frequency errors in Hz.

Units which are not allowed in the current operating mode are disabled.

In polar diagrams, the units for the X-axis and Y-axis are equal. The softkeys *X UNIT...* are suppressed.

The time representation, the units time (*X UNIT TIME*) or symbols (*X UNIT SYMBOLS*) can be used for the X-axis. The softkey for the X-axis unit are only shown in time representation.

If a marker is active, the marker values are read out in the current scale units.

Only for MEAS RESULT: MAGNITUDE CAP BUFFER:

Possible display units: *YUNIT LOG [dB], YUNIT LINEAR, dBm , Volt* and *Watt.*

IEC/IEEE-bus command

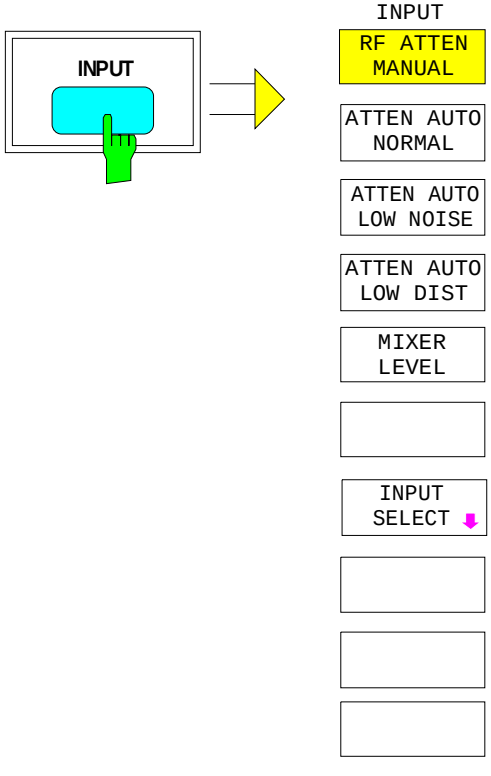
```
:CALCulate<1|2>:UNIT:POWer
   DB |UNITless |DEG |RAD |DBM
          |VOLT |WATT |S |SYMB
```

Table 4-5 Allocation table of selectable units or, in case of error display, of the displayed units in operating mode *DIGITAL DEMODULATION* depending on *RESULT DISPLAY* and *MEAS RESULT*

RESULT DISPLAY ---------- MEAS RESULT	MAGNITUDE CAP BUFFER	MAGNI-TUDE	PHASE	FREQUENCY [with FSK and MSK only]	REAL/ IMAG PART	EYE DIAG	POLAR [IQ] VECTOR	POLAR [IQ] CONSTELL
MEAS SIGNAL	Y_UNIT LINEAR Y-UNIT LOG[dB] dBm VOLT WATT	Y_UNIT LINEAR Y-UNIT LOG[dB]	DEG/RAD	Hz	Y_UNIT LINEAR	Y_UNIT LINEAR	Y_UNIT LINEAR	Y_UNIT LINEAR
REFERENCE SIGNAL	--	like MEAS SIGNAL	like MEAS SIGNAL	like MEAS SIGNAL	like MEAS SIGNAL	like MEAS SIGNAL	like MEAS SIGNAL	like MEAS SIGNAL
ERROR SIGNAL	--	[%] [dB]	PHASE DEG/RAD	Hz	--	-	-	-
VECTOR ERROR	--	[%] [dB]	DEG/ RAD	--	[%]	-	[%]	[%]

Configuration of RF Input in Vector Signal Analysis

This section is identical to that of the spectrum analysis mode.



Note: *The operating mode recommended for the vector analyzer input is ATTEN AUTO NORMAL. If ATTEN AUTO LOW NOISE is set (or for MIXER LEVEL ≥ –30 dB), the higher signal modulation occuring within the IF-bandwidth causes a nonlinear behavior in the IF branch. This leads to increased measurement errors, in particular for modulation types with a non-constant level (e.g. PSK).*

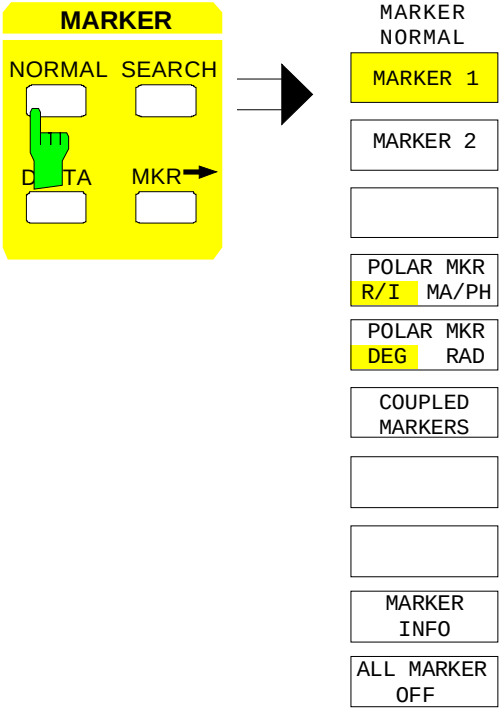
MARKER Key Group

In the vector analyzer mode markers may be used for highlighting points in a trace and for reading out measured values.
For detailed information see section 'Marker Function' in chapter 'Analyzer Mode'.
In the vector analyzer mode marker softkey functions depend on the selected measurement.

Main Marker - *NORMAL* Key

The main markers and their functions are selected with the *NORMAL* key.

MARKER NORMAL menu



The *NORMAL* key calls up a menu comprising all standard marker functions.

Activated marker functions are indicated by a dark background of the softkeys. If no marker is activated when the *NORMAL* key is pressed, MARKER 1 is activated as a reference and set to the maximum value in the curve. (automatic switch-on of peak search function provided at least one trace is active; not with polar diagram). In all other cases the reference marker is activated but no automatic peak search is performed.

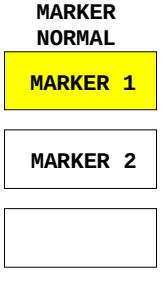
In the marker field the marker position (time), the measured value or values (in the case of a complex display) and the trace relevant for the marker (here [T1]) are displayed.

Example:
Marker display in the digital demodulation and I/Q display mode:

```
Marker 1 [T1/3] 22.3 µs
Real            0.998
Imag           -0.124
```

When the symbol table is displayed (softkey *SYMB TABLE/ERRORS* in submenu *MEAS RESULT*) the marker moves from symbol to symbol in the table. The position of the marker is indicated by a dark background and its numerical value in inverse video.

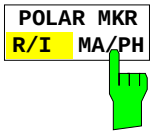
In the marker field, the marker position and the decimal value of the symbol are displayed.



The *MARKER 1* and *MARKER 2* softkeys switch the respective marker on or off or define it as an entry marker (reference marker).

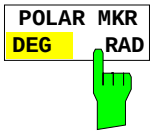
IEC/IEEE-bus command

```
:CALCulate<1|2>:MARKer<1|2>  ON | OFF;
:CALCulate<1|2>:MARKer<1|2>:X 22.3us;
:CALCulate<1|2>:MARKer<1|2>:Y?
```



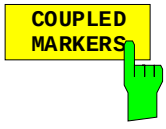
The *POLAR MARKER R/I / MA/PH* softkey selects magnitude and phase (*MA/PH*) or real and imaginary part (*R/I*) for the numeric result display in the polar diagram.
When measured values are indicated versus time this softkey is disabled.

IEC/IEEE-bus command
```
:CALCulate<1|2>:MARKer<1|2>:READ MPHase | RIMaginary
```



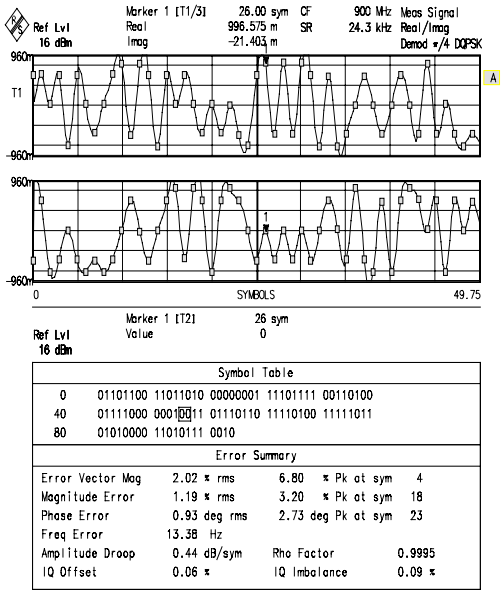
The *POLAR MARKER DEG/RAD* softkey selects the unit degree (*DEG*) or radiant (*RAD*) for indication of the phase of the marker in the respective diagram.

IEC/IEEE-bus command
```
:CALCulate<1|2>:UNIT:ANGLe  DEG | RAD
```

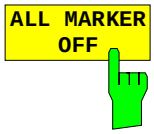


The *COUPLED MARKER* softkey couples markers (and delta markers) of different traces in the combined display mode *REAL/IMAG PAR*. In this case the X position of corresponding markers is identical.
This allows complex marker values to be displayed which correspond to the polar display.

Marker 1 6.75 SYM [T1/3]
RE 0.895
IM 1.002
If several windows are displayed, the markers of **all** windows are coupled when the *COUPLED MARKERS* function is active.

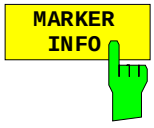


IEC/IEEE-bus command
```
:CALCulate<1|2>:MARKer<1|2>:COUPled ON|OFF
```



The *ALL MARKER OFF* softkey switches all markers including reference and delta markers off and closes the marker entry window. In addition the *MARKER INFO* softkey is switched off.

IEC/IEEE-bus command `:CALCulate<1|2>:MARKer<1|2>:AOFF`



The *MARKER INFO* softkey allows several markers to be displayed in the grid, in addition to the display of marker information in the marker field of the diagram headline.
In the top right-hand corner of the grid the two markers or delta markers are displayed with symbols ∇/Δ, marker number (1, 2), position and measured value (may be complex). The number of symbols for specifying the marker position is limited in certain cases.

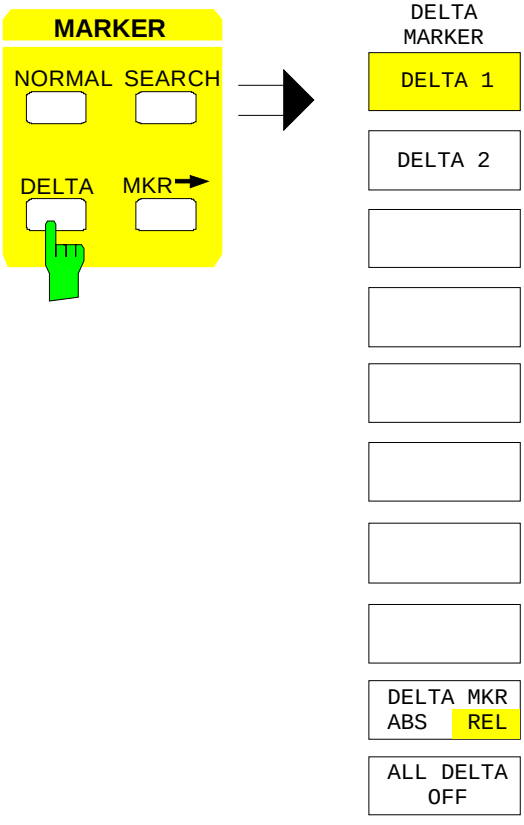
If there are not enough lines for displaying all active markers and delta markers, the markers are listed first and then the delta markers.

In the *SPLIT SCREEN* display this list is divided into two lists, one for *SCREEN A* and one for *SCREEN B*.

IEC/IEEE-bus command `:DISPlay:WINDow<1|2>:MINFo ON | OFF`

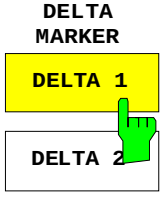
Delta Marker - DELTA Key

MARKER DELTA menu



The *DELTA* key in the MARKER key group selects the delta markers.

Delta markers are always referenced to the active reference marker . When no marker is active, switching on a delta marker automatically activates marker 1. Delta markers are displayed as an unfilled symbol ▽. When the delta marker is active for entry, a filled symbol ▼ is displayed.



