ROHDE&SCHWARZ

Test and Measurement
Division

Operating Manual

RADIOCOMMUNICATION SERVICE MONITOR CMS 33

840.0009.34

Printed in the Federal
Republic of Germany

1078.1930.12-01-



ROHDE&SCHWARZ

Test and Measurement
Division

Basic Instrument and Options

Printed in the Federal
Republic of Germany

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2 Operation

The values stated in this section are not guaranteed; only the technical data on the data sheet are binding.

The numbers printed in bold type and italics refer to the controls shown in the front and rear views Figs. 2-1 and 2-2.

2.1 Explanation of Front and Rear Views

2.1.1 Front Panel

(see Fig. 2-1 in appendix)

1

Display

All information for the user is output on the display. It contains a menu heading and status line, describes the functions of the softkeys and indicates the set and measured values in digital and analog form. The information shown on the display changes depending on the selected menu.

2

Softkeys

16 softkeys with alternating functions. The respective function is output on the display directly next to the softkey.

Numbers have been assigned to the softkeys for referencing in the text:

Left-hand softkey column	Right-hand softkey column
0	8
1	9
2	10
3	11
4	12
5	13
6	14
7	15

3

Numeric keypad 0 to 9

For entering values.
With tone sequences:
numeric value for SELCAL

4

Dimension key with ENTER function

Frequency	MHz
Level	mV
Modulation(AM), distortion	%
With tone sequences:	
numeric value	A

5

Dimension key with ENTER function

Frequency, modulation(FM)	kHz
Level	µV
Power	W
With tone sequences:	
numeric value	B

6

Dimension key with ENTER function

Frequency, modulation (FM)	Hz
Level	dBµV
With tone sequences:	
numeric value	C

7

Dimension key with ENTER function

Quasi-dimension for relative settings, SINAD, S/N	dB
Level, power	dBm
Modulation (ϕM)	rad
With tone sequences:	
numeric value	D

8

Minus sign

Every number is positive unless a minus sign is entered.
Input of tone sequences:

With DTMF	#
With all other codes	F

9

Decimal point

Input of tone sequences:

with DTMF	*
with all other codes	E

10

ENTER
ON

- Terminating key for all inputs which do not have or require a dimension or quasi-dimension.
- Switching-on the functions which were switched off by OFF.

11

CLEAR
OFF

- Abortion of commenced input strings.
- Switching-off of functions
- Switching-off of functions such as REF, RANGE, VAR, TOL.
- Deletion of a deletable message in the 2nd status line.

12

VAR

Settings can be varied using this spinwheel. The step size and the assignment of the parameter can be defined using the function key VAR.

13

SHIFT

The keys ***14*** to ***20*** have dual functions. The SHIFT key must be pressed to reach the function printed in the top line. The softkeys ***0*** to ***15*** also have a dual function depending on the menu. The second function (top or bottom) is made accessible by first pressing the SHIFT key. The status line indicates when the SHIFT function is active.

14

H.COPY
START

H.COPY: Output hard copy of screen on a printer.
START: Execution of autorun control program (one of the most important functions).

15

RETURN
STOP

STOP: Transfer from IEC bus mode to manual mode.

The following applies in autorun control mode:

RETURN: Transfer from IEC bus mode to manual mode.
Transfer from autorun control mode to manual mode.

STOP: Stop current autorun control program.

16

RECALL
STORE

RECALL: Recall instrument settings.
STORE: Store instrument settings.

17

RESET
MENU ↓

RESET: Set instrument to its factory-setting. Autorun control programs are not cleared in this way.
Menu ↓: Enables searching for submenus together with the active cursor in the display

18

REF
MENU ↑

REF: Entered or measured values are declared as reference values.
MENU ↑: Transfer to higher-level menu.

19

RANGE
VAR

RANGE: Storing of full-scale value with analog display.
VAR: Definition of setting increment when using VAR spinwheel.

20

- TOL
+ TOL

Definition of upper and lower limits. The tolerance markers are set in the analog display, and the tolerance evaluation is defined in the autorun control.

21

CONTRAST

Adjustment of loudspeaker volume.

22

VOLUME

Adjustment of screen contrast.

23

MEMORY

Plug-in for the chip card CMS-Z1 or CMS-Z2.

24

AF/SCOPE
INPUT
1 MΩ

Input for all AF and DC measurements. The signals connected here can be evaluated by the AF and DC measurement points or displayed on the scope. Input resistance depends on the model or option.

25

MOD GEN
OUTPUT

Output of AF generator.

26

MOD EXT
INPUT
1 MΩ

Input for external modulation signals, also second input for the scope.

27

DEMOD
OUTPUT

Output for the demodulated signal.

28

RF IN 2

⚠ 1 V_{MAX}
~50 Ω

Second RF input; high sensitivity, therefore suitable for remote measurements.

29

RF IN/OUT

⚠ 125 W_{MAX}
50 Ω

RF power input, also output for RF signals of instrument. This connector is usually linked to the antenna connector of the radiotelephone.

2.1.2 Rear Panel

(see Fig. 2-2 in appendix)

40

F2: T10 IEC127/2
Fuse for battery operation.

41

L		B
I	O	A
N	F	T
E	F	T

This switch has 3 positions:
Line mode ON
Line and battery modes OFF
Battery mode ON

42

11...30 V DC

Connection of external DC source to instrument. Connection for battery pack with trickle charging.

45

Blower

The blower and the vents in the instrument housing must not be covered since both the power loss of the instrument and the output power of the radiotelephone are discharged via this blower.

46

MIC/TEL1 socket

47

VSWR connector

48

TEL 2 socket

49

PRINTER PARALLEL INTERFACE

Printer output (Centronics).

50

CONTROL

Connection to the Remote Control Box.

51

IEC 625
IEC/IEEE bus connection

52

AC supply voltage selector and fuse holder
100/120 V: IEC 127/2 - T1.6D
230/240 V: IEC 127/2 - T800

53

AC power connection

47 to 420 Hz

2.1.3 Remote Control Box

(see Fig. 2-3 in appendix)

60

Display

Two line display for information of the auto run program.

61

MIC Tel1 socket

62

Tel2 socket

63

←
Selection of various values during autorun.

64

→
see 63

65

ACCEPT
To accept a setting during autorun.

66

REJECT
To reject a setting during autorun.

67

REPEAT
To repeat a measurement during autorun.

68

CONTINUE
To continue an auto run program after stop.

69

STOP
To stop an autorun program.

70

START
To start an autorun program

2.1.4 Batterie pack

(see Fig. 2-4 in appendix)

80

MIC Tel1 socket

81

VSWR connector

82

Tel2 socket

83

Remote Control connector

84

Battery full indication

85

Charging indication

86

Battery empty indication

2.2 Preparation for Use

Unpack the instrument and check that the listed accessories are present. Before switching on for the first time, refer to Sections 2.2.1 and 2.2.2.

2.2.1 AC Power Mode

Setting the AC Supply Voltage

⚠ Before setting the AC supply voltage disconnect the AC power supply cable!

The instrument is designed for rated AC voltages of 100 V, 120 V, 220 V or 240 V (frequency 47 to 420 Hz). Before switching on the instrument for the first time, check that the correct AC supply is set. With new instruments, the set voltage is printed on the yellow label on the AC connector. If this does not agree with the local voltage, convert as follows:

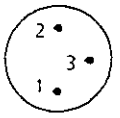
- Unscrew fuse holder *52* by $^1/_2$ rotation to the left and remove.
- Remove fuse from fuse holder.
- Set desired voltage (arrow). For this purpose, insert voltage selector switch and rotate.
- Insert fuse with required rating (fuses included in accessories).
  A fuse T 1.6 D is required for 100/120 V,
  a fuse T800 for 230/240 V.
- Insert fuse holder and lock by $^1/_2$ rotation to the right.

Once the AC cable has been inserted into the connector *53*, the instrument can be switched on using the rocker switch *41* on the rear panel (LINE position). The instrument is switched off when in the OFF position, even if the AC cable is connected (no standby mode but trickle charging the battery pack). The power consumption with the basic configuration is approx. 50 VA.

2.2.2 Battery Mode

An external DC supply can be connected to the connector 11 ... 30 V DC *42*. The DC battery socket CMS-Z7 can be purchased using the ordering code 841.1350.02. The connection is made as follows:

(viewed onto soldered side)



1 Instrument ground
2 +
3 for trickle charging the battery pack

Note: *Connector 42 can only be inserted in one position and thus prevents incorrect polarity. The instrument is not protected against incorrect polarity, however, e.g. when soldering the battery socket.*

Spare fuses for battery mode are included in the accessories.

Once the connection to the DC supply has been made, the instrument can be switched on using the rocker switch *41* on the rear panel (BATT position). The instrument is switched off when in the OFF position, even if the battery cable is connected (no standby mode). The power consumption is approx. 40 W.

2.2.3 Operating Instructions for CMS Z-42 Battery Pack 1065.5803.02

The Battery Pack is used for battery operation of the CMS 33. It consists of a splash-proof, handy cabinet accommodated in a small, highly tear-resistant bag with removable transparent cover. A zip fastener over all four sides permits attachment to the CMS 33 carrying bag.

The battery pack includes two series-connected, closed lead-acid batteries requiring no maintenance as well as a battery charger with overdischarging protection.

The DC cable with the coded DC socket of the battery pack reliably prevents unintentional wrong connection which would cause damage to the battery pack or the CMS 33.

Caution: *Only connect the battery pack to the CMS 33!*

As a safety precaution, a DC fuse (T10A) is located next to the charger board, which can only be replaced after opening the battery pack. A spare fuse is supplied as an accessory part.

Pin assignment of DC connector:
Pin 1: - battery voltage (GND)
Pin 2: + battery voltage
Pin 3: + charging voltage

Furthermore, the battery pack includes the 50-contact control socket for connection of the remote control box, the 8-contact VSWR socket and the MIC/TEL sockets on the front panel. These sockets are connected with the CMS 33 control socket via a cable at the rear.

Battery operation and charging of the batteries

For battery operation of the CMS 33, the DC cable provided with the battery pack must be connected to the CMS 33.

Set the switch on the rear panel of the CMS 33 to the BATT position.