The *DELTA 1* and *DELTA 2* softkeys switch on delta markers 1 and 2.

Operation of delta markers is identical to that of markers. When a delta marker is switched on, all entries apply to the delta marker. For changing the position of the main marker, the main marker has to be reactivated. Displayed differences normally apply to the active reference marker.

In the delta marker field, the number of the delta marker, the time difference to the reference marker and the difference of measured values between the active delta marker and reference marker are displayed.

IEC/IEEE-bus commands

```
:CALCulate<1|2>:DELTamarker<1|2>[:STATe]  ON | OFF
:CALCulate<1|2>:DELTamarker<1|2>:X 14us
:CALCulate<1|2>:DELTamarker<1|2>:Y?
```



The *DELTA ABS / REL* softkey switches between absolute (*ABS*) and relative (*REL*) input of time of the delta marker.

Default setting is *REL* (input relative to the reference marker)

IEC/IEEE-bus command

```
:CALCulate<1|2>:DELT<1|2>:MODE  ABS | REL
```



The *ALL DELTA OFF* softkey switches off all active delta markers and any associated functions.

IEC/IEEE-bus command

```
:CALCulate<1|2>:DELTamarker<1|2>:AOFF
```

Search Functions (Marker Search menu) - SEARCH Key

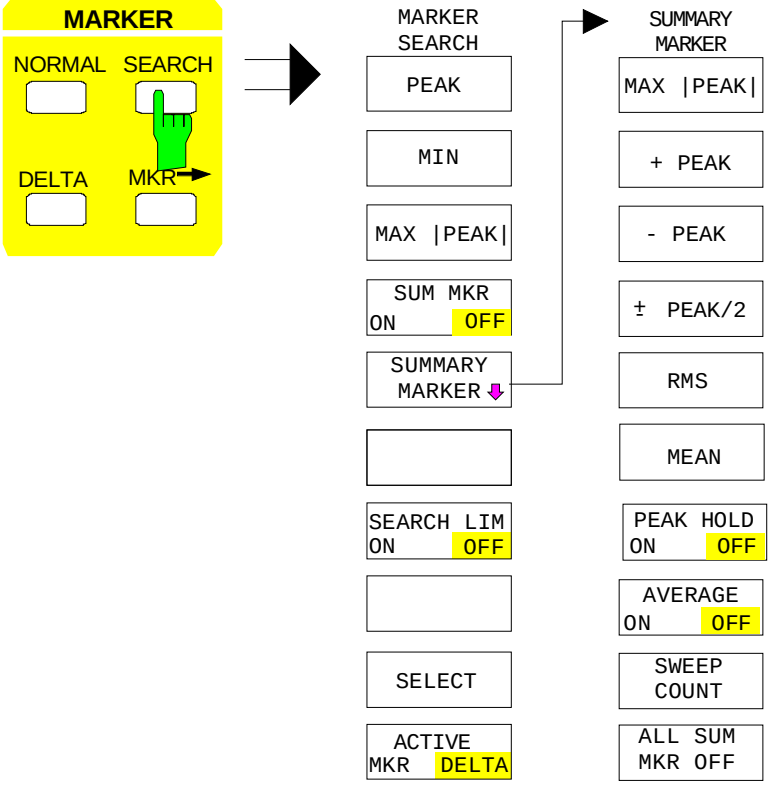
The menus called up with *SEARCH* offer functions for a peak/min search and universal marker functions for overall evaluation of traces. The search functions can be used for markers and delta markers.

Important: With polar diagrams, peak/min. peak values refer to the vector length (with origin as reference), in all other cases to the Y deflection. In this diagram, summary markers cannot be switched on or are not displayed.

Functions in the *MARKER SEARCH* menu refer to the marker or delta marker active during entry. Switchover between the active marker and delta marker is possible with the *ACTIVE MKR DELTA* softkey.
If no marker is switched on when the *SEARCH* key is pressed, marker 1 is activated as reference marker (by means of peak search).

The search range can be limited by time lines (*TIME LINE 1/2*) switched on with *SEARCH LIM ON/OFF*. The limitation of the search range is valid for all the marker search functions including the SUMMARY MARKERS and for error calculation during *SYMB TABLE/ERRORS*.
The time lines are only visible for diagrams versus time, i.e. not for polar diagrams and for diagrams of *SYMB TABLE/ERRORS*. The limitation of the search range is valid for *SEARCH LIMITS ON* for all diagrams irrespective of whether the time lines are visible or not.

MARKER SEARCH menu



The search range can be limited by the time lines (TIME LINE 1/2) (softkey *SEARCH LIM ON/OFF)*. The limitation of the search range extends to all marker search functions including the *SUMMARY MARKER* as well as to error calculation during *SYMB TABLE/ERRORS*.

The time lines are only visible for diagrams versus time, ie not for polar diagrams and for diagrams representing *SYMB TABLE/ERRORS* . The limitation of the search range during *SEARCH LIM ON* extends to all types of representation, irrespective of whether the time lines are visible or not.
The functions in the *MARKER SEARCH* menu refer to the marker or delta marker that is currently active for entries. Softkey *ACTIVE MKR DELTA* may be used to switch between the active marker and the active delta marker. If no marker is switched on before *SEARCH* is pressed, marker 1 will be activated as reference marker (with peak search).

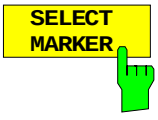


The *ACTIVE MKR / DELTA* softkey switches over between active marker and active delta marker.

With *DELTA* highlighted, subsequent search functions are carried out with the active delta marker.

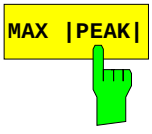
Note: *Switchover between marker and delta marker entry is also possible with the NORMAL and DELTA keys.*

IEC/IEEE-bus command --



The *SELECT MARKER* softkey opens the table for selection of the marker or delta marker.

IEC/IEEE-bus command --

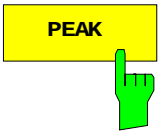


The *MAX* |*PEAK*| softkey sets the active marker or delta marker to the highest magnitude displayed (*PEAK* or *MIN*) in the associated curve.

For instance, the function searches for the maximum phase error of a signal, which may be positive or negative.

IEC/IEEE-bus commands

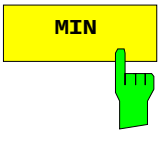
```
:CALCulate<1|2>:MARKer<1|2>:MAX:APEak
:CALCulate<1|2>:DELTamarker<1|2>:MAX:APEak
```



The *PEAK* softkey sets the active marker or delta marker to the highest value displayed in the associated measured curve.

IEC/IEEE-bus commands

```
:CALCulate<1|2>:MARKer<1|2>:MAX
:CALCulate<1|2>:DELTamarker<1|2>:MAX
```



The *MIN* softkey sets the reference marker to the lowest value in the associated curve.

IEC/IEEE-bus commands

```
:CALCulate<1|2>:MARKer<1|2>:MIN
:CALCulate<1|2>:DELTamarker<1|2>:MIN
```



The *SEARCH LIMIT ON/OFF* switches between limited (ON) and unlimited (OFF) search range.
The search range can be limited by time lines (*TIME LINE1/2)* for peak- and min-search functions as well as for the summary markers.

If *SEARCH LIMIT* is *ON*, a search for the corresponding signals is only performed between the two lines.

If only one line is switched on, *TIME LINE 1* is valid as lower limit (the upper limit is the stop frequency), *TIME LINE 2* defines the upper limit value.

If no line is active, lines 1 and 2 are switched on automatically and positioned to 20 % and 80 % of the grid.

If the function is switched off, the lines continue to be switched on.

Time lines are not visible for polar diagrams and for Symb Table/Errors. The limitation of the search range, however, remains effective.

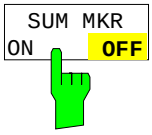
Default value is *SEARCH LIMIT OFF.*

IEC/IEEE-bus command

```
:CALCulate<1|2>:MARKer<1|2>:X:SLIMits ON|OFF
```

The Summary Marker

MARKER SEARCH menu



The *SUM MKR* softkey switches the display of the summary marker values in the marker info field on and off. The measured values are updated after every sweep end (in case of AVG/*HOLD OFF)*.

If one trace is in *AVERAGE*, *MAX HOLD* or *MIN HOLD* mode, the summary markers for this trace cannot be switched on.

On the other hand, the summary markers are switched off if the trace functions *AVERAGE*, *MAX HOLD* or *MIN HOLD* are activated (only valid for the same trace).

The maximum and average values can be maintained or displayed for all summary markers by means of function *HOLD ON/OFF* or *AVERAGE ON/OFF* if Sweep Count >0.

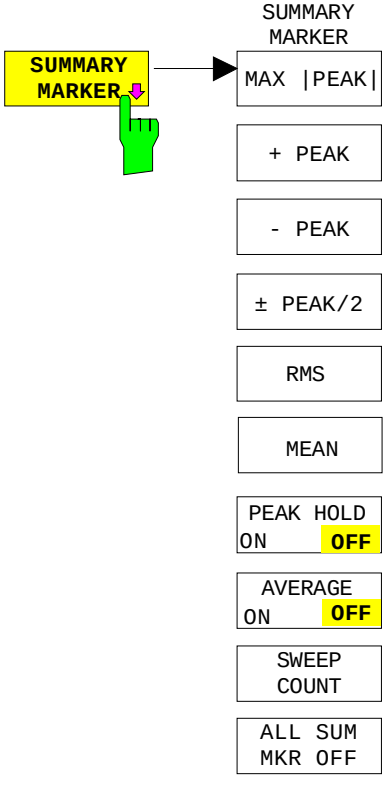
Example:
Marker info field for :
Summary Marker: + *PEAK* and *MEAN* switched on, *PEAK HOLD ON* and *AVERAGE ON*:

```
▼1                63. sym
  MAGN CAP      2.40 Watt
 +PEAK HOLD     2.55 Watt
 +PEAK AV       2.39 Watt
  MEAN HOLD     2.33 Watt
  MEAN AV       2.29 Watt
```

The measurement range can be restricted by means of the function *SEARCH LIMITS ON* and the time lines (*TIME LINE 1,2*).

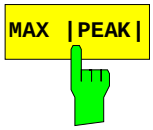
IEC/IEEE-bus command

```
:CALCulate<1|2>:MARKer<1|2>:FUNCtion:SUMMary ON|OFF
```



The *SUMMARY MARKER* softkey calls up the submenu for selecting the summary marker values to be displayed in the marker info field.

The measured values are updated for every sweep.
(In case of setting *SYMB TABLE/ERRORS* the marker info field is not displayed).



The *MAX |PEAK|* softkey selects the measurement of the magnitude of the higher of the two peaks *+PEAK* and *-PEAK* per sweep.

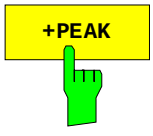
The search range can be limited by means of function *SEARCH LIMITS ON*.

With the *PEAK HOLD* function activated, the highest peak value that has occurred since the activation of *PEAK HOLD* is displayed.

With the *AVERAGE* function activated, the highest peak values are averaged and displayed.

IEC/IEEE-bus commands

```
:CALCulate<1|2>:MARKer<1|2>:FUNC:SUMM:MAX ON|OFF
:CALCulate<1|2>:MARKer<1|2>:FUNC:SUMM:MAX:RES?
:CALCulate<1|2>:MARKer<1|2>:FUNC:SUMM:MAX:AVER:RES?
:CALCulate<1|2>:MARKer<1|2>:FUNC:SUMM:MAX:PHOL:RES?
```



The *+PEAK* softkey selects the measurement of the positive peak value per sweep.

The search range can be limited with the function *SEARCH LIMITS ON*.

With the PK Hold function activated, the highest positive peak value that has occurred since the activation of *PEAK HOLD* is displayed.

With the AVERAGE function activated, the positive peak values are averaged and displayed.

IEC/IEEE-bus commands

```
:CALCulate<1|2>:MARKer<1|2>:FUNC:SUMM:PPEak ON|OFF
:CALCulate<1|2>:MARKer<1|2>:FUNC:SUMM:PPEak:RES?
:CALCulate<1|2>:MARKer<1|2>:FUNC:SUMM:PPEak:AVER:RES?
:CALCulate<1|2>:MARKer<1|2>:FUNC:SUMM:PPEak:PHOL:RES?
```



The *-PEAK* softkey selects the measurement of the negative peak value per sweep.

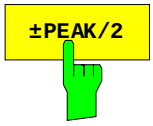
The search range can be limited with the function *SEARCH LIMITS ON*.

With the peak hold function switched on, the highest negative peak value that has occurred since the activation of *PEAK HOLD* is displayed.

With the *AVERAGE* function switched on, the highest negative peaks are averaged and displayed.

IEC/IEEE-bus commands

```
:CALCulate<1|2>:MARKer<1|2>:FUNC:SUMM:MPEak ON|OFF
:CALCulate<1|2>:MARKer<1|2>:FUNC:SUMM:MPEak:RES?
:CALCulate<1|2>:MARKer<1|2>:FUNC:SUMM:MPEak:AVER:RES?
:CALCulate<1|2>:MARKer<1|2>:FUNC:SUMM:MPEak:PHOL:RES?
```



The *±PEAK* softkey selects the measurement of the average value of the positive and negative peak value per sweep.

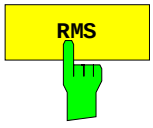
The search range can be limited with the *SEARCH LIMITS ON* function.

With the peak hold function switched on, the highest average value that has occurred since the activation of *PEAK HOLD* is displayed.

With the AVERAGE function switched on, the average values of the positive and negative peak value (versus time) are averaged and displayed.

IEC/IEEE-bus commands

```
:CALCulate<1|2>:MARKer<1|2>:FUNC:SUMM:MIDD ON|OFF
:CALCulate<1|2>:MARKer<1|2>:FUNC:SUMM:MIDD:RES?
:CALCulate<1|2>:MARKer<1|2>:FUNC:SUMM:MIDD:AVER:RES?
:CALCulate<1|2>:MARKer<1|2>:FUNC:SUMM:MIDD:PHOL:RES?
```



The *RMS* softkey selects the measurement of the rms value of the signal per sweep.

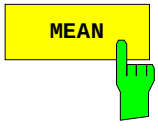
The search range can be limited with the *SEARCH LIMITS ON* function.

With the peak hold function switched on, the highest rms value that has occurred since the activation of the *PEAK HOLD* function is displayed.

With the *AVERAGE* function switched on, the rms values are averaged versus time and displayed.

IEC/IEEE-bus commands

```
:CALCulate<1|2>:MARKer<1|2>:FUNC:SUMM:RMS ON|OFF
:CALCulate<1|2>:MARKer<1|2>:FUNC:SUMM:RMS:RES?
:CALCulate<1|2>:MARKer<1|2>:FUNC:SUMM:RMS:AVER:RES?
:CALCulate<1|2>:MARKer<1|2>:FUNC:SUMM:RMS:PHOL:RES?
```



The MEAN softkey selects the measurement of the average value of the signal per sweep. Thus, the average carrier power can be measured during a GSM burst (during display of *MAGNITUDE CAP BUFFER*).

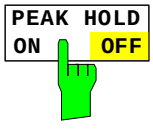
The search range can be limited with the *SEARCH LIMITS ON* function.

With the peak hold function switched on, the highest average value that has occurred since the activation of *PEAK HOLD* is displayed.

With the *AVERAGE* function switched on, the average values (of a trace) are averaged versus time and displayed.

IEC/IEEE-bus commands

```
:CALCulate<1|2>:MARKer<1|2>:FUNC:SUMM:MEAN ON|OFF
:CALCulate<1|2>:MARKer<1|2>:FUNC:SUMM:MEAN:RES?
:CALCulate<1|2>:MARKer<1|2>:FUNC:SUMM:MEAN:AVER:RES?
:CALCulate<1|2>:MARKer<1|2>:FUNC:SUMM:MEAN:PHOL:RES?
```



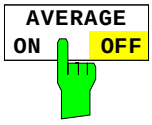
The *PEAK HOLD ON / OFF* softkey switches the peak hold function of the summary markers on or off.

All active summary markers are only updated after every sweep end if higher values have occurred.

The measured values can be reset by switching the *PEAK HOLD ON / OFF* softkey off and on again.

IEC/IEEE-bus command

```
:CALCulate<1|2>:MARKer<1|2>:FUNC:SUMM:PHOLd ON | OFF
```



The *AVERAGE ON / OFF* softkey switches the averaging of the summary markers on or off.

The measured values can be reset by switching the *AVERAGE HOLD ON / OFF* softkey off and on again.

IEC/IEEE-bus command
`:CALCulate<1|2>:MARKer<1|2>:FUNC:SUMM:AVER ON | OFF`



The *SWEEP COUNT* softkey activates the entry of the number of measurements (sweeps) in the *SINGLE SWEEP* mode.

The number of measurements can be selected between 0 and 32767.

If an averaging of measured values or the peak hold mode is set, *SWEEP COUNT* also determines the number of measurements required for averaging or maximum averaging.

SWEEP COUNT = 0	10 measured values are always required for a running averaging.
SWEEP COUNT = 1	no averaging is performed.
SWEEP COUNT > 1	averaging is performed over the set number of measured values.

In case of *CONTINOUS SWEEP* the FSET (*AVERAGE ON*) performs an averaging until the number of sweeps set under *SWEEP COUNT* is attained and then performs a running averaging.

Maximum averaging is infinite irrespective of *SWEEP COUNT*.

Note : *This setting is equivalent to the settings in the menus TRACE and* SWEEP-SWEEP.

IEC/IEEE-bus command `:[SENSe<1|2>:]SWEep:COUNt 10`

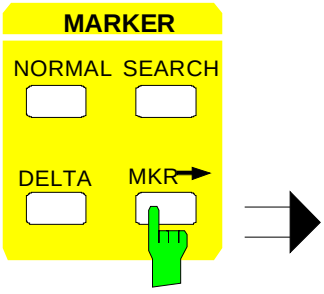


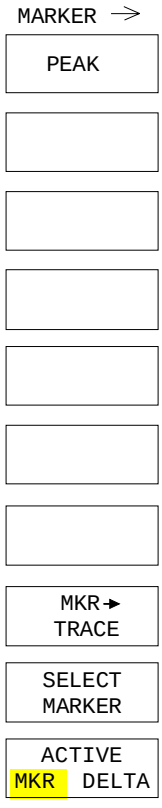
The *ALL SUM MKR OFF* softkey switches off the summary markers.

IEC/IEEE-bus command
`:CALCulate<1|2>:MARKer<1|2>:FUNC:SUMM:AOFF`

Varying Instrument Settings by means of Markers - MKR➔Key

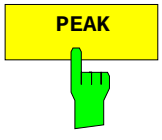
MARKER MKR➔ menu





The *MKR* -> key calls up a menu which offers functions for varying instrument parameters by means of the currently active marker. Same as in the *SEARCH* menu, the functions are also valid for the delta markers.

The selection of marker or delta marker depends on the currently active frequency entry for marker or delta marker. If no entry is active, the marker with the lowest number is activated as reference marker.



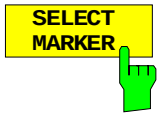
To simplify operation, the *PEAK* search function is also available in the *Marker→* menu.

IEC/IEEE-bus commands `:CALCulate<1|2>:MARKer<1|2>:MAX`
`:CALCulate<1|2>:DELT<1|2>:MAX`



The *MKR → TRACE* softkey opens a window in which the marker can be positioned on a new trace. Only selectable traces are displayed in the window.

IEC/IEEE-bus command `:CALCulate<1|2>:MARKer<1|2>:TRACe 3`



The *SELECT MARKER* softkey opens the table for selection of the marker or delta marker.



The *ACTIVE MKR / DELTA* softkey is used for switchover between active marker and delta marker.

With *DELTA* activated (highlighted), the following marker functions are carried out with the active delta marker.

Note: *Switchover between marker and delta marker entry is also possible by means of the NORMAL and DELTA keys.*

IEC/IEEE-bus command - -

Setup of Display and Limit Lines – *LINES* Key Field

Display Lines – *D LINES Key*

Display lines are aids which, similar to markers, make the evaluation of measurement curve data more convenient. The function of display lines is similar to that of a movable scale which can be used to measure absolute and differential values on measurement curves.
In addition, the display lines can also be used to limit the range of search for marker functions.

In vector analyzer mode, the FSET provides four different types of display lines:

- two horizontal threshold lines for marking measurement values or for defining measurement value search ranges – Display Line 1/2,
- two vertical time lines for marking times or for defining time search ranges – Time Line 1/2,
- a threshold line which, for example, sets the search threshold for maximum values (Peak Search) – Threshold Line
- a reference line – Reference Line

For purposes of clarity, each line is annotated on the right side of the display diagram by the following abbreviations:

D1	Display Line 1	D2	Display Line 2
T1	Time Line 1	T2	Time Line 2
TH	Threshold Line	REF	Reference Line

The lines for level, threshold and reference are displayed as continuous, horizontal lines over the full width of the diagram. They are movable in the y-direction.
The lines for time are displayed as vertical, continuous lines over the total height of the diagram. They are movable in the x-direction.

For measurement operations in two separate windows, (Split Screen-Modus), the display lines are available independently in both windows. In the currently active window, the display lines can be activated and/or shifted. Lines previously defined in the currently inactive window remain unchanged.

Note: *The softkeys for setting and switching the display lines on and off operate similar to a three-position switch:*
Initial condition: The line is switched off (softkey has grey background)

1st press: The line is switched on (softkey has red background) and data entry is activated. The position of the display line can be adjusted by using the roll-key, the step keys or through direct numerical inputs via the data-entry keypad. If some other arbitrary function is requested, the data-entry keypad is disabled. In this case, the display line remains switched on (softkey has green background).

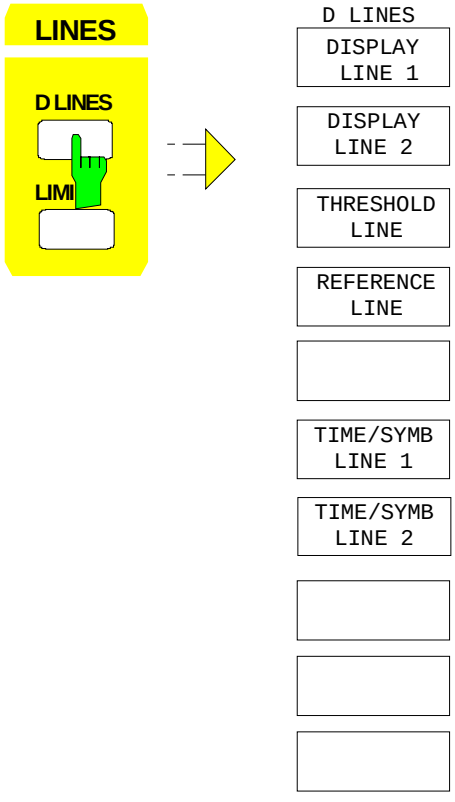
2nd press: The display line is switched off (softkey has grey background).

Initial condition: The line is switched on (softkey has green background)

1st press: The line is switched on (softkey has red background) and data entry is activated. The position of the display line can be adjusted by using the roll-key, the step keys or through direct numerical inputs via the data-entry keypad. If any other arbitrary function is requested, the data-entry keypad is disabled. In this case, the display line remains switched on (softkey has green background).

2nd press: The display line is switched off (softkey has grey background).

Menu *LINES-D-LINES*



DISPLAY LINE 1

The *DISPLAY LINE 1/2* softkeys switch the display lines on/off and activate the entry of the line location.
The display lines mark the selected levels in the measurement window.

IEC\IEEE-bus commands

```
:CALCulate<1|2>:DLINe<1|2>:STATe  ON | OFF;
:CALCulate<1|2>:DLINe<1|2> <num_value>
```

THRESHOLD LINE

The *THRESHOLD LINE* softkey switches the threshold line on/off and activates the entry of the line location.
The threshold line is a display line which defines a threshold value. This threshold value serves as a lower search limit for maximums/minimums in the marker functions (*MAX PEAK*, *MIN PEAK*, *NEXT PEAK* etc.).