In the fully charged state, the built-in batteries permit the CMS 33 to be operated for 1 hour at 0 to 50 °C. A red flashing LED indicates when the battery voltage is too low. In this case, the battery should only be used for another five to ten minutes in order to ensure a long battery life.

If an overdischarging protection is built in, the battery is automatically cut off when the discharge voltage is reached.

The battery pack must be recharged as soon as possible then!

After inserting the power plug on the CMS 33 (rocker switch in the OFF position) and connecting the DC cable of the battery pack to the CMS 33, the battery charger automatically carries out the charging process without time limit (yellow LED illuminated).

A completely discharged battery must be charged for approx. 12 to 14 hours in order to achieve a state of charge of approx. 90%.

To achieve full capacity, charging should continue for some more hours (green LED starts to light).

The battery charger is equipped with a permanent charging facility, which compensates for self-discharge of the battery, making sure that fully charged batteries are always available (trickle charge).

After unintentional overdischarging (battery pack has not been recharged over a longer time period after discharging) - > self-discharging) the battery pack can be recharged by prolonging the charging time (yellow/green LED are not illuminated first, since only a small charging current is used with a low battery voltage!).

However, a discharged battery should not be kept longer than a few days without being recharged.

A fully charged battery features extremely little self-discharging; recharging of a fully charged battery is required after 9 months at the latest at a storage temperature of + 20 °C.

At low temperatures, recharging is only required after a longer time period, whereas it is necessary at shorter time intervals at higher temperatures.

To make sure that the battery is fully charged and ready for use at any time, the charger should always be connected to the power supply. Overcharging of the battery is not possible due to the voltage-limited charging technique.

Operating and storage temperatures

The operating temperature range extends from 0°C to + 50°C with the battery capacity being reduced by up to 20% at low temperatures. If the battery is fully charged, the storage temperature extends from -15°C to + 40°C.

Caution: *Due to a reduction in the specific gravity of the electroyte, only fully charged batteries may be stored at low temperatures.*

The batteries should be stored in dry rooms (50% humidity) at temperatures ranging from 0°C to + 35°C, if possible!

Battery replacement and lifetime

If the batteries are properly stored and charged, they feature a max. lifetime of approx. 200 charging and full discharging cycles.

Use only batteries from Rohde and Schwarz order no. 1077.944 and replace both batteries at the same time. Make sure to dispose of lead-acid batteries properly!

Possible dangers

Keep batteries away from fire.

Do not short-circuit the terminals.

Do not open batteries.

If the battery is damaged and diluted sulphuric acid comes into contact with the skin or clothes, the affected area should immediately be washed with water.

If diluted sulphuric acid gets into your eyes, immediately wash them with large quantities of water and contact a doctor.

A discharged battery should be recharged as fast as possible.

In any case, read through the instructions before using the battery.

2.3 Operation

The instrument functions are possible in three main operating modes:

- Manual operation
- Autorun control
- Remote control via IEC/IEEE bus.

2.3.1 Power-Up Status

A selftest including various internal operating point adjustments is carried out following power-up. The selection menu is output in the display if no errors are detected, otherwise the corresponding error message is output (cf. Section 2.11.11).

The instrument is equipped with a back-up battery so that the set parameters and measured values are retained when the instrument is switched off or in the event of a power failure. Only the settings for the selection menu and RF and AF levels do not correspond to the status prior to switch-off. This is for clarity reasons as well as for the safety of devices under test and the instrument itself.

A status independent of the previous settings is achieved using the keys SHIFT RESET. Apart from data entered by the user (such as e.g. tone sequence frequencies), this state corresponds to the state when delivered.

If the RESET key is actuated and retained during switch-on, all data entered - except for the autorun control programs - are reset (factory-setting).

2.3.2 Controls

The instrument controls comprise the keys and the VAR spinwheel ***12***.

All instrument outputs with respect to manual operation are on the display ***1***.

2.3.2.1 Softkeys

The softkeys have alternate functions. The respective function is output on the display directly next to the softkey. Together with the display, the softkeys are the main elements for menu operation.

Maximally two functions are output on the display next to a softkey depending on the menu.

The function indicated in inverted form (light characters on dark background) is applicable; the other function can be selected using the SHIFT key ***13*** or by pressing again the same softkey.

2.3.2.2 Hardkeys

2.3.2.2.1 Function-based Hardkeys

An active cursor on the display (▸) indicates the current function. The hardkeys refer to this function.

Function-based hardkeys:

RANGE, VAR, REF, -TOL, +TOL, MENU ↓ (DOWN), dimension keys, ENTER, CLEAR

Examples of hardkey applications:

RANGE

The full-scale value of the analog display usually matches itself to the measured value (auto-ranging). It is sometimes necessary to fix this value during adjustments.

RANGE/ENTER
The full-scale value is held at the current value.

RANGE/CLEAR
Autoranging becomes active again.

RANGE/number/ENTER
The full-scale value is the entered number or next higher number in steps of 1-2-5. The dimension corresponds to that in the display.

RANGE/number/dimension
The full-scale value is the entered number or next higher number in steps of 1-2-5 with the selected dimension.

To indicate that the RANGE HOLD function is switched on, the full-scale value on the analog display is inverted.

VAR

The VAR spinwheel can be used to vary set parameters. The VAR function is used to define the variation increment and the associated function.

Unless a specific VAR operation is made, the function of the spinwheel always corresponds to the current setting parameter with display of VAR symbol ◦ (see Fig. 2.3-1).

VAR ENTER
The VAR spinwheel is assigned the selected function; it can only be changed by VAR or VAR ENTER with another function. At the same time, the VAR symbol ◦ is changed to •.

VAR/CLEAR
Cancellation of fixed assignment.

VAR/number/ENTER
Sets a desired variation increment. The dimension corresponds to that in the display.

VAR/number/dimension
Sets a desired variation increment. The dimension corresponds to that in the display.

VAR/0/ENTER
Selection of minimum increment.

Exceptions:

- In the case of a frequency setting on the modulation generators 1 and 2, the VAR spinwheel is used to vary frequencies from a fixed series.

- The VAR function is automatically assigned to certain functions (time, amp. and Y pos. on the scope) without the user having to press the VAR key.

The assignment of the VAR function is identified in the display by a symbol.

If a parameter which is assigned the VAR function is switched off using OFF, rotating of the VAR spinwheel has no effect.

REF

The output of measured values or settings on the display can be absolute or referred to a reference value.

Measurements which are always relative values (SINAD, S/N) cannot be referred even further to a reference value. Frequencies are indicated as a frequency difference relative to the reference value. All other relative displays are in dB.

REF/ENTER
The current value is defined as reference value.

REF/number/ENTER
The number is defined to be the reference value. The dimension of the reference value corresponds to that in the display.

REF/number/dimension
The number with the dimension is defined to be the reference value.

REF/CLEAR
Return to absolute dimension.

Identification of relative displays:

The quasi-dimension dB is a relative display. In the case of frequencies, the sign (also ÷) shows that relative frequencies are displayed.

The analog display has a special feature in the case of relative dimensions or quasi-dimensions:

The 0 point is always on the left.

Either the right-hand half of the axis is shown with a positive full-scale value or the left-hand half of the axis with a negative full-scale value depending on the current measured value. The full-scale value is always displayed on the right, however.

TOL

Entered tolerance values have two effects:

- Limits are entered on the scale of the analog display. They serve for optical orientation during adjustments.
- They enable an evaluation during autorun control depending on the result: tolerance in or tolerance out.

+/- TOL/ENTER
The current measured value becomes the tolerance limit.

+/- TOL/number/ENTER
The entered number is defined to be the tolerance limit. The dimension corresponds to that in the display.

+/- TOL/number/dimension
The entered number with dimension becomes the tolerance limit.

+/- TOL/CLEAR
Deletion of tolerance markers.

Special features:

The two tolerance markers are not always visible.

A tolerance marker is not displayed if it is above the full-scale value. If one tolerance limit is above 0 and the other below 0 in the case of a relative display, not more than one tolerance marker will be visible on the screen because only one of the two branches (either above 0 or below 0) can be displayed depending on the measured value.

Take care with the sign when selecting the tolerance marker if a relative dimension is present:

e.g. -105 dBm is smaller (-TOL) than -95 dBm (+TOL).

MENU ↓ (DOWN)

If the function which the active cursor points to in the display has a submenu, this is indicated in the status line by an arrow pointing downwards. The corresponding submenu is selected by pressing the MENU ↓ key, and a further submenu can be called if present by pressing again. (MENU ↑ (UP): return to status existing before MENU ↓ (DOWN) was entered).

Dimension keys

For settings:

Number/dimension
Setting of value including dimension.

Dimension
Conversion of set value into selected dimension.

With measurements:

Dimension
Representation of measured value in selected dimension.

Entered dimensions are modified by the instrument automatically if the desired dimension is not compatible with the display format.

Exception:

When entering tone sequences, the dimension keys have the significance of digits. The termination function is also cancelled in this context. Tone sequence entries are terminated by the ENTER key.

ENTER, ON

The ENTER key terminates input strings.

These can be commands (REF/ENTER), or also inputs. The ENTER key is used if the dimension is to remain unchanged or if the entered value has no dimension. ENTER can also be used to restore set values previously switched off by CLEAR.

CLEAR, OFF

The 4 functions of CLEAR are:

- Abortion of a commenced input string.
- Switching-off of hardkey functions such as REF, RANGE, VAR or TOL.
- Switching-off of set values; particularly suitable for relative settings with a logarithmic scale since the number "0" has the meaning "Reference value" in this case and not the meaning "Off".
- Deletion of a deletable message in the second status line.

2.3.2.2.2 Mode-related Hardkeys

The instrument can be operated in 6 different modes:

Manual operation mode
IEC/IEEE bus mode (remote)
Autorun control RUN mode
Autorun control HOLD mode
Autorun control LEARN mode
Autorun control AUTORUN menu

The functions of the hardkeys START, RETURN and STOP correspond to the instrument mode selected.

IEC/IEEE bus mode (Remote)

STOP
Allows for entering the manual mode providing RWLS (remote with lockout state) was not set. (Meaning : local).

Autorun control: RUN mode

STOP
Results in leaving the RUN mode and entering the HOLD mode.

Autorun control: HOLD mode

START
The autorun control enters the RUN mode and continues the program. (Meaning: continue).