IEC\IEEE-bus commands

```
:CALCulate<1|2>:THReshold ON | OFF;
:CALCulate<1|2>:THReshold <num_value>
```

REFERENCE LINE

The *REFERENCE LINE* softkey switches the reference line on/off and activates the entry of the line position.

IEC\IEEE-bus commands

```
:CALCulate<1|2>:RLINe:STATe ON | OFF;
:CALCulate<1|2>:RLINe <num_value>
```

TIME/SYMB LINE 1

The *TIME/SYMB LINE 1/2* softkeys switch the time lines 1/2 on/off and activate the entry of line locations.
The time lines mark the selected times or define the search range (see section "Marker Functions").

IEC\IEEE-bus commands

```
:CALCulate<1|2>:TLINe<1|2>:STATe ON | OFF;
:CALCulate<1|2>:TLINe<1|2> <num_value>
```

Limit Lines – *LIMITS Key*

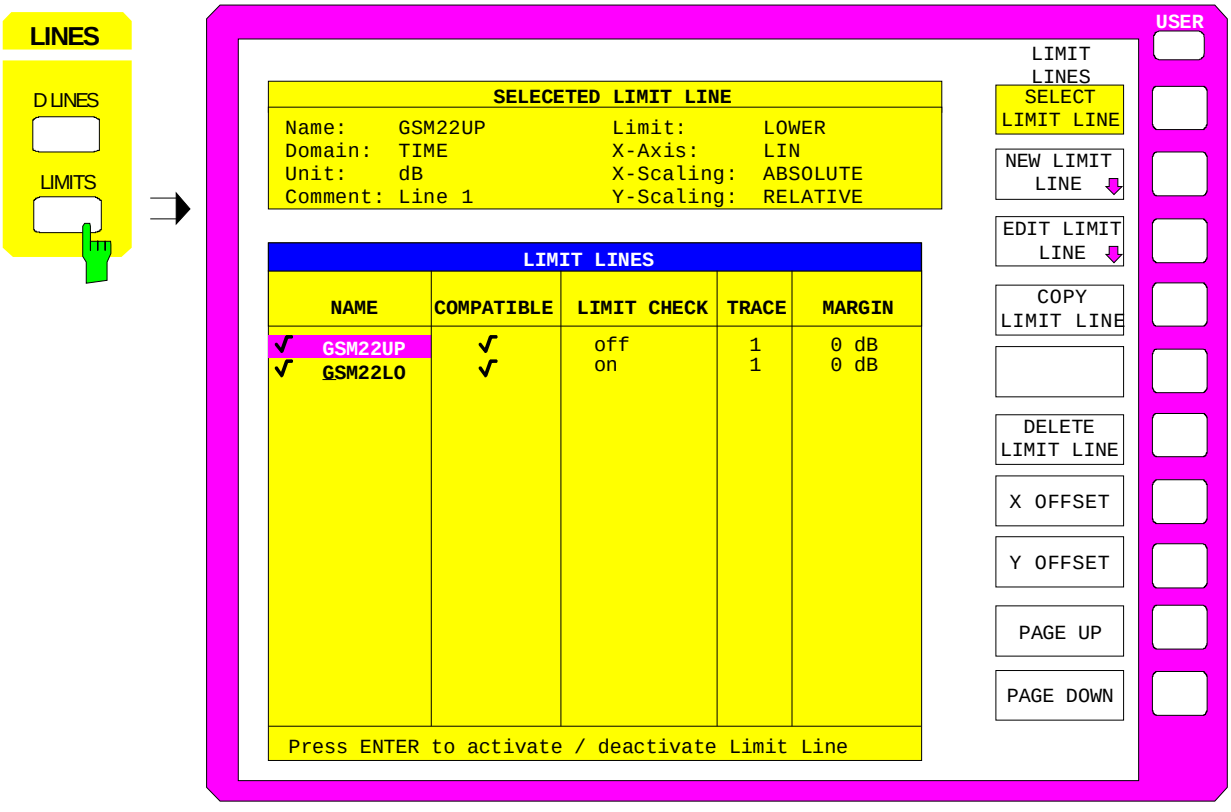
Limit lines are used to define amplitude curves or error boundaries on the display screen which are not to be exceeded. They indicate, for example, the upper limits for modulation errors which are permissible from a Unit Under Test (UUT). For transmission of information in TDMA (e.g. GSM), the amplitude 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 FSET supports up to 300 limit lines, each of which may have a maximum of 50 data points. For each limit line, the following characteristics must be defined:

- The name of the limit line. The limit line can be specified for time units or symbols. Time units can be entered as absolute time or time in relation to set reference time. Symbols can be entered as absolute symbols or symbols in relation to set reference symbol
- The reference of the interpolation points to the X-axis. The limit line may be specified either for absolute times or for times which are 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). If the reference line is switched on, it is used as reference when relative setting has been selected.
- The type of limit line (upper or lower limit). With this information and the active limit checking function (*LIMIT CHECK* softkey), the FSET checks for compliance with each limit.
- The limit line units to be used. The units of the limit line must be compatible with the vertical axis in the active measurement window.
- The measurement curve (trace) to which the limit line is assigned. For the FSET, 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.

In the *LINES LIMITS* menu, the compatible limit lines can be enabled in the *LIMIT LINES* table. The *SELECTED LIMIT LINE* display field provides information concerning the characteristics of the marked limit lines. New limit lines can be specified and edited in the *NEW LIMIT LINE and EDIT LIMIT LINE* sub-menus, respectively.

LINES LIMIT menu



Limit Line Selection

The *SELECTED LIMIT LINES* table provides information about the characteristics of the marked limit line :

Name	name
Domain	time domain (unit: seconds or symbols)
Unit	vertical unit
Comment	commentary
Limit	upper/lower limit
X-Axis	linear interpolation
X-Scaling	absolute or relative times
Y-Scaling	absolute or relative Y-units

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 columns contain the following information:

Name	Enable the limit line.
Compatible	Indicate whether 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. 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 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 trace assigned to a line is not switched on, the line is displayed in the window the trace would be displayed in.

Example:
In split screen mode, trace 2 is assigned measuring window B. A line assigned to trace 2 is always displayed in measurement window B.

If the scale of the Y-axis is 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

```
:CALCulate<1|2>:LIMit<1..8>:NAME <string>;
:CALCulate<1|2>:LIMit<1..8>:STATe ON | OFF
```

***Limit Check* - Activate automatic limit violation check**

When *LIMIT CHECK ON* is activated, a GO/NOGO test is performed. 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 2 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 `:CALCulate<1|2>:LIMit<1..8>:FAIL?`

***Trace* - Select the trace to which the limit line is assigned.**

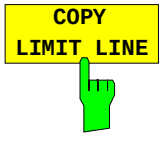
The selection of the measurement curve (trace) takes place in an entry window. Allowed are the integer entries 1, 2, 3 or 4. The default setting is trace 1. If the selected limit line is not compatible with the assigned measurement curve, then the limit line is disabled (display and limit check).

IEC\IEEE-bus command `:CALCulate<1|2>:LIMit<1..8>:TRACe 3`

***Margin* - Setting a margin.**

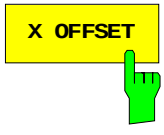
The margin is defined as the signal-level distance to the limit line. When the limit line is defined as an upper limit, the margin means that the level is below the limit line. When the limit line is defined as a lower limit, the margin means that the level is above the limit line. The default setting is 0 dB (i.e. no margin).

IEC\IEEE-bus commands
```
:CALCulate<1|2>:LIMit<1..8>:LOWer:MARGin <num_value>
:CALCulate<1|2>:LIMit<1..8>:UPPer:MARGin <num_value>
```



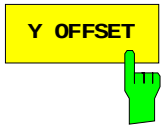
The *COPY LIMIT LINE* softkey copies the data file describing the marked limit line and saves it under a new name. In this way, a new limit line can be easily generated by parallel translation or editing of an existing limit line. The name can be arbitrarily chosen and input via an entry window (max. of 8 characters).

IEC\IEEE-bus command
```
:CALCulate<1|2>:LIMit<1..8>:COPY 1..8 | <name>
```



The *X OFFSET* softkey activates the entry of the value for horizontally shifting a limit line which has been specified for relative times (X-axis).

IEC\IEEE-bus command
```
:CALCulate<1|2>:LIMit<1..8>:CONTrol:OFFset <num_value>
```



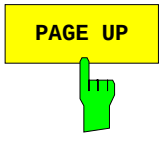
The *Y OFFSET* softkey activates the entry of the value for vertically shifting a limit line, which has relative values for the Y-axis (levels or linear units such as volt).

IEC\IEEE-bus commands
```
:CALCulate<1|2>:LIMit<1..8>:UPPer:OFFset <num_value>
:CALCulate<1|2>:LIMit<1..8>:LOWer:OFFset <num_value>
```

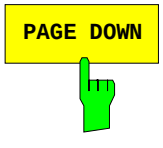


he *DELETE LIMIT LINE* softkey erases the selected limit line. Before deletion, a message appears requesting confirmation.

IEC\IEEE-bus command `:CALCulate<1|2>:LIMit<1..8>:DELete`



The *PAGE UP* softkey sets the limit line table to the next page.



The *PAGE DOWN* softkey sets the limit line table to the previous page.

Entry and Editing of Limit Lines

A limit line is characterized by

- its name
- the unit of the time data points
- the vertical unit
- linear interpolation
- the scaling in absolute or relative times
- the vertical scaling
- the definition of the limit line as either upper or lower limit.
- the data points for time and level or modulation measurement values.

At the time of entry, the FSET immediately checks that all limit lines are in accordance with certain guidelines. These guidelines must be observed if specified operation is to be guaranteed.

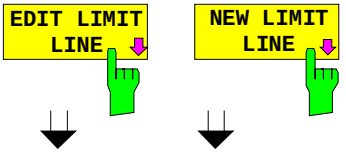
- The times for each data point must be entered in ascending order, however, for any single time, two data points may be input (vertical segment of a limit line).

  The data points are allocated in order of ascending time. Gaps are not allowed. If gaps are desired, two separate limit lines must be defined and then both enabled.

- The entered times must not necessarily be selectable in FSET. A limit line may also exceed the specified time domain and negative times may also be entered. The allowable range is -1000 s to +1000 s.

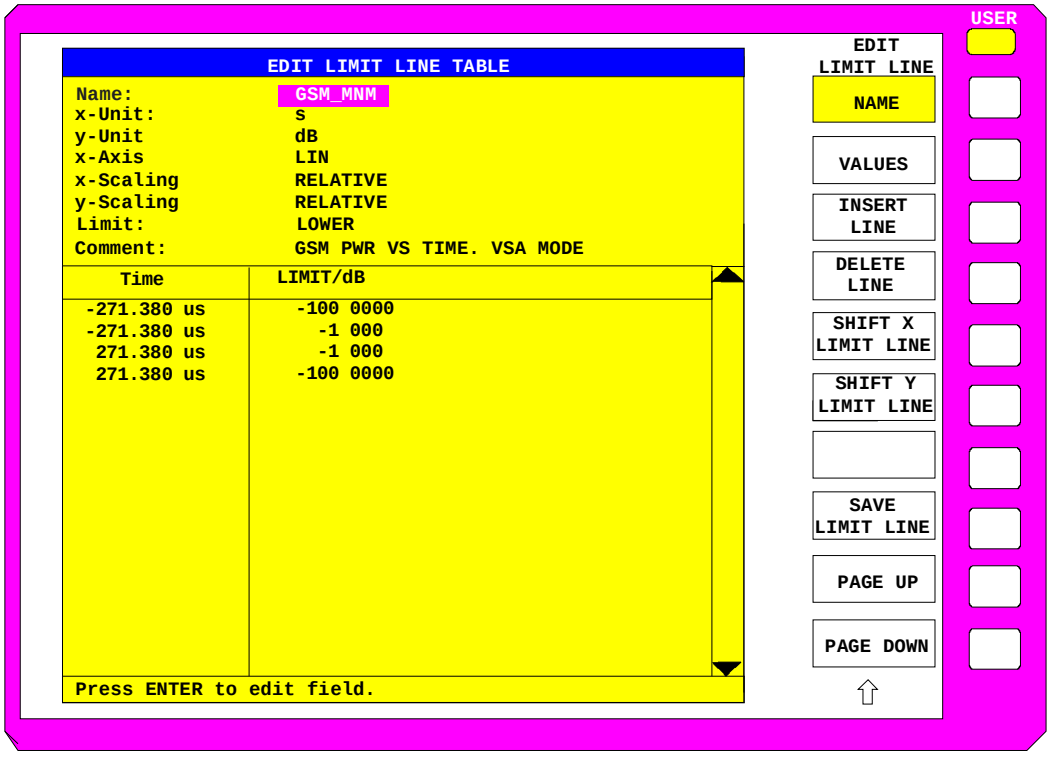
- The minimum/maximum value for a limit line is -200 dB to +200 dB for the logarithmic or 10^{-20} to 10^{+20} or-99.9% to + 999.9% for the linear amplitude scales.

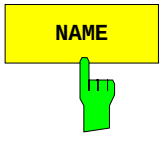
LINES LIMIT-EDIT LIMIT LINE menu



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 time and level values are entered in the columns.

Name	Enter name.
x-Unit	Selection of unit.
y-Unit	Selection of vertical unit.
X-Axis	Indication of interpolation
X-Scaling	Entry of absolute or relative values for the X-axis
Y-Scaling	Entry of absolute or relative values for the Y-axis
Limit	Select upper/lower limit.
Comment	Enter comments.
Time	Enter time for the data points.
Limit/dB(..)	Enter magnitudes for the data points.





The *NAME* softkey enables the entry of characteristics in the table heading.

***Name* - Enter name**

A maximum of 8 characters are 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

```
:CALCulate<1|2>:LIMit<1...8>:NAME <string>
```

***x-Unit* - Select the unit (TIME)**

Only time domain is available in vector analyzer mode. Possible units are s or Symb.

IEC\IEEE-bus command-

```
:CALCulate<1|2>:LIMit<1..8>:CONTrol:UNIT S|SYM
```

***y-Unit* - Select the vertical unit for the limit line (LIMIT)**

The selection of the unit is made in the selection box. The default setting is dBm.

IEC\IEEE-bus command

```
:CALCulate<1|2>:LIMit<1...8>:UNIT
   DB| DBM| RAD| DEG| PCT| HZ| S|
   VOLT| WATT| UNITless
```

***X-Axis* - Indication of interpolation**

Linear interpolation is carried out between the reference points of the table.

IEC\IEEE-bus commands

```
:CALCulate<1|2>:LIMit<1...8>:CONTrol:SPACing LIN
:CALCulate<1|2>:LIMit<1...8>:UPPer:SPACing LIN
:CALCulate<1|2>:LIMit<1...8>:LOWer:SPACing LIN
```

***Scaling* - Select absolute or relative scaling**

The limit line can either be scaled in absolute 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 times are interpreted as absolute physical units.
X-Scaling RELATIVE	In the data point table, the times are referred to the left boundary of the diagram.
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 units dB or % are always relative values.

The *RELATIVE* scaling is always suitable, if masks for bursts are to be defined.
An X-offset with half the sweep time may be entered in order to shift the mask into the center of screen.

IEC\IEEE-bus commands

```
:CALCulate<1|2>:LIMit<1...8>:CONTrol:MODE   REL | ABS
:CALCulate<1|2>:LIMit<1...8>:UPPer:MODE   REL | ABS
:CALCulate<1|2>:LIMit<1...8>:LOWer:MODE   REL | ABS
```

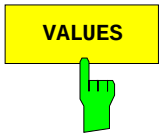
***Limit* - Select upper/lower limit**

A limit line can be defined as either an upper or lower limit.

***Comment* - Enter comments**

Comments are arbitrary, however, they must be less than 40 characters long.

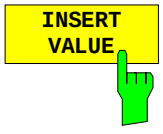
IEC\IEEE-bus command
`:CALCulate<1|2>:LIMit<1..8>:COMMent 'string'`



The *VALUES* softkey activates the entry of the data points in the table columns *Time* and *Limit/dB*..

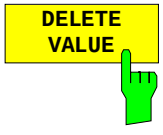
The desired time data points are entered in ascending order (two repeated time values are permitted).

IEC\IEEE-bus command
```
:CALCulate<1|2>:LIM<1..8>:CONT <num_value>,<num_value>,.
:CALCulate<1|2>:LIM<1..8>:UPP <num_value>,<num_value>,..
:CALCulate<1|2>:LIM<1..8>:LOW <num_value>,<num_value>,..
```



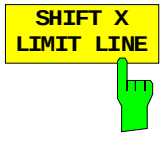
The *INSERT VALUE* softkey creates an empty line above the current cursor position where a new data point may be entered. However, during the entry of new values, it is necessary to observe an ascending order for time.

IEC\IEEE-bus command `--`



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 `--`

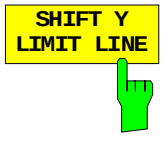


The *SHIFT X LIMIT LINE* softkey calls an entry window where the complete limit line may be shifted parallel in the horizontal direction.

The shift takes place according to the horizontal scale in 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
`:CALCulate<1|2>:LIMit<1...8>:CONTrol:SHIFt <num_value>`



The *SHIFT Y LIMIT LINE* softkey calls an entry window where the complete limit line may be shifted parallel in the vertical direction.

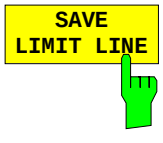
The shift takes place according to the vertical scale:

– 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
```
:CALCulate<1|2>:LIMit<1...8>:UPPer:SHIFt <num_value>
:CALCulate<1|2>:LIMit<1...8>:LOWer:SHIFt <num_value>
```



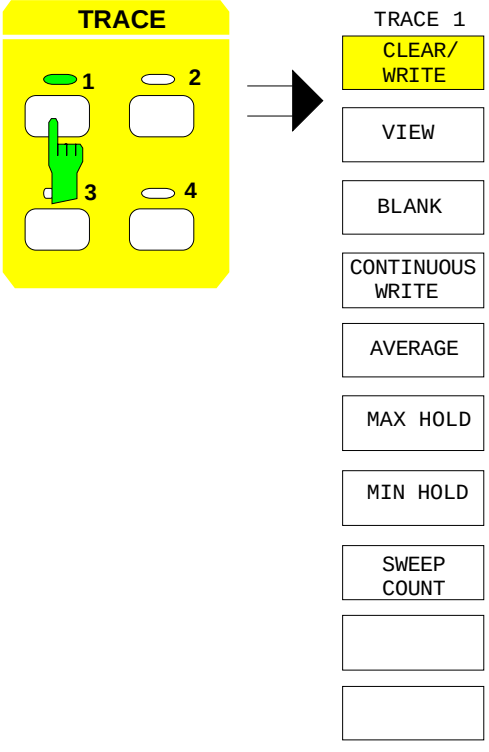
The *SAVE LIMIT LINE* softkey stores the currently edited limit line. The name can be entered in an input window (max. 8 characters)

IEC\IEEE-bus command `--`

Selection and Setting of Traces - TRACE Key Group

The function of keys TRACE 1 to 4 in vector signal analysis is largely identical with the function in *ANALYZER* mode as long as traces are displayed. If numeric values or tables (e.g. *SYMBOL TABLE*) are displayed, they are also linked with a trace (some of the trace functions are not available then).

Example: In diagram *SYMB TABLE / ERRORS* the symbol table refers to trace 1 and the error table to trace 2 (not for *SPLIT SCREEN*!) .



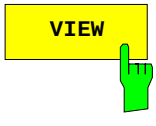
The TRACE keys 1 to 4 call up a menu in which the selected trace can be set.



The *CLEAR/WRITE* softkey displays a new trace for each measurement or outputs a measured value. Values from previous measurements are deleted.

IEC\IEEE-bus command

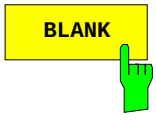
```
:DISPlay[:WINDow<1|2>]:TRACe<1..4>:MODE WRITe
```



The *VIEW* softkey freezes the current contents of the trace memory and displays them. If the device setting is changed, the displayed trace does not change. The measurement data are then invalid with reference to the current setting. This is shown by the enhancement label "*" at the right grid end.

IEC\IEEE-bus command

```
:DISPlay[:WINDow<1|2>]:TRACe<1..4>:MODE VIEW
```



The *BLANK* softkey blanks the trace or the measured values on the display. They are internally stored so that they can be displayed again with the aid of *VIEW*. The markers linked to a trace are also deleted with *BLANK*, but restored after reactivating the trace with *VIEW* or *CLEAR/ WRITE*.

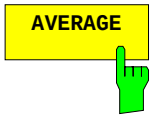
IEC\IEEE-bus command

```
:DISPlay[:WINDow<1|2>]:TRACe<1..4> ON | OFF
```



The *CONTINUOUS WRITE* softkey outputs measured values for each sweep or displays a trace without clearing the previous measurements.
This function can be useful for the display of the constellation or eye diagram, where test runs are required for in-depth information.

IEC\IEEE-bus command
`:DISPlay[:WINDow<1|2>]:TRACe<1..4>:MODE:CWRite ON|OFF`



The *AVERAGE* softkey switches the trace averaging on. The average value is derived from several sweeps.

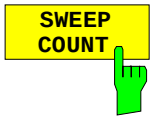
After switch-on of averaging, the first trace is written in the *CLEAR/WRITE mode*. Successive averaging is performed from the second sweep.
Averaging is restarted if the *AVERAGE* softkey is pressed. The trace memory is then deleted. This is also the case if the trace memory is set to *VIEW* or *BLANK* in the *AVERAGE* position.

If the *AVERAGE* function is active, the highest values are indicated for peak values (incl. AMPLITUDE DROOP) for the display of the error table. A square averaging is performed for RMS values. For all other displays a linear averaging is performed.

Switch-on of function *AVERAGE* on a trace where the summary markers are active results in a switch-off of summary markers.
On the other hand, summary markers cannot be activated on a trace if one of the *AVERAGE (or MAX HOLD or MIN HOLD)* functions is switched to this trace.

For description of average procedure see 'Traces - TRACE Key Group' in chapter 'Analyzer mode.

IEC\IEEE-bus command
`:DISPlay[:WINDow<1|2>]:TRACe<1..4>:MODE AVER`

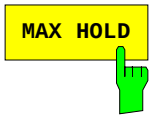


The SWEEP COUNT softkey activates the entry of the number of sweeps required to perform the averaging.
The permissible range of values for the Sweep Count is 0 to 32767. In case of 0, the FSET carries out a running averaging over 10 sweeps in the Average mode. No averaging is performed in case of 1.

The default setting is 10 sweeps (Sweep Count = 0). Programming of course influences the sweep duration. The number of sweeps required for averaging or the average time are identical for all 4 traces.

Note: *This sweep number setting in the trace menu is equivalent to that of the sweep menu. If both averaging and hold functions of the summary markers or trace averaging (or MAX HOLD or MIN HOLD) are active on different traces, the SWEEP COUNT counter simultaneously refers to summary markers and trace averaging.*

IEC\IEEE-bus command `:[SENSe<1|2>:]SWEep:COUNt 10`

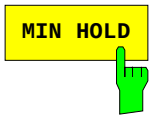


The *MAX HOLD* softkey activates peak-value averaging.
For every sweep run, the FSET identifies the highest value and compares it with the current value. The highest of the two values is then stored in the updated trace memory. Thus, the maximum value of a signal can be evaluated over several test runs.

The trace memory is deleted by pressing the *MAX HOLD* softkey again. Peak-value averaging is started again.

IEC\IEEE-bus command

```
:DISPlay[:WINDow<1|2>]:TRACe<1..4>:MODE MAXH
```



The *MIN HOLD* softkey activates minimum-value averaging. For every sweep run, the FSET identifies the smallest of the two values and compares it with the current value. The smallest of the two values is then stored in the updated trace memory. Thus, the minimum value of a signal can be evaluated over several test runs.

The trace memory is deleted by pressing the *MIN HOLD* softkey again. Minimum averaging is stared again.