STOP
Change from HOLD mode to manual operation. (Final stop)

RETURN
Entering the AUTORUN menu of autorun control.

Autorun control: LEARN mode

START
Start of LEARN mode.

Learn mode commences in the selection menu when it is called for the first time. It commences in the last processed menu if it is called again.

Autorun control: AUTORUN menu

START
Start of selected program (new start in contrast to continue).

2.3.2.2.3 Independent Hardkeys

The hardkeys described here always have the same meaning.

SHIFT
A key pressed upon entering SHIFT selects the second function. This is the function indicated in the top line on the hardkeys. With the softkeys, this is the function with the non-inverted label, which can be output in the display next to the corresponding softkey in the top or bottom line.

CLEAR
Cancels an unintentional input of SHIFT.

RESET
Sets the instrument to a defined initial status. Only user-specific parameters such as the assignment of tone frequencies to digits or programs are retained.

MENU ↑ (UP)
Return to next higher menu. This key has no effect in the selection menu.

STORE
This key has 2 functions:

- In the autorun control (LEARN mode), completely entered commands are stored in autorun control programs. The STORE key has a terminating function in this case.
- In addition, instrument states are transferred to the memory using the STORE key.
  Syntax: `STORE/number/ENTER`

  Numbers 1, 2 or 3:
  Internal storage of complete instrument settings.
  Frequencies for AF1 are stored only if the function AF COUPL (submenu DIST/SINAD, DIST) is off.

  Numbers 4 to 9:
  Storage of instrument settings on the memory card.

  Numbers 20 to 39 (two-digit):
  Storage of RF frequencies.

RECALL
The RECALL function corresponds to the STORE function.

- The internally-stored instrument status is set by entering
  `RECALL/number (single-digit)/ENTER`
- The stored frequency is output in the status line by entering
  `RECALL/number (two-digit)`
  and can be accepted using ENTER or deleted using CLEAR.

The STORE and RECALL functions can also be integrated in an autorun control program.

Example:

10/MHz	STORE	STORE/3/ENTER	STORE
Set 10 MHz	Implementation in an autorun control program	Store RF setting in memory 3	Implementation of storage procedure in the autorun control program

H.COPY
Produce hard copy of current display on a printer.

2.3.2.3 VAR Spinwheel

In contrast to specific entry of parameters using the keys, the VAR spinwheel is used for parameter variation. Its function is very similar to that of the VAR key (see function-based hardkeys (VAR), Section 2.3.2.2.1). The VAR spinwheel can either be specifically assigned to a desired function or can be assigned to the current function. The variation is possible in any step sizes, also logarithmic. The setting values are increased by rotating clockwise and decreased by rotating counterclockwise. The VAR spinwheel is automatically assigned to the scope functions amplitude, time and Y-position.

Special features of VAR spinwheel:

The input `VAR/0/ENTER` does not lead to the minimum increment in the case of a frequency setting on modulation generators 1 and 2. In this case, frequencies from a fixed series are varied using the spinwheel:

0.3 / 0.6 / 1 / 1.25 / 2.7 / 3 / 6 / 10 kHz
(default settings)

The VAR spinwheel has no effect (even in background mode) if it is used on a set value which has been switched off using OFF.

If RF levels are reduced using the VAR spinwheel, these settings differ from the corresponding direct key entries in the following manner:

The spinwheel variation utilizes the interruption-free, electronic reduction in level as far as possible (-19.9 dB with FM and φM, -4.9 dB with AM), whereas the mechanically switched attenuators are used as far as possible to set the level with a key input.

Entry of level via keys:
Best possible broadband S/N ratio, but interruption in level when changing (audible switching of attenuator set).

Entry of level using the VAR spinwheel:
Interruption-free level variation, e.g. for squelch measurements.

In contrast to all other settings, an analog display is also provided for the RF level setting. This represents the interruption-free level fine variation (when reducing from right to left).

In the case of the two-function softkeys (e.g. COUNT/SET RF), when the VAR spinwheel can only be used for one of the softkey functions, the activated VAR symbol is displayed also if the softkey function without possible VAR operation is selected.

2.3.2.4 Display

The functions of the display are to indicate user inputs, to display setting and measured values in analog and digital form and to describe the respective function of the softkeys.

Status lines

The operating mode of the instrument is described in the top status line. The second status line contains messages.

Softkey inscriptions

The respective function of the softkeys is output at the right-hand and left-hand margins of the display, directly next to the softkeys. The function displayed in inverted form is currently active. If the softkey is assigned two functions, the second function can be activated using the SHIFT key. The active cursor is positioned next to one of these fields (see fig. 2.3-1). It marks the function which can be manipulated by entering values or by using the function-based hardkeys (see Section 2.3.2.2.1).

The VAR symbol ∘ is changed to • if the adjacent parameter has been set for VAR spinwheel variation.

Representation of measured and set values

Measured and set values are output in the centre of the display. Set values are usually displayed in digital form only (exception: RF level setting with VAR spinwheel). Measured values are displayed in digital and analog form. Attributes such as RMS or PK refer to the nature of the measured value. The analog displays may be provided with tolerance markers (see function-based hardkeys (TOL), Section 2.3.2.2.1).

The submenus at the lowest position in the hierarchy usually fill a small section of the display only. These display fields overwritten by the submenu are emphasized by italic lettering.

The display can also copy the oscilloscope or spectrum monitor display in addition to the digital and analog outputs of individual measured values. It is only used as an editing or displaying tool in certain menus.

The display characteristics are described in detail in the individual menus.

If the CMS is not operated on for some time, the display will become dark so as to save energy (which is of particular importance when the CMS is operated from battery). It will be bright again by pressing any key. This keystroke does not have any other function then.

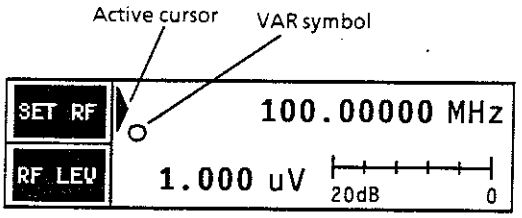


Fig. 2.3-1 Active cursor and VAR symbol

2.3.3 Menu Structure

Fig. 2.3-2 illustrates the menu structure of the instrument without consideration of lower hierarchical levels.

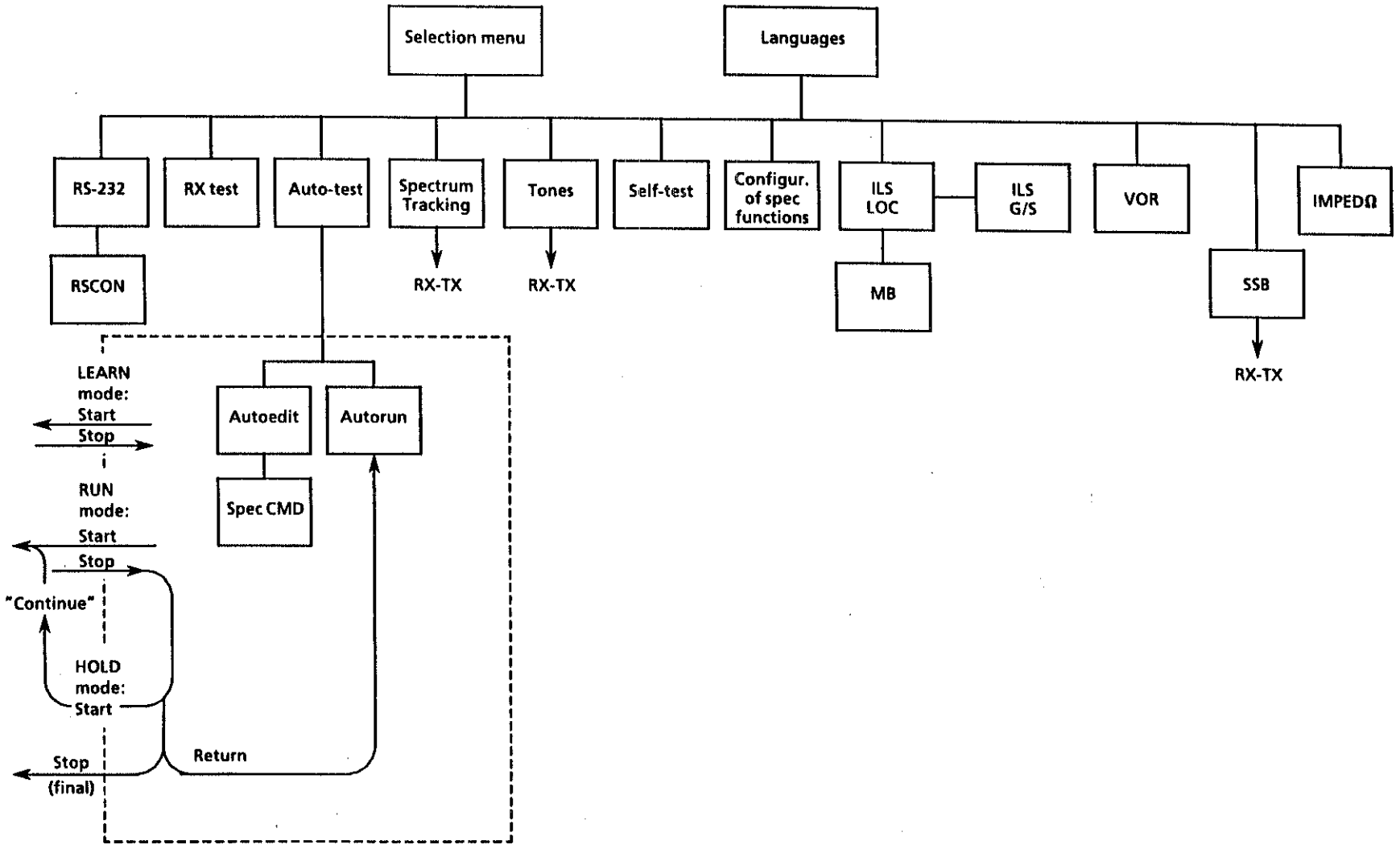


Fig. 2.3-2 Menu structure

2.3.4 Error Reaction

If erroneous operation occurs, the instrument outputs an error message in the status line and produces an audible signal, and rejects the setting. Range violations beyond the minimum value are replaced by the minimum value. Range violations above the maximum value are rejected in order to protect the connected device under test. The instrument also reacts to faulty test routines by display of a message and by an audible signal.

2.3.5 Connection of the Device under Test (DUT)

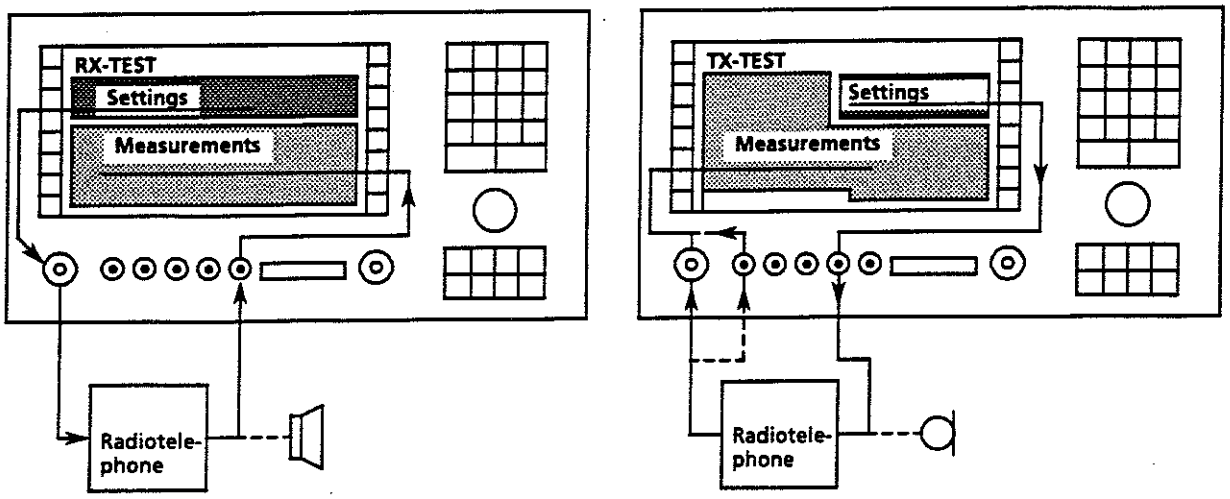


Fig. 2.3-3 Connection of the device under test

2.3.6 Selection Menu

After switching on the instrument the selection menu offers all main menus.

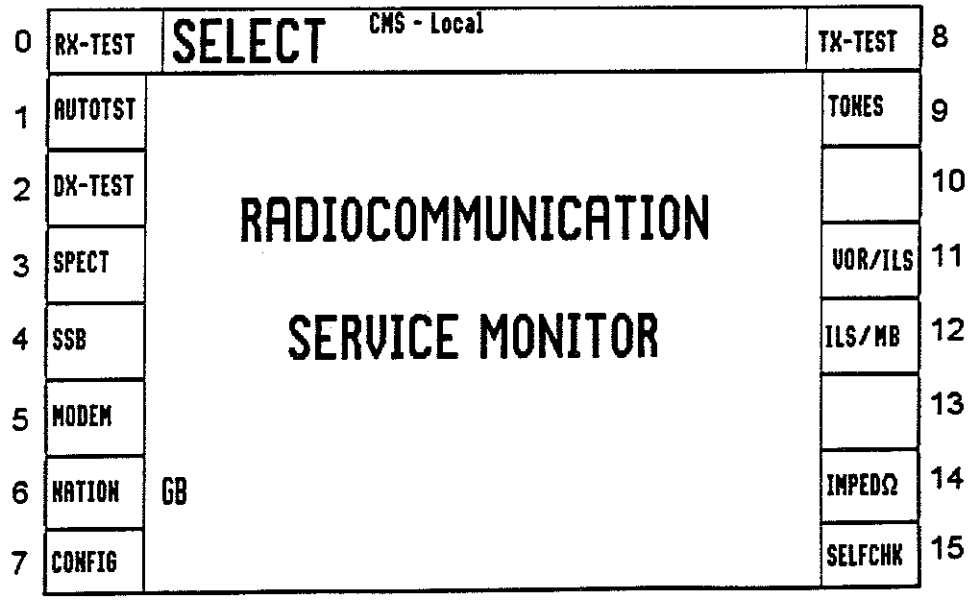


Fig. 2.3-4 Selection menu

Note: *The hardware for DX-TEST (2) is not included in the CMS33. If you press these keys you get the message "Necessary option not fitted."*

2.4 Transmitter Test (TX-Test)

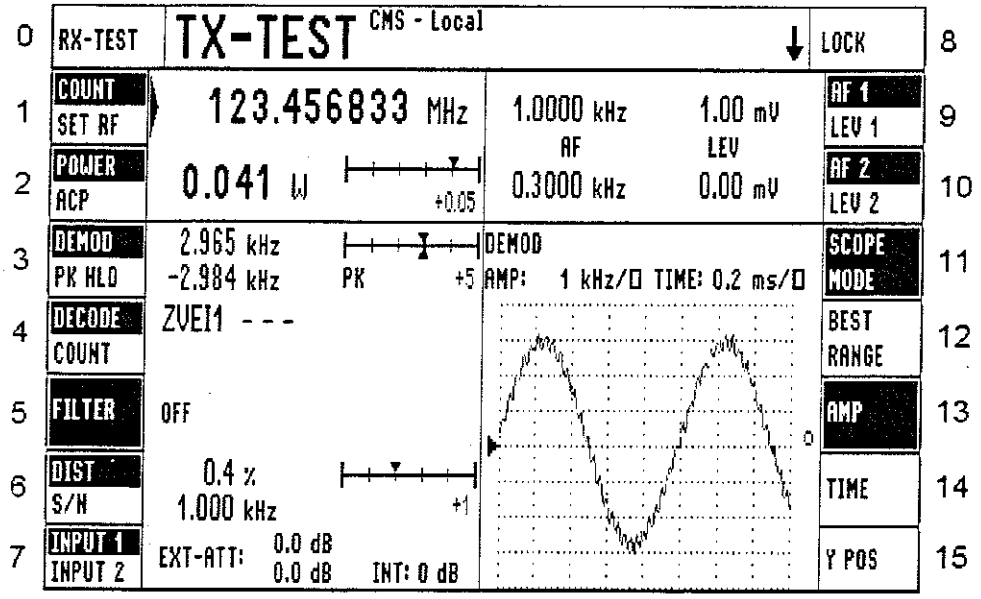


Fig. 2.4-1 Main menu TX-TEST

Starting with the main menus of the selection menu, the main menu TX-TEST (transmitter test) can be entered by pressing the softkey TX-TEST.

This menu contains all controls required to carry out a standard transmitter test. Almost every function contains submenus. These provide controls for more transmitter test functions, which are less often required.

Softkey 0 can be used to directly branch to the main menu for the receiver test (RX-TEST).

2.4.1 RF Measurement

In the case of simple transmitter tests the instrument measures the transmitter frequency and sets the demodulators to this frequency. The receiver frequency of the instrument can also be preset if the device under test outputs several carrier frequencies or if the time for counting is insufficient for the demodulator to respond rapidly (demodulation of a fast acknowledgement).

COUNT Function

The count function is constantly active if the COUNT field is shown in inverted form.

The counter resolution can be set using the following input sequence: `softkey COUNT/number 1 or 10/terminating key Hz` or `ENTER`. Thus 1 Hz (slow) or 10 Hz (fast) is selected as the counter resolution.

The sensitivity of the RF counter in particular with frequencies < 1 MHz can be enhanced by switching the IF filter on (FILTER submenu 2, softkey 6: IF-NARROW).

Relative counting

There are two possibilities for selecting a reference frequency for relative counting.

Input of softkey `COUNT/REF/ENTER` declares the frequency just measured as the reference frequency; input of `softkey COUNT /REF /number /termination key dimension` or `ENTER` declares the entered frequency as the reference frequency.

A sign in front of the result indicates that a relative frequency count is being carried out. Absolute frequency counting can be reselected by entering softkey COUNT/REF/OFF.

The dimensions MHz, kHz or Hz can be selected for direct or relative counting, e.g. softkey COUNT/Hz.

COUNT Function: Submenu

The function COUNT has a submenu which is output in the display fields next to softkeys 3, 4 and 5.

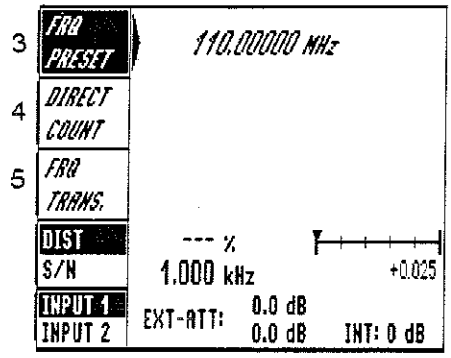


Fig. 2.4-2 COUNT submenu

The normal count function comprises a coarse direct broadband count and a subsequent exact narrowband IF count. The direct count is possible only at the connector RF IN/OUT, the IF count is possible at both inputs (RF IN/OUT and RF IN 2).

Softkey 3: FRQ PRESET (IF count)

A frequency count can be initiated in a narrowband range (approx. 100 kHz) by entering a frequency.

Switch-on: Softkey3/number/dimension or ENTER
The entered frequency replaces the coarse count.

Switch-off: Softkey3/OFF

Applications:

The IF count method can also be used at the input RF IN 2. If a source outputs several carrier frequencies with a sufficiently large spacing (approx. > 1.5 MHz), this method can be used to select a carrier frequency and to selectively count it. (Method of selection: see softkey 5 (FILTER:IF NARROW) in the main menu).

Note:

If the squelch function of the CMS is deactivated (submenu DEMOD), only a restricted COUNT function is possible:
OFF: no function
ON: first apply the RF signal to be measured, then press softkey COUNT.

Softkey 4: DIRECT COUNT

Switch-on: Softkey 4/number 100 or 1000/dimension Hz or ENTER. Direct counting is carried out with a resolution of 100 or 1000 Hz, but only via the connector RF IN/OUT.

Switch-off: Softkey 4/OFF

Applications:

Measurements can be performed on relay stations even if the instrument is not equipped with a duplex modulation meter. The signal generator of the instrument stimulates the receiver of the relay station, while the direct counter determines the frequency of the relay station transmitter, which may also be in a completely different frequency band.