IEC\IEEE-bus command

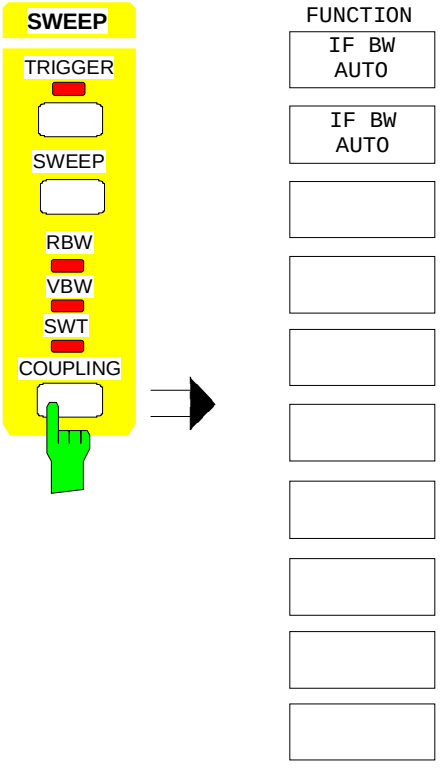
```
:DISPlay[:WINDow<1|2>]:TRACe<1..4>:MODE MINH
```

SWEEP Key Group

Setting the Analog Bandwidth - *COUPLING* Key

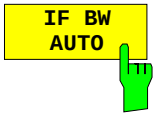
In the vector analysis mode, bandwidth limiting is not at the IF but in the baseband by means of digital filtering. The analog IF filters only serve for attenuating far off signals. The IF filters are set more broadly as required by the signal to be measured in order to increase the measurement accuracy. Thus, the measurement signal is less distorted by the amplitude and phase response of the IF filtering.

SWEEP COUPLING menu



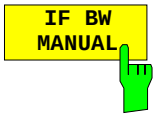
The *COUPLING* key calls up the menu for setting the analog bandwidth.

The *MAIN PLL BANDWIDTH* softkey in the side menu is without function in vector analyzer mode.



The *IF BW AUTO,* the FSET automatically sets the resolution bandwidth to the maximum 10-MHz bandwidth for digitally modulated signals.

IEC\IEEE-bus command `:[SENSe<1|2>:]BWIDth:AUTO ON | OFF`



The *IF BW MANUAL* softkey opens a window for entering the bandwidth for the analog prefiltering.

With *IF BW MANUAL,* the FSET can be manually set. When the demodulators are used for digitally modulated signals, the minimum analog bandwidth corresponds to the set symbol rate. Since modulation errors increase when narrow analog bandwidths are selected because of the amplitude and phase distortions, UNCAL is displayed for analog bandwidths below 10 times the symbol rate.

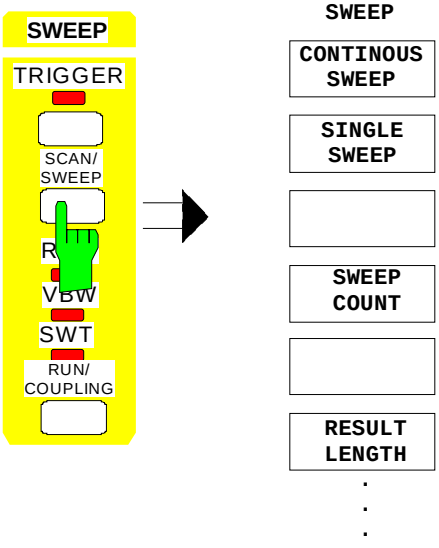
Bandwidths below 1 kHz cannot be set as the smallest bandwidth implemented by analog filtering is 1 kHz. When a smaller bandwidth than permitted is set, the FSET signals:

RBW out of range

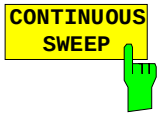
IEC\IEEE-bus command `:SENSe<1|2>:]BWIDth <num_value>`

Sweep Setup - SWEEP Key

Menu SWEEP SWEEP

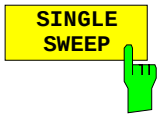


The *SWEEP* key calls up a menu in which the type of measurement - single or continuous measurement - and the measurement result length to be displayed in time or symbols are defined.



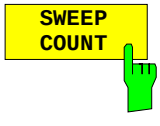
The *CONTINUOUS SWEEP* softkey starts a continuous measurement after defining the trigger condition and selected measurement settings. Following triggering, the measured values will be collected and then evaluated and displayed.
If, for split screen display, measurements in both windows are in the vector analysis mode, data in the measurement RAM are used for the two evaluations.

IEC\IEEE-bus command
```
:INITiate<1|2>:CONTinuous ON;
:INITiate
```



The *SINGLE SWEEP* softkey starts n measurements with the given trigger settings. The number of sweeps n is determined with *SWEEP COUNT*. The measurement is stopped after n measurements. It can be restarted by pressing *SINGLE SWEEP* again or by *CONTINUOUS SWEEP*.

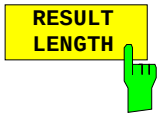
IEC\IEEE-bus command
```
:INITiate<1|2>:CONTinuous OFF;
:INITiate
```



The *SWEEP COUNT* softkey opens a window for entering the number of measurements for the single sweep
The number of measurements can be selected between 0 and 32767.
With averaging of measured values set, SWEEP COUNT also determines the number of measurements required for averaging.

SWEEP COUNT = 0	10 measurements are used for a running averaging.
SWEEP COUNT = 1	no averaging is performed.
SWEEP COUNT >1	averaging is performed for the set number of measurements.

IEC\IEEE-bus command
```
:[SENSe<1|2>:]SWEep:COUNt 10
```



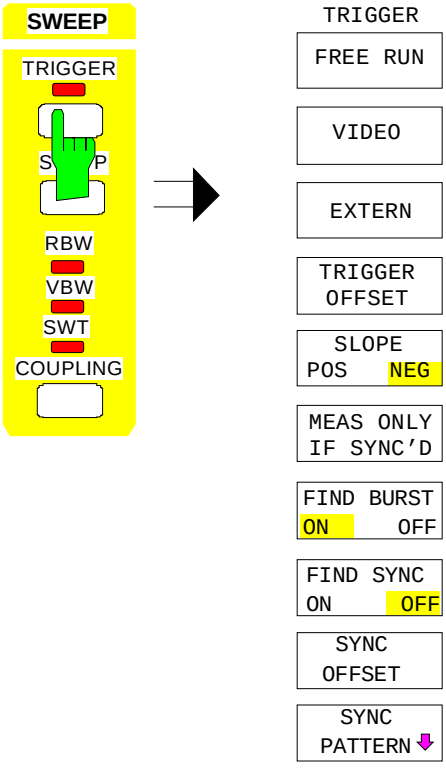
The *RESULT LENGTH* softkey defines the number of symbols or the time slot to be displayed. The maximum number of symbols that can be displayed is equal to the frame length.

IEC\IEEE-bus command
```
:[SENSe<1|2>:]DDEMod:TIME <num_value>
```

Triggering Data Storage - TRIGGER Key

The trigger in the vector analyzer mode determines the time from which data are stored in the result memory. For the demodulation of digitally modulated signals, the time reference can also be obtained by synchronization to a given bit sequence or, for TDMA signals, by searching for a burst in the result memory.

Menu: *SWEEP TRIGGER*



The *TRIGGER* key opens a menu in which the different trigger sources can be set and trigger slopes selected.



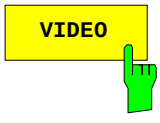
The *FREE RUN* softkey activates the measurement without trigger. After a measurement, the memory is prepared to store data for a new measurement.

The free-run mode is recommended if a continuously modulated signal is applied to the RF input or, for TDMA signals, the capture time is long enough to enter a full burst into the result memory.

The capture time is influenced by the memory size (max. 16384 points), the set symbol rate as well as the number of points per symbol.

IEC\IEEE-bus command

```
:TRIGger<1|2>[:SEQuence]:SOURce  IMMediate
```

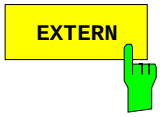


The *VIDEO* softkey starts the measurement by the video voltage of the analog path of the spectrum analyzer. Parallel to the vector signal analyzer, the analog video voltage of the spectrum analyzer is evaluated.

Video triggering calls for the entry of the trigger threshold. It is identical to the trigger threshold of the spectrum analyzer. The entry of the trigger threshold into the data window is numeric in % of the last grid which has been active in the analyzer mode.
To determine a suitable value for the trigger threshold it is possible to switch to the display MAGNITUDE CAP BUFFER or to measure the threshold in the analyzer mode.

IEC\IEEE-bus command

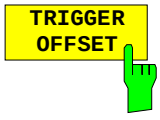
```
:TRIGger<1|2>:SOURce VIDeo
:TRIGger<1|2>:LEVel:VIDeo <num_value>
```



The *EXTERN* softkey activates triggering by means of an external voltage between -5 V to +5 V at the rear BNC connector *EXT TRIGGER / GATE*. The desired value is to be entered into the window.

IEC\IEEE-bus command

```
:TRIGger<1|2>:SOURce EXTernal
:TRIGger<1|2>:LEVel:EXTernal <num_value>
```



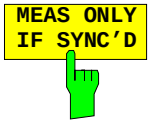
The *TRIGGER OFFSET* softkey opens a window for entering the desired offset.

With *TRIGGER OFFSET,* the start time for the data storage relative to the trigger event is determined. Both positive values (for a trigger delay) and negative values (for a pretrigger) are permitted.

Entry is in absolute time independent of the scaling of the X axis.

For positive values of the trigger offset (trigger delay), values from 40 ns to at least 10 ms are permitted, depending on the symbol rate and the number of points per symbol. The range of values for negative trigger offsets (pretrigger) depends on the selected memory size and is not more than half the memory size.

IEC\IEEE-bus command `:TRIGger<1|2>:HOLDoff <num_value>`



Softkey *MEAS ONLY IF SYNC'D* sets the vector analyzer so that measurements are performed if synchronization to the selected sync pattern was possible.
The measured values are displayed and taken into account in the error analysis only if the set sync pattern is found. Bursts with a wrong sync pattern (sync not found) are ignored.
If an invalid sync pattern is found or if there is none, the measurement is halted and continued in the presence of a valid sync pattern.

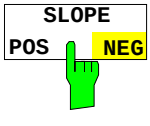
This softkey is available only if *FIND SYNC* = *ON*.
The default setting is OFF. If the digital standard is changed, OFF is always activated.

Example:

An EDGE-compatible base station can send EDGE and GSM bursts alternately. The demodulator thus sees EDGE (8PSK) and GSM bursts (GMSK).
If GSM is activated in the vector analysis, the measurement and error analysis are disturbed by an EDGE burst. This can be prevented by activating softkey *MEAS ONLY IF SYNC'D.* The EDGE bursts are ignored in the error analysis.

IEC\IEEE-bus command

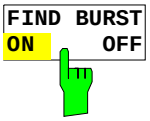
```
:[SENSe<1|2>:]DDEMod:SEARch:SYNC:MONLy ON|OFF
```



The *SLOPE POS/NEG* softkey determines the trigger slope in case of triggering by means of the video signal or external trigger.

The sweep starts after a positive or negative slope of the trigger signal. With a free-running trigger the setting is irrelevant.

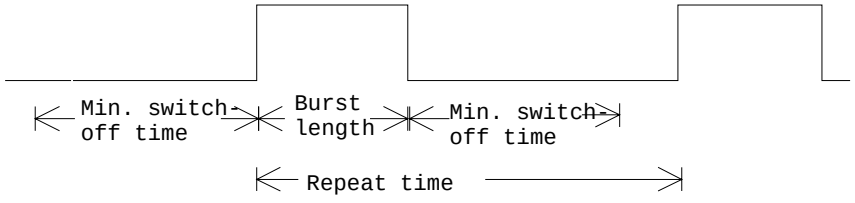
IEC\IEEE-bus command `:TRIGger<1|2>[:SEQuence]:SLOPe POS|NEG`



The *FIND BURST ON/OFF* softkey searches for a burst in the stored data (within the entered memory size), demodulates it within the entered frame length and displays it with the set result length.

The *FIND BURST* mode is particularly useful for TDMA signals if a burst is to be completely displayed (and would otherwise not be demodulated due to the mark-to-space ratio at the maximum setable frame length of 800 symbols*)*. The time required for searching for a burst is determined with memory size.
A burst must have a minimum length of 30 symbols to be identified.