Softkey 5: FRQ TRANS (Transfer function)

Actuating this softkey once transfers the measured frequency as CMS receiver frequency.

In the main menu, this action switches from the COUNT function to the SET function.

Application:

Softkey 5 facilitates operation with regard to the entry of multi-digit and often unknown transmitter frequencies as CMS receiver frequency.

SET RF Function

The receiver frequency of the instrument is fixed using the SET RF function. It is not based on the counter result. If the SET RF function is not already active (displayed in inverted form), it can be activated by entering SHIFT/softkey SET RF. The CMS receiver frequency is usually entered and displayed as a frequency value.

The CMS receiver frequency is entered using softkey SET RF/number/dimension or ENTER.

The receiver frequency setting can be varied using the VAR function and the VAR spinwheel. The receiver frequency setting can also be relative.

The reference frequency can be entered using sofkey SET RF/REF/ENTER if the current frequency is to become the reference frequency, or using the softkey SET RF/REF/number/dimension or ENTER if a frequency is to be set different from the reference frequency.

SET RF Function: Submenu

The SET RF function has a submenu which is output in the display fields next to softkeys 3 to 7.

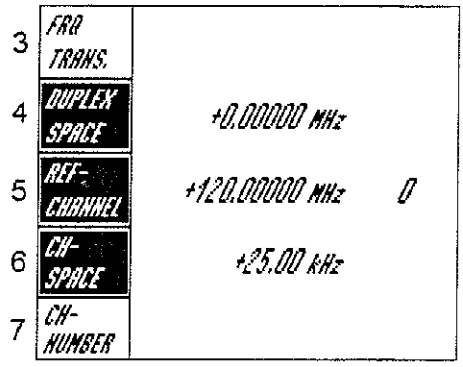


Fig. 2.4-3 SET RF submenu

Softkey 3: FRQ TRANS (Frequency transfer function)

Actuating this softkey switches the frequency transfer function on or off.

An activated transfer function has the following effects:

- At the point of switchover from TX→RX, the RX RF frequency is calculated from the RF frequency set or counted in the TX test and the duplex spacing.
- At the point of switchover from RX→TX, the TX RF frequency is calculated from the RF frequency set in the RX test and the duplex spacing, if the RF counter in the TX test is off.
- When the RX RF frequency in the duplex menu is changed, the TX RF frequency continuously follows displaced by the duplex spacing, if the RF counter is off.
- When the TX RF frequency is changed (by RF counter or setting), the RX RF frequency follows displaced by the duplex spacing.

Softkey 4: DUPLEX SPACE

The duplex spacing is entered by sequence sign/ number/(dimension or ENTER).

Values between -500MHz and +500MHz are possible.

The duplex spacing is positively counted if the RX RF frequency is larger than the TX RF frequency.

Softkeys 5, 6 and 7 serve to define the channel numbers.

Softkey 5: REF CHANNEL (Reference channel)

The reference channel is entered by number/ ENTER.

Values between 0 and 9999 are possible.

Entries are permissible only if the channel number mode is off (softkey 7).

This entry establishes reference between frequencies and channel numbers. In addition to the reference channel entry, also the respective reference frequency is displayed.

At a duplex spacing not equal to zero, the reference frequency in the TX and RX test is different. In the DX test, the reference frequency is always referred to the RX frequency.

Softkey 6: CH-SPACE (Defining of channel spacing)

The channel spacing is entered by sequence sign/ number/(dimension or ENTER).

Values between -1MHz and + 1MHz are possible.

Entries are permissible only if the channel number mode is off (softkey 7).

A positive sign means that higher channel numbers correspond to higher frequencies.

Softkey 7: CH NUMBER (hannel number)

Actuating softkey 7 switches the channel number mode on or off.
When channel number mode is on, frequencies are only displayed as channel numbers plus offset. Reference between channel numbers and frequencies is made when the reference channel is entered.

If the channel number mode is activated in the RX or DX test, the RX RF frequency is assigned to the reference channel selected by softkey 5. The TX channel number is calculated from the TX RF frequency and the duplex spacing and displayed if present in the menu.

If the channel number mode is activated for the TX test, the TX RF frequency is assigned to the reference channel selected by softkey 5.

With VAR spinwheel variations, also the frequencies are varied in the channel number mode. This gives the offset to the channel number.

Offset also occurs if the RF counter counts frequencies that are not exactly in line with the channel spacing.

Frequencies with channel numbers below 0 or above 9999 are not indicated as channel number plus offset, but by normal frequency display.

2.4.2 Power Measurement

POWER Function

The broadband RF power measurement can only be performed at the RF IN/OUT socket; the selective RF power measurement can also be carried out at the RF IN 2 socket (input 2). The dimensions of the broadband RF power measurement are W or dBm, those of the selective RF power measurement are mV, W, dBµV or dBm.

A logarithmic relative display based on a reference value can be selected. Tolerance markers can be set on the analog bar for the dimensions mentioned above; Autorange or Range Hold can be selected on the analog display for the full-scale value.

Selective power measurement:

In this measurement mode the CMS is automatically operated in the mode BEAT mode with an IF of 2 kHz (LO frequency of the local oscillator is 2 kHz **below** the frequency indicated).
The demodulator is switched off. The test bandwidth is approximately the set receiving frequency ± 50 kHz.

The dynamic range is depending on the input:
RF IN/OUT: approx. -62 ... + 50 dBm
RF IN 2: approx. -50 ... -35 dBm

Measurement sensitivity can be increased by reducing the test bandwidth using the filters available in the CMS.

The use of the CCITT filter may cause problems as, in accordance with the definition, it features no constant attenuation characteristic in the pass band.

In contrast to the broadband RF power measurement, the selective RF power measurement also includes the Peak Envelope Power (= PEP). With AM results that are up to 6 dB higher (100%) are therefore obtained.
Calibration of the selective RF power measurement is not required.

Note: ***Limiting sensitivity may be reduced as a result of strong signals outside the measuring bandwidth. If the frequency of the device under test strongly deviates from the nominal frequency, the measurement may be impaired. (Remedy: Monitoring the 2-kHz beat signal by way of the loudspeaker or scope.***

POWER Function: Submenu 1

Pertaining to the POWER function a submenu is available, which is assigned to the fields beside the softkeys 3 to 6 in the display.

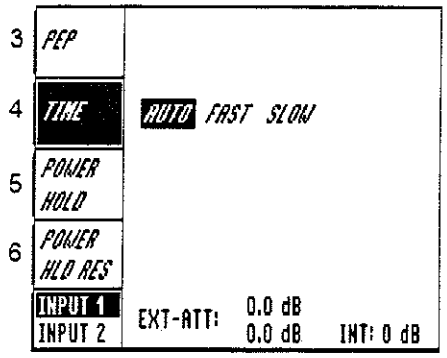


Fig. 2.4-4 POWER submenu

Softkey 3: PEP
The type of RF power measurement (selective or broadband) is selected using this softkey.

ON: Selective RF power measurement
OFF: Broadband RF power measurement

Softkey 4: TIME
With broadband RF power measurements a low-pass filter in the measurement path is switched on (SLOW) or off (FAST) using this function. With the setting AUTO the lowpass is switched on during AM modulation; otherwise the lowpass is off. Its cutoff frequency is about 4 Hz.

Softkey 5: POWER HOLD
Storage of the maximum value is switched on when actuating this softkey, i.e. the highest measured value of each RF power measurement (selective or broadband) is stored until deletion. The maximum value is deleted by pressing the softkey 6 (POWER HLD RES) or softkey 2 (POWER).

Softkey 6: POWER HLD RES
The maximum value of RF power measurement currently stored is deleted provided that softkey 5 (POWER HOLD) is activated.

POWER Function: Submenu 2

VSWR - Voltage Standing Wave Ratio

VSWR measurement comprises the determination of the forward and reflected power and the calculation of their ratios (VSWR).

VSWR measurement is effected using a measuring head (NAS-Z1, Z3, Z5, Z6, Z7) which is connected at the rear of the CMS via a sub-D cable at the 50-contact connector.

The measuring head, which is inserted between transmitter and antenna, determines the forward and reflected voltage. An analysis of the data supplied by the measuring head is effected in the CMS, with an additional indication of the ratios of the two voltages.

VSWR measurement is executed within the TX test.

After the VSWR measurement has started, the values of the forward and reflected voltage as well as the ratio of these two values are indicated one below the other. These values are indicated in digital form with an additional representation on the analog bar.

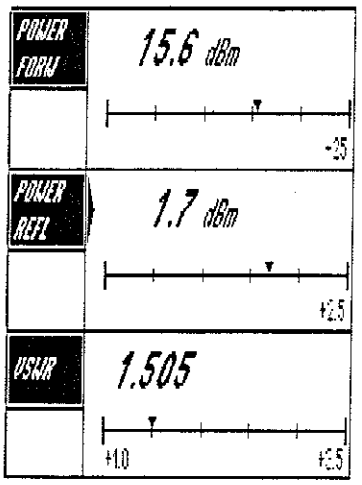


Fig. 2.4-5

Functions "TOL" and "REF" cannot be used for the indication of the VSWR value. A change of unit is neither possible in the indication of this value which has no unit. Further, the analog bar scaling of the VSWR result always starts with 1.

ACP Function

Adjacent Channel Power Measurement (ACP)

This function is not available in the CMS 33.

2.4.3 Demodulation

Softkey 3 is assigned two functions:

DEMOD (continuous demodulation)
PK HLD (demodulation with peak hold function)

The first or second function is selected using the SHIFT key.

DEMOD Function

The instrument is able to demodulate the transmitter signal according to AM, FM or ϕM. One of the three demodulation modes is selected by the following input:

`softkey DEMOD/dimension.` FM demodulation is then used for the dimensions Hz and kHz, AM demodulation for % and ϕM demodulation for rad.

Different weighting modes can be selected in the submenu. If peak weighting is selected, the positive and negative peaks are displayed at the same time. Tolerance markers and decision criteria such as e.g. branching in the autorun control program always refer to the positive peak value, however. The RMS weighting generates only one measured value.

Modulation sensitivity

The modulation sensitivity is integrated in a search routine, which varies the AF voltage of the modulation generator at the transmitter input until a predefined modulation depth, frequency deviation or phase deviation is attained as transmitter modulation.

The entry is made using:

`Softkey DEMOD/number/dimension.`
The number corresponds to the entered modulation value and the dimension to the demodulation mode of the CMS.

If the demodulation mode output in the display is to be retained, ENTER can be input instead of the dimension.

The anlog display can be assigned a full-scale value depending on the measured value or a fixed full-scale value (see function-based hardkeys (RANGE), Section 2.3.2.2.1). The positive peak value applies if the fixed full-scale value is to be derived from the currently measured value.

Tolerance markers can be entered in the analog display (see function-based hardkeys (TOL), Section 2.3.2.2.1). In the event of two measured values it is again the positive peak value which is used for the tolerance weighting.

DEMOD Function: Submenu

The DEMOD function has a submenu which is output in the fields in the display next to softkeys 4 to 7.

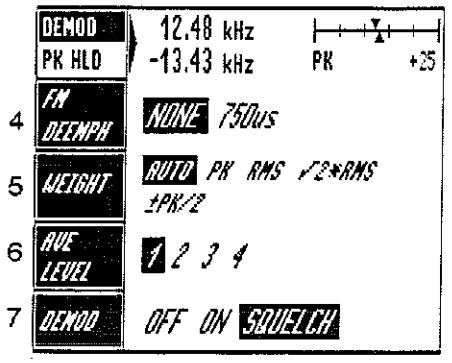


Fig. 2.4-6 DEMOD submenu

Softkey 4: FM DEEMPH (deemphasis)

Softkey 4 can be used to switch on or off a 750-µs-deemphasis. This function is only of significance with FM selected.

Softkey 5: WEIGHT (rectifier)

Softkey 5 is used to select the detector. There are five different possibilities:

AUTO: Noise signals are RMS weighted and wanted signals are peak weighted. Small signals are automatically considered to be noise signals and large signals to be wanted signals.

The limit (RMS) is
200 Hz frequency deviation for FM
0.2 rad phase deviation for ϕM
1 % modulation depth for AM.

PK: Simultaneous positive and negative peak-value measurements.

RMS: Real RMS measurement.

√2 * RMS: Real RMS measurement multiplied by 1.41.

This measurement is used for determination of the peak value when modulating with sinewave signals, and the integrating effect of the RMS detector is to be used at the same time (e.g. with noisy signals).

± PK/2: Average of positive and negative peak-value measurement.

Softkey 6: AVE LEVEL (averaging factor)

Softkey 6 can be used to select an averaging factor for RMS and 1.41 RMS measurements. Four averaging possibilities are provided.

1: One measurement determines the result.

2: The result is the average of two measurements.

3: The result is the average of three measurements.

4: The result is the average of four measurements.

Each single measurement corresponds to the average of 5 AD measurements.

in IEC bus mode, the single measurements are repeated following a delay time in the case of large changes in signal level.

The peak-value measurement is always performed with one cycle only.

Averaging factors are selected if reproducible results or a constant analog display are desired despite noise. The repetition rate of the measurements is of course reduced with high averaging factors.

Softkey 7: DEMOD (demodulator)

Softkey 7 offers the following alternatives:

OFF: Switching off demodulator
ON: Switching on demodulator
SQUELCH: Activation of squelch

The squelch switches on the demodulator with a sufficiently high IF level and switches it off at a low level.

Applications:

It is recommended to have the demodulator continuously switched on for remote measurements. The squelch function is activated if the noise of the uncontrolled demodulator results in interferences (e.g. before and after a transmitter burst of limited duration).

The OFF function (demodulator off) is provided as a precautionary measure for switching off e.g. a high-level signal at the output of the demodulator to prevent interference with other sensitive measurements in the CMS.

PK HLD Function

The demodulation mode for the PEAK HOLD function is based on the DEMOD function. Pressing the PK HLD softkey resets the display and stores the largest measured value of the positive peak-value meter until cleared again.

It is also possible with PEAK HOLD to program the full-scale value of the analog display just as with DEMOD. The setting of tolerance markers is also possible.

Using the functions "750-µs deemphasis" and "Squelch" of the demodulator from the DEMOD submenu with the PEAK HOLD function is also advantageous.

Nevertheless, a submenu has not been produced for PEAK HOLD so that functions from the main menu which are used particularly frequently together with the PEAK HOLD function, e.g. decoding of a tone sequence, are not covered by the submenu. If these functions are required, they can be set in the DEMOD submenu and used for the PEAK HOLD function.

See Section 2.9 for further special functions.

2.4.4 AF Measurement

Softkey 4 is assigned two functions:

DECODE (tone sequence decoding)
COUNT (frequency measurement of demodulated or beat signal)

The shift key is used to select between first and second function.

DECODE Function

The tone sequence decoder is activated following actuation of Softkey5/ENTER. A decoding result is deleted if present in the display and the tone sequence decocde expects a sequence for decoding. Once this has arrived, it is output in two lines on the display together with the designation of the standard.

The digits 0 to 9 and possibly the special characters A to F are displayed, and also * and # with dual-tone sequences. X indicates a non-decodable frequency and P indicates a pause. The PEAK HOLD function is activated together with the decoding function since the modulation is usually also of interest in addition to the contents of the tone sequence.

DECODE Function : Submenu 1

The function DECODE branches into two submenus, which are output in the display fields next to softkeys 3 to 7. By pressing ENTER, the decoder can also be started from this menu.

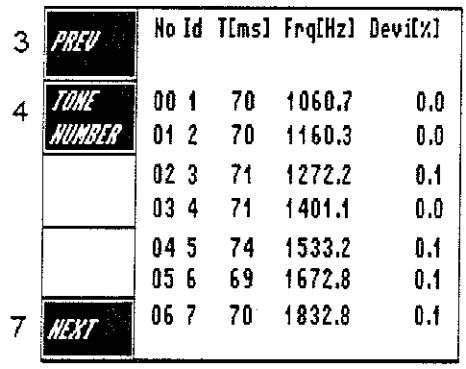


Fig. 2.4-7 DECODE submenu 1

This submenu reads out the contents of the decoded telegram in more detail. Each entry in the measurement buffer is identified by a sequential number starting with "0".

The column "T" gives the measured duration of each displayed tone.

With the tone sequence standards 1 to 9, additionally the frequency measured for each received tone is displayed in the column "FRQ [Hz]", as well as the deviation from the rated frequency in percent in the column "Devi [%]". No information will be shown for invalid tones or tone pauses or, as the case may be, dual tones. Restarting the decoder in submenu 1 causes the data of the new telegram to be output sequentially - beginning with "0" - when the tone sequence has been received completely.

Softkey 3: PREV (Page down)

The display pages down to the previous page. This softkey has no function when the first page is already displayed.

Softkey 4: TONE NUMBER
(Printing of individual lines)

By programming <TONE:NUMBER value>, the contents of a respective line can be printed in the report. If no value is entered, all the lines are printed in form of a table.

Softkey 7: NEXT (Page up)

The display pages up to the next page. This softkey has no function if the last tone that was decoded is already shown.

Remarque:

DECODE Function: Submenu 2

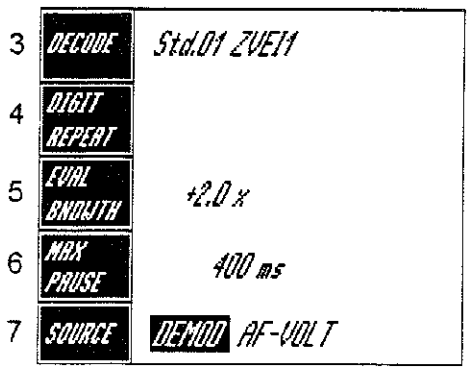


Fig. 2.4-8 DECODE submenu 2

Softkey 3: DECODE (tone sequence standard)

Softkey 3 is used to select the tone sequence standard. The entry is made using softkey 3/number/ENTER where each number is assigned a tone sequence standard.

Tabelle 2.4-1

Standard number	unmodified	modified
0	Std.0 Fixed Frequencies	Std.0
1	Std.1 ZVEI 1	Std.1
2	Std.2 ZVEI 2	Std.2
3	Std.3 CCIR	Std.3
4	Std.4 EEA	Std.4
5	Std.5 EIA	Std.5
6	Std.6 VDEW	Std.6
7	Std.7 EURO	Std.7
8	Std.8 CCITT	Std.8
9	Std.9 NATEL	Std.9
10	Std.10 DTMF	Std.10
11	Std.11 VDEW direct dial	-------

Standards 1 to 9 are the most common single-tone sequences. To differentiate between unmodified and modified tone sequences, the CMS outputs the standard number and name in the display or, with modified tone sequences, only the standard number.

The assignment of frequencies to numbers is displayed in the definition menu for tones and can also be modified. Standard 0 reacts like a completely normal tone sequence standard. In this case the frequencies are the fixed frequencies for the AF generators. Standard 10 is the dual-tone standard and cannot be modified for evaluation purposes.

Softkey 4: DIGIT REPEAT

Softkey 4 can be used to switch on/off the digit repeat. Since tone length information cannot be used for evaluation purposes, a double digit is not represented by an extra-long tone but by a tone followed by a further tone (tone E) as the repeat tone. The double digit appears with the digit repeat function switched on, the digit and the special character E appear with the digit repeat function switched off.

Softkey 5: EVAL BNDWTH (evaluation bandwidth)

The evaluation bandwidth of the decoder is programmed by entering softkey 5/number/ENTER. The number should be selected as the magnitude in % which is permissible as a positive or negative deviation from the rated frequencies. Frequencies within this window are decoded as valid. Frequencies outside this window are marked by X.

The tolerance window should not be extended too far, especially in the case of tone sequences with narrow frequency steps, since this could lead to overlapping of the tolerance ranges and thus ambiguous decoding results.

Softkey 6: MAX PAUSE (tolerable pause)

The decoder waits for brief pauses and then continues decoding. The tone sequence is considered to be terminated if the pauses are too long, then the result is displayed. This time limit can be defined using softkey 6/number/ENTER. The dimension of the number is ms.