Digital communication systems operating according to the TDMA access methods transmit or receive information in the form of bursts. The carrier power is only switched on for a certain time. The transmitter switches the carrier on if an information is to be transmitted and switches it off again.



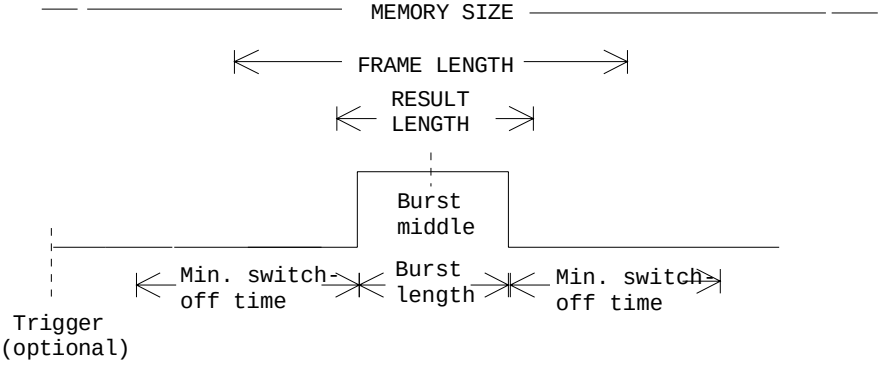
The carrier power is switched off between two bursts. With *FIND BURST,* the FSET earches for a complete burst, i.e. for a carrier that can be switched on ***and*** off. If no complete burst is found within the search time, the message *BURST NOT FOUND* is displayed.

If a trigger (video or extern) is used for the storage of the measured values, a negative trigger offset (pretrigger) is recommended so that a sufficiently long switch-off time of the carrier is available at the beginning of the search time.

The search time has at least to be as long as the burst length plus twice the switch-off time to ensure that the burst is found.

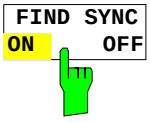
For a free-running trigger, set the length of the captured data *(MEMORY SIZE)* to a minimum (repeat time + 2 x switch-off time + burst length) so that the burst can be found.

The FSET centers the number of symbols (*FRAME LENGTH*) required for demodulation as well as the displayed symbols (*RESULT LENGTH*) to the center of the found burst (*FIND SYNC OFF*).



IEC\IEEE-bus command

```
:[SENSe<1|2>:]DDEMod:SEARch:PULSe:STATe ON|OFF
```

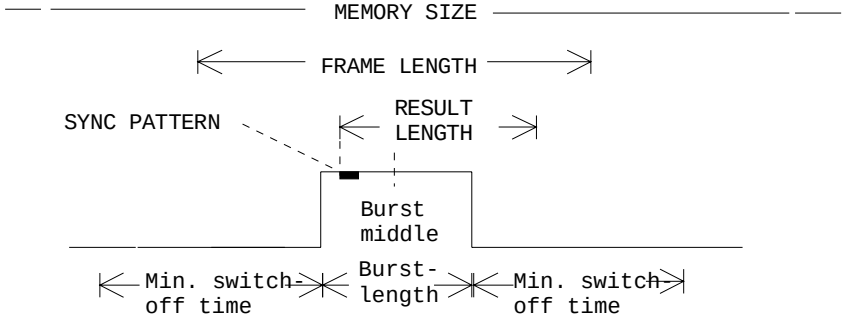


The *FIND SYNC ON,* softkey searches for a defined bit sequence (sync pattern) within the set frame length. The measurement result is displayed with the set result length with reference to the first symbol of the synchronization sequence.

If the synchronization sequence is not found, a result is still output according to the set result length. The message*: SYNC NOT FOUND* is then output.

Centering the burst on the middle of the picture cannot be carried out if the burst is found at the very beginning of the data set (of the memory size) and a **Result Length >Burst Length + 2×20 symbols** is set. A precondition for burst recognition is that before the rising edge measured values corresponding to at least 20 symbols are present in the current trace memory. In this case, the burst is represented from the first measured value in the trace memory.
If the consequent centering of the burst is indispensable for the user, the result length has to be reduced according to the above precondition.

In case of *FIND BURST ON* and *FIND SYNC ON,* the FSET only centers the frame length to the center of the burst while the result length is displayed from the beginning of the bit sequence (in case of *SYNC OFFSET* 0) or around the *SYNC OFFSET*.



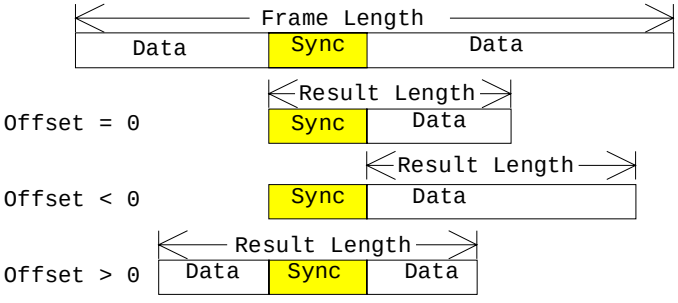
IEC\IEEE-bus command

```
:[SENSe<1|2>:]DDEMod:SEARch:SYNC:STATe ON|OFF
```

SYNC OFFSET

The *SYNC OFFSET* softkey opens a window for entering the offset in symbols.

SYNC OFFSET defines the display time prior to the synchronization sequence in SYNC SEARCH. It thus determines the position of the displayed trace or symbols (result length) within the demodulated signal (frame length). The modulated signal may have a preamble or a midamble. Depending on the configuration it is thus desirable to display the measurement signal from a synchronization sequence or prior to the synchronization sequence.



A positive or a negative offset can be set.

The minimum or maximum offset depends on the following parameters:

- frame length
- result length and
- position of the sync sequence in the burst

In order to find the sync sequence correctly regardless of its position within the burst and to obtain enough measured values for the diagram, the *FRAME LENGTH* for the *FIND SYNC* function should be set at least twice as large as the *RESULT LENGTH*.

Any offset can basically be entered provided that the measurement result is within the *FRAME LENGTH*. If the *FRAME LENGTH* is extended, a higher offset can be entered. If the *RESULT LENGTH* is extended, the maximum offset is reduced.

If an offset is set that is too large (i.e. that, togeher with the selected *FRAME LENGTH, prevents the RESULT LENGTH combined with the determined sync sequence to be* completely displayed), the error message *SYNC OFFSET INVALID* ! appears on the screen.

In this case, either the *FRAME LENGTH* must be increased, or the sync offset must be adapted to the position of the sync sequence in the burst.

The frame buffer contains the data available for the evaluation (*FRAME LENGTH*).

The message "SYNC OFFSET INVALID" indicates that there are not enough data available for displaying the *RESULT LENGTH*.

The following examples explain how *FRAME LENGTH*, *SYNC OFFSET* and *FRAME LENGTH* are related.

IEC\IEEE-bus command

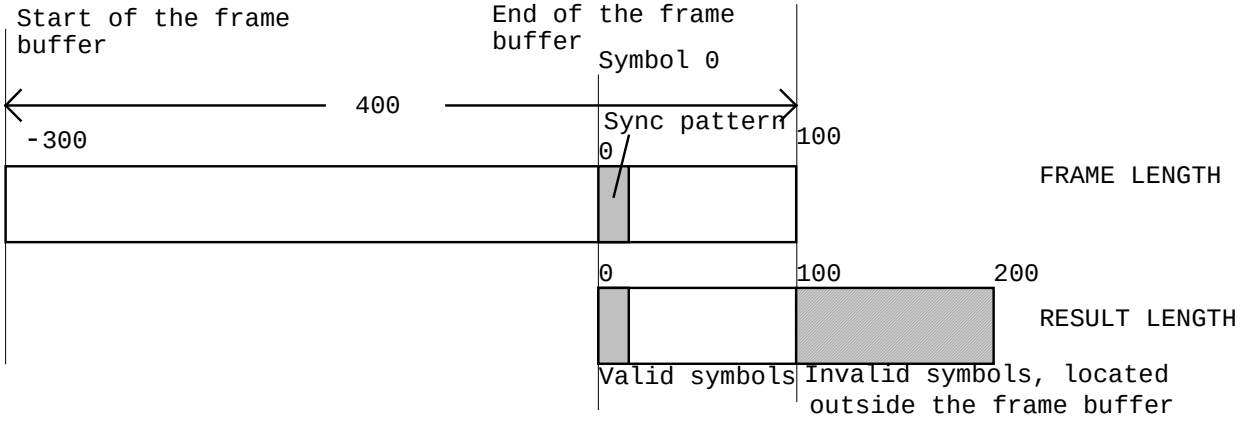
```
:[SENSe<1|2>:]DDEMod:SEARch:SYNC:OFFSet <num_value>
```

Example 1 (input signal without burst):

Device settings:

- Input signal (without burst)
- FIND BURST off
- FIND SYNC on
- FRAME LENGTH = 400
- RESULT LENGTH = 200
- SYNC OFFSET = 0

The start of the frame buffer is at symbol -300 (with respect to the sync pattern), the FSET displays the results starting with symbol no. 0, but there are no more than 100 valid symbols in the file, 100 symbols of the result length are invalid because they are located outside the frame buffer.



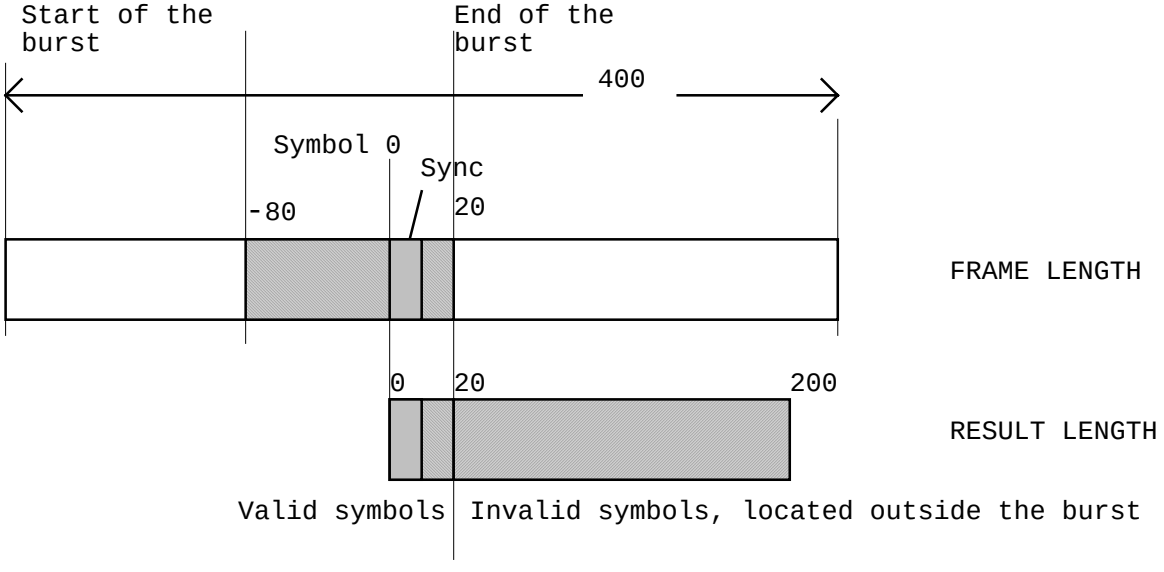
Solution: diminish result length to 100 symbols *or*
extend frame length to 800 symbols.

Example 2 (input signal with burst):

Device settings:

- Input signal (burst length 100 symbols)
- FIND BURST on
- FIND SYNC on
- FRAME LENGTH = 400
- RESULT LENGTH = 200
- SYNC OFFSET = 0

After successful search of the burst, only the symbols inside the burst are marked as valid.
The synchronization pattern is found in the burst (Symbol 0), the FSET displays starting with symbol no.0, but there are only 20 valid symbols in the burst, 180 symbols of the result length are invalid because they are located outside the burst.