This pause definition must not be confused with the pause between two tones which is defined in the standard and which can be influenced in the definition menu for tones. The latter is smaller than the previously defined time limit. A "P" is set during the evaluation if only the intertone pause is exceeded.

Softkey 7: SOURCE (signal source)

Softkey 7 is used to select either the demodulator or the AF voltmeter socket (AF/SCOPE) as the decoder source.

COUNT Function

The frequency of the demodulated signal or the beat signal is counted by pressing softkey 4.

A relative measurement can be made in two different manners:

- The currently measured frequency is selected as the reference frequency by entering softkey 4/REF/ENTER.
- The frequency corresponding to the number is selected as the reference frequency by entering REF/number/dimension or ENTER.

The relative result is the difference from the reference frequency. Relative measurements are identified by a sign in front of the result.

COUNT Function: Submenu

The COUNT function has a submenu which is output in the fields in the display next to softkeys 5 and 6.

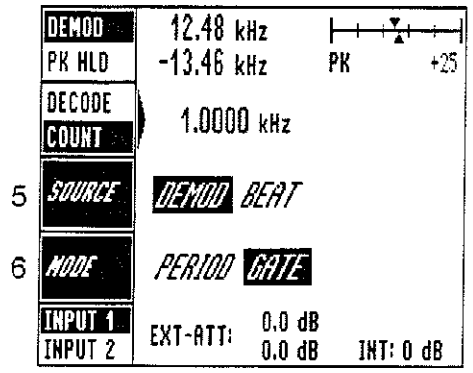


Fig. 2.4-9 COUNT submenu

Softkey 5: SOURCE (Signal source)

Softkey 5 can be used to switch between the signal sources DEMOD (demodulated signal) and BEAT (beat signal).
Since the beat measurement is usually carried out with an unmodulated signal, the AF-generator of the CMS is switched off following the activation of softkey 4 (COUNT) provided that Beat is selected.

Softkey 6: MODE (Operating mode and resolution of counter)

There are two alternatives:

Period counting
Gate time counting

Period counting has a resolution of 0.1 Hz up to 100 kHz; the resolution is 1 Hz at frequencies above this value. Period counting is fast but requires a signal without noise.

Gate time counting is less sensitive to noisy signals.

2.4.5 Filter Selection

FILTER Function

Various AF filters can be switched on or off using softkey 5/ON or OFF. The IF and AF filters and their characteristic frequencies can be selected in two submenus.

FILTER Function: Submenu 1

The FILTER function branches to two submenus, which are both output in the display fields next to softkeys 4 and 7.

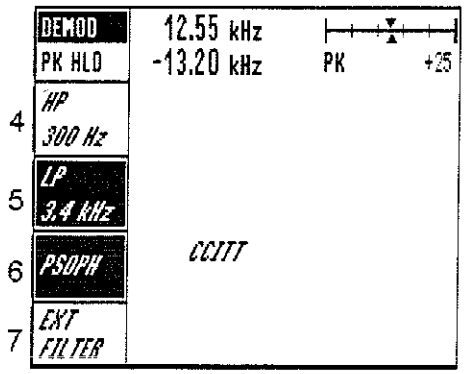


Fig. 2.4-10 FILTER submenu 1

Softkey 4: HP 300 Hz (300-Hz highpass)

Switching the 300-Hz highpass on and off.

Softkey 5: LP 3.4 kHz (3.4-kHz lowpass)

Switching the 3.4-kHz lowpass filter on and off.

Softkey 6: PSOPH (psophometric filter)

Switching the psophometric filter on and off. The psophometric filter is a CCITT filter.

Softkey 7: EXT FILTER

Switching the external filter on and off. An input and output for the external filter are fitted to the rear of the device (CONTROL socket ***47***; pin 10 = input/pin 42 = output).

The FILTER submenu 2 can be called by pressing the MENU ↓ (DOWN) key.

Example of an external filter

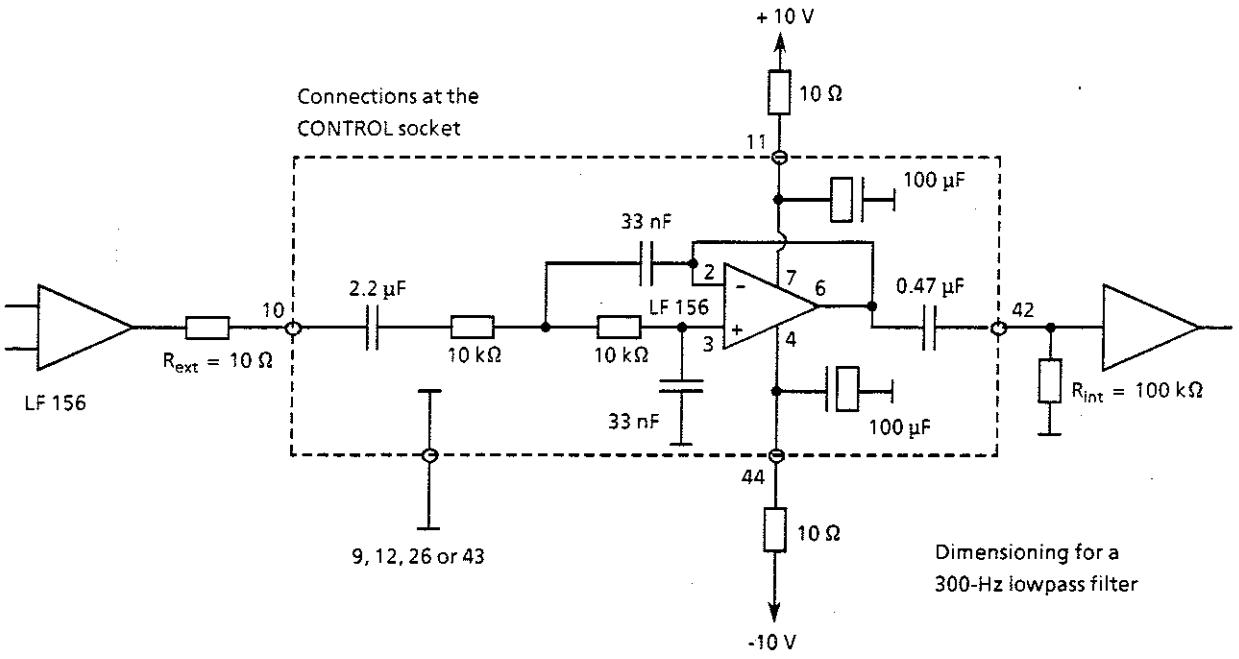


Fig. 2.4-11

FILTER Function: Submenu 2

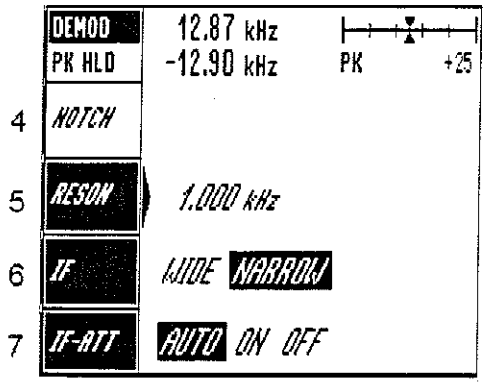


Fig. 2.4-12 FILTER submenu 2

Softkey 4: NOTCH (notch filter)

The notch filter is switched on using softkey 4/ON and off using softkey 4/OFF.

Stop frequency of notch filter:
The stop frequency of the notch filter is also selected using softkey 4. The entry is made using softkey 4/number/dimension or ENTER.

Since the resolution of the set frequencies cannot always be set as required, the actually set frequency is output in the display.

Softkey 5: RESON (resonance filter)

The resonance filter is switched on using softkey 5/ON and off using softkey 5/OFF.

Resonance frequency of resonance filter:
Softkey 5 is used to select the resonance frequency of the filter. The entry is made using softkey 5/number/dimension or ENTER. The actually set frequency is displayed as with the notch filter.

Filter combinations

For better understanding all filters can be envisaged as a series connection of three filter groups:

- Highpass filter - lowpass filter
- Psophometric filter - external filter
- Notch filter - resonance filter

Highpass and lowpass filters can be combined independently into four different filter configurations.

The psophometric filter and the external filter cannot be combined, the same applies to the notch filter and the resonance filter. Since the notch filter is used for distortion and SINAD measurements, the last filter group cannot be used for evaluation during a distortion or SINAD measurement.

Notch filter and resonance filter are also being switched off when quitting or selecting a new RX-test and TX-test, since in this case SINAD or DIST measurements automatically continue to run.

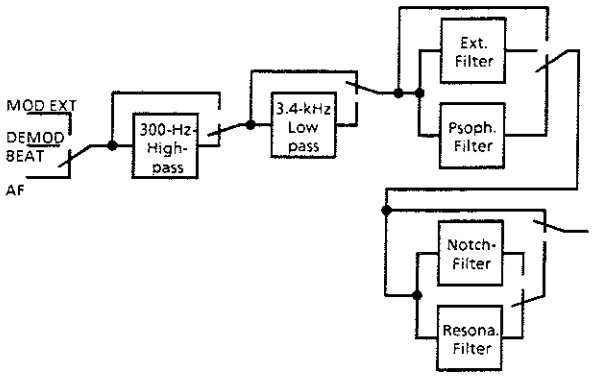


Fig. 2.4-13 Signal paths

Softkey 6: IF (IF filter)

The IF filter can be switched on and off using softkey 6. The IF bandwidth is limited to approx. 25 kHz by the NARROW filter. This improves the S/N ratio, especially when receiving small RF levels, but also results in a distortion at higher deviations and/or modulation frequencies.

Softkey 7: IF-ATT (IF attenuation)

The attenuator of the IF control can be switched on or off (important with AM demodulation). Also an automatic function is available.

2.4.6 Distortion and S/N Measurements

Softkey 6 is assigned two functions:

DIST (distortion measurement)
S/N (S/N measurement)

The SHIFT key is used to select between first and second function.

DIST Function

The distortion measurement can be performed with the dimension % or dB. The test frequency may vary between 100 Hz and 4 kHz.

Dimension

The measurement is performed in dB by entering softkey 6/dimension/dB and in % by entering softkey 6/dimension/%.

Test frequency

The test frequency is defined using softkey 6/number/dimension/Hz or kHz.