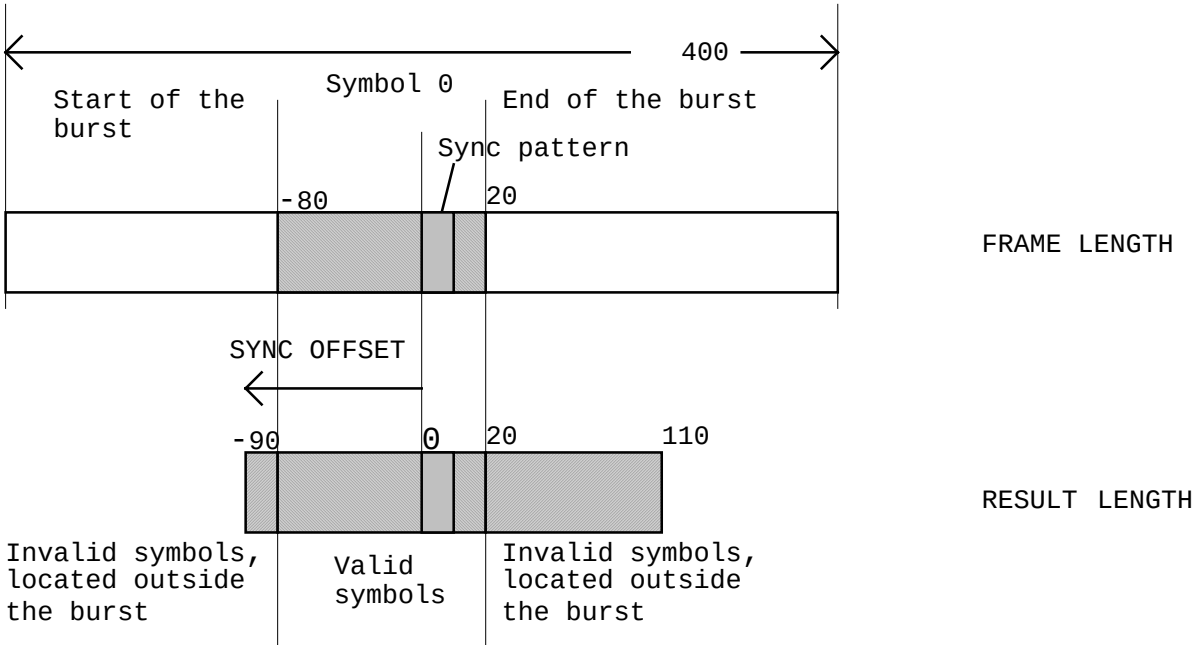
Solution: diminish result length to 20 symbols.

Example 3 (input signal with burst):

Device settings:

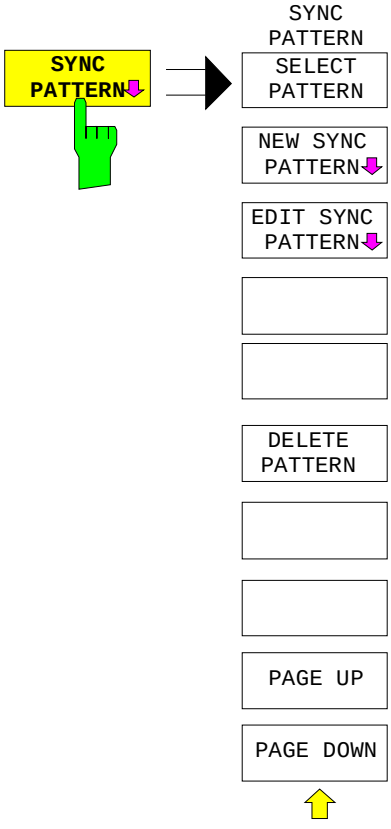
- Input signal (burst length 100 symbols)
- FIND BURST on
- FIND SYNC on
- FRAME LENGTH = 400
- RESULT LENGTH = 200
- SYNC OFFSET = 90

After successful search of the burst, only the symbols inside the burst are marked as valid.
The synchronization pattern is found in the burst (Symbol 0), the FSET displays starting with symbol no. -90 up to +19, the beginning of the display range is located before the start of the burst !



Solution: diminish result length to 100 symbols (= burst length)
set sync offset to 80 (beginning of the burst lies 80 symbols before the sync-pattern).

Submenu: *SWEEP TRIGGER*



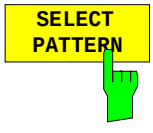
The *SYNC PATTERN* softkey calls up a submenu, allowing to select available patterns.

These patterns are displayed in the table *PATTERN NAME*. If a pattern is activated, the bit sequence of the selected pattern is displayed in the table *PATTERN VALUE*.

The synchronization pattern defines a bit sequence which is searched for in the signal to be demodulated. When the *FIND SYNC* function is activated, this bit sequence is used for synchronizing measurement results. The FSET demodulates the signal to be measured down to bit level and searches for this predefined sequence. The first symbol in the bit sequence is the reference time (for *SYNC OFFSET* = 0).

The bit sequence of digitally modulated signals often includes a preamble or midamble which is used on the one hand for assessing the channel impulse response and setting the channel equalizer in the receiver and on the other hand to synchronize the receiver. This bit sequence may be used in the FSET to find and display particular signal sections.

The maximum pattern length of the FSET is 200 bits. The number of symbols depends on the significance of the modulation method. With QPSK, for instance, 200 bits correspond to 100 symbols, with 16QAM to 50 symbols. The FSET always uses an integral multiple of the bits per symbol. Bits which are not multiples or exceed the maximum length are omitted.

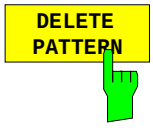


The *SELECT PATTERN* softkey marks the first field in the *PATTERN NAME* table.

The bit sequence of the selected pattern is displayed simultaneously with the *PATTERN VALUE* table.

IEC\IEEE-bus command

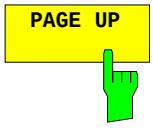
```
:[SENSe<1|2>:]DDEMod:SEARch:SYNC:SELect <pattern_name>
```



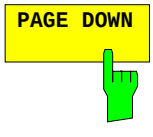
The *DELETE PATTERN* softkey clears the pattern marked by the cursor.
To avoid the pattern being inadvertently deleted, a confirmation is required..

IEC\IEEE-bus command

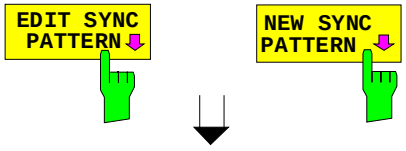
```
:[SENSe<1|2>:]DDEMod:SEARch:SYNC:DELete
```



The *PAGE UP/PAGE DOWN* softkey causes the next/last page of the sync pattern table to be displayed.

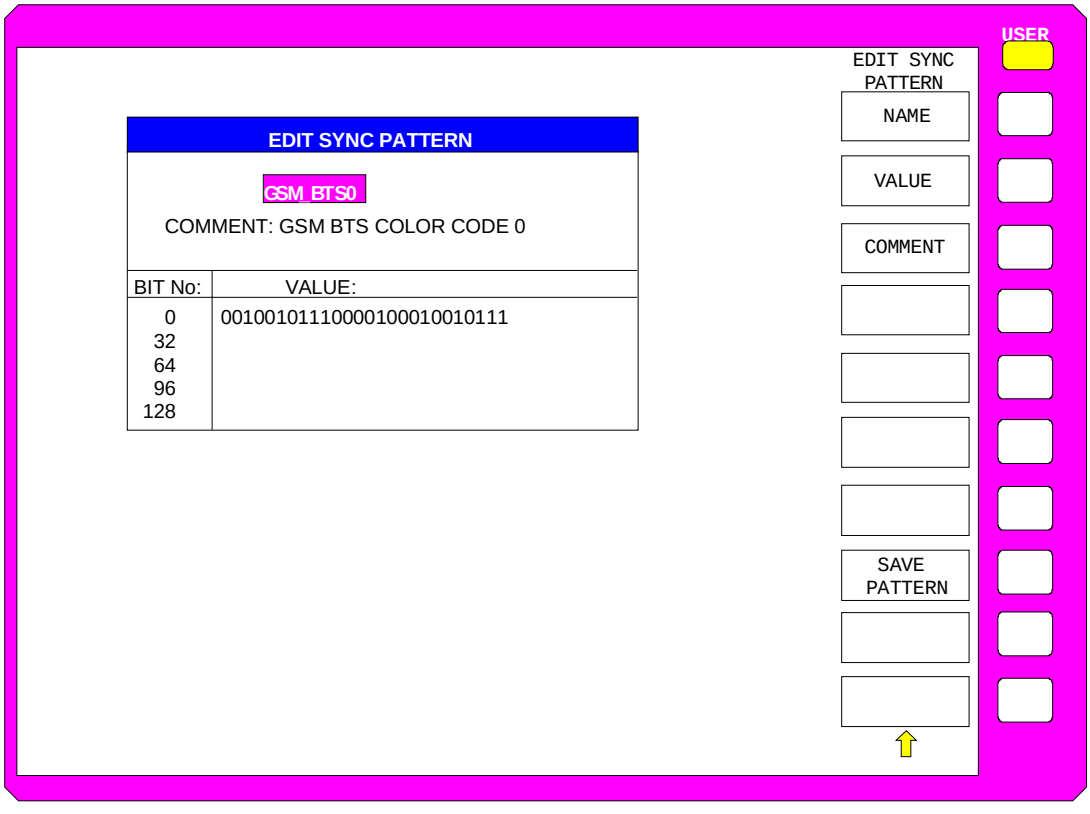


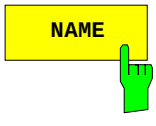
Submenu: *SWEEP TRIGGER - SYNC PATTERN*



The *NEW PATTERN* and *EDIT PATTERN* softkeys call up the *EDIT SYNC PATTERN* submenu for generating sync pattern.
In the head line of the table the name and comment of the sync pattern to be edited or modified can be entered.

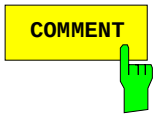
The sync pattern is entered or modified in the *VALUES* field, using the DATA ENTRY keys "*0*", "*1*" und "**.**" .





The *NAME* softkey activates the input of the name of the sync pattern. A maximum of eight characters can be entered.
When the sync pattern is stored, the extension .PAT is automatically appended.

IEC\IEEE-bus command
`:SENSe<1|2>:]DDEMod:SEARch:SYNC:NAME <pattern_name>`



The *COMMENT* softkey activates the input of a comment for the sync pattern.

IEC\IEEE-bus command
`:[SENSe<1|2>:]DDEMod:SEARch:SYNC:COMMent <string>`

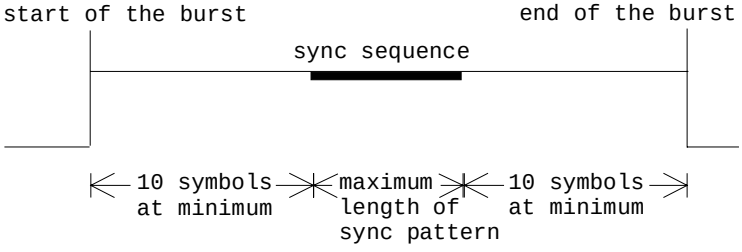
VALUE

The *VALUE* softkey activates the input of the bit pattern of the sync pattern.

The sync pattern may include "don't care bits" which are not considered when searching for the valid bit pattern.. The don't care bits are marked by an 'x' in the *VALUE* field.

The sync pattern has to start and end with a valid bit, a don't care bit can not be the first or last bit of the sync pattern.

During burst search, the sync pattern has to start and to end 10 symboles before the beginning and end of the burst, respectively.



IEC\IEEE-bus commands

```
:[SENSe<1|2>:]DDEMod:SEARch:SYNC:DATA <string>
:[SENSe<1|2>:]DDEMod:SEARch:SYNC:PATTern <string>
```

SAVE PATTERN

The *SAVE PATTERN* softkey stores a newly edited pattern under the current name.

IEC\IEEE-bus command -- (The pattern is automatically saved under the name remote.pat)

10 Index

Note:

- *The softkeys are listed alphabetically under the keyword "Softkey".*
- *For each softkey, the page in chapter 6 containing the description of the corresponding remote command is quoted in addition.*
- *The assignment between IEEE-bus commands and softkeys is described in Chapter 6, Section "Table of Softkeys with IEC/IEEE-Bus Command Assignment".*
- *Chapter 6 contains an alphabetical list of all IEEE-bus commands*

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