The full-scale value can also be influenced in the analog display for the distortion measurement:

The currently measured value is used to define the full-scale value by entering softkey 6/RANGE/% or dB or ENTER.

A number is used to define the full-scale value by entering Softkey 6/RANGE/number/% or dB or ENTER.

Tolerance markers can be set in the analog display using the same syntax: softkey 6/TOL/number/% or dB or ENTER.

DIST Function: Submenu

The DIST function branches into one submenu, which is ouput in the display fields next to softkeys 5 and 7. Softkey 6 is assigned to the main menu.

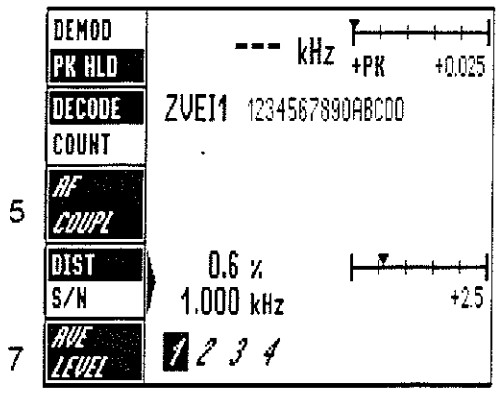


Fig. 2.4-14 DIST submenu

Softkey 5: AF COUPL (test frequency)

Softkey 5 can be used to define whether the test frequency selected in the main menu under distortion is also to define the frequency of the modulation generator or not.

Application:

Generally, coupling offers advantages. The modulation generator supplies the signal to be measured by the distortion meter following the device-under-test. However, coupling is switched off if the radiotransmitter has a scrambler, and the modulation generator signal is set independently of the distortion test frequency.

Softkey 7: AVE LEVEL (averaging factors)

Softkey 7 selects four averaging factors:

1: One measurement determines the result.

2: The result is the average of two measurements.

3: The result is the average of three measurements.

4: The result is the average of four measurements.

Each single measurement corresponds to the average of five AD measurements.

In IEC bus mode, the single measurements are repeated after a delay time in the case of large changes in signal level.

S/N Function

Whereas the wanted signal is masked out by a filter in the case of a distortion measurement, it is switched off with the S/N measurement.

This measurement can also be performed in two dimensions; the dimensions are selected by entering softkey 6/dimension % or dB.

The current measured value is used to define the full-scale value in the analog display by entering softkey 6/RANGE/% or dB or ENTER.

The entered numeric value is used to define the full-scale value by entering softkey 6/RANGE/number/% or dB or ENTER.

Tolerance markers can be set in the analog display by entering softkey 6/TOL/number/% or dB or ENTER.

S/N Function: Submenu

The S/N function branches to one submenu which is output in the display fields next to softkeys 5 and 7. Softkey 6 remains assigned to the main menu.

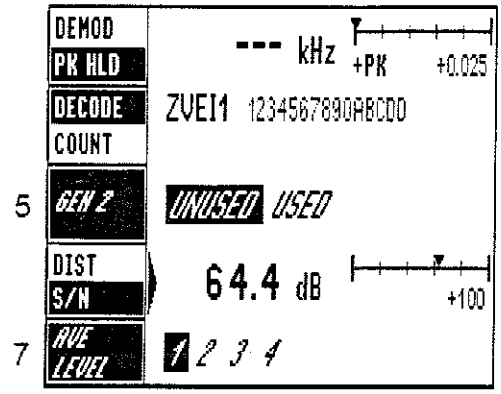


Fig. 2.4-15 S/N submenu

Softkey 5: GEN 2 (modulation generator 2)

The wanted modulation signal is switched on and off alternately in the course of the S/N measurement. Softkey 5 is used to select whether the modulation generator 2 is to to follow this rythm or not.

Softkey 7: AVE LEVEL (averaging factors)

Softkey 7 selects four averaging factors:

1: The result is the average of one signal measurement and two noise measurements.

2: The result is the average of one signal measurement and three noise measurements.

3: The result is the average of two signal measurements and four noise measurements.

4: The result is the average of two signal measurements and five noise measurements.

Each single measurement corresponds to the average of five AD measurements.

In manual operation and IEC bus mode, the single measurements are repeated after a delay time in the case of large changes in signal level. (Different S/N ratios (measurement times) may be the result).

2.4.7 Input Switchover

INPUT 1/INPUT 2 Function

The selected RF input (RF IN/OUT or RF 2) is shown in inverted form. The other input can be selected by entering SHIFT/ softkey 7. It is possible to inform the CMS of the attenuation value connected prior to the associated input. By entering softkey 7/number/dB or ENTER the CMS takes into account the entered attenuation for the level with RF measurement and setting.

2.4.8 Lock

LOCK Function

Softkey 8 is assigned a simple changeover key function.

If the LOCK mode is active, TX test can only be reached by operation in the RX test. With the LOCK function deactivated the switchover from RX test to TX test is only possible by applying an RF power to the RF IN/OUT socket ***29.*** The RX test is automatically activated again by an RF voltage drop. This return to RX test can, however, be eliminated when switching over to the TX test via keys or by calling a submenu in the TX test.

Application:

The LOCK status is used if discontinuous transmitter tests are performed, e.g. power pulses of limited duration with superimposed modulated data messages. The LOCK function prevents the CMS from returning to the receiver test following each pulse. A typical example is an acknowledge call. The LOCK function is automatically switched on in this case and with certain other measurements such as e.g. cellular radio.

2.4.9 Modulation Generators

Softkey 9 is assigned all functions of the first modulation generator, softkey 10 those of the second modulation generator. The frequency is the first function and the level of the modulation generator is the second. Switching between the two functions is possible by entering SHIFT/softkey 9 or 10.

AF 1/AF2 Function

The frequency is entered using softkey 9 or 10/number/dimension or ENTER. The modulation generator is switched off by entering softkey 9 or 10/OFF. This switch-off function for the level with a frequency entry has the following purpose:
The levels of tone sequences generated naturally by modulation generators are set using the level function. If the modulation generator is not switched off using the above-mentioned method, the valid continuous tone is output before and after the tone sequence. The modulation generator can be switched on again using softkey 9 or 10/ON.

Variation function

The variation increment for the VAR spinwheel can be entered using softkey 9 or 10/VAR/number/dimension or ENTER. In contrast to usual operation, VAR/0/ENTER does not set the minimum increment but leads to variation with the fixed frequency series (see VAR function, Section 2.3.2.2.1 and definition menu for tones, Section 2.8).

Reference function

The selected frequency is defined to be the reference by entering REF/number/dimension or ENTER. The set frequencies must be understood as a difference from the reference frequency (see REF function, Section 2.3.2.2.1).

LEV1/LEV2 Function

Since the source impedance of the modulation generator is very low, the set level is to be understood as the EMF.

The modulation generator level is entered using softkey 9 or 10/number/dimension or ENTER. The power is referred to 600 Ω when the dimension dBm is selected. The level is switched off using softkey 9 or 10/OFF, and the previously valid level is switched on again using softkey 9 or 10/ON (a special method for switching off the level is described with the AF1/AF2 function). Calling the beat frequency measurement automatically switches off the two modulation generators.

Variation function

The variation increment on the VAR spinwheel can be set using softkey 9 or 10/VAR/number/dimension or ENTER.

Application:
The modulation signal must be increased by 20 dB in the case of certain measurements. It is recommendable to enter softkey 9 or 10/VAR/20/dB in this case. One step on the VAR spinwheel switches the 20-dB overload on and off independent of the selected level.

Reference function

The variation increment for the level on the VAR spinwheel can be set using softkey 9 or 10/REF/number/dimension or ENTER.

2.4.10 Oscilloscope / DC Measurement

The scope mode is activated by means of the softkey SCOPE MODE. If the active cursor is located at this position, a submenu may be called for handling the signal sources for the scope and activating the DC measurement.

If the active cursor is located at this position, it can also mean when entering

<CLEAR> : Switching on the FREEZE mode. Signal recording is stopped. "FREEZE" appears in the display.

<ENTER>: Switching off the FREEZE mode. Signal recording continues.

Quitting the current main menu leads to deactivation of the FREEZE mode.

SCOPE MODE Function

Softkey 12: BEST RANGE

The automatic amplitude scaling can be switched on and off using this softkey. With the automatic amplitude setting switched on, the best gain (filling the complete format) is set in steps of 1-2-5. The associated scale is displayed on the scope screen.

Softkey 13: AMP (amplitude setting)

With softkey 13 activated (active cursor), the gain setting can be selected manually in steps of 1-2-5 using the VAR spinwheel.

Softkey 14: TIME (time scaling)

If softkey 14 is activated, the time scale can be varied using the VAR spinwheel in steps of 1-2-5.

Softkey 15: Y POS (Y-position)

Activating softkey 15 allows for shifting the position of the displayed signal in the vertical direction using the VAR spinwheel.

SCOPE MODE Function: Submenu 1

The SCOPE MODE function has a submenu which is displayed in the fields next to softkeys 11 to 15.

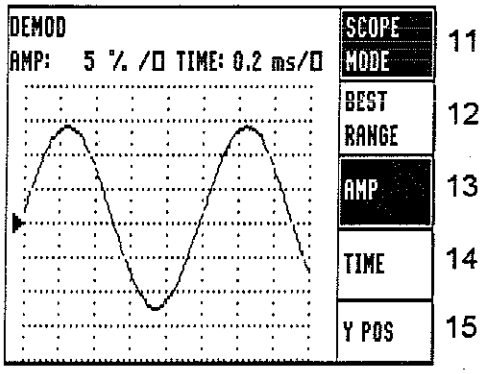


Fig. 2.4-16 SCOPE MODE submenu

Softkey 11: SOURCE AUTO (automatic signal source selection)

If softkey 11 is used to switch on the automatic source selection, the demodulated signal is automatically displayed in the transmitter test and the signal at the AF/SCOPE connector in the receiver test.

Softkey 12: SOURCE FIX (Manual selection of signal source)

AF: AF signal at AF/SCOPE connector

DEMOD/BEAT: Selection of demodulated signal or beat signal. The beat signal is displayed on the scope screen.

MOD EXT: Modulation input for external signals.

DIST

When this softkey is activated, the signal path SOURCE DIST shown in Fig. 2.4-17 will be applied to the sope.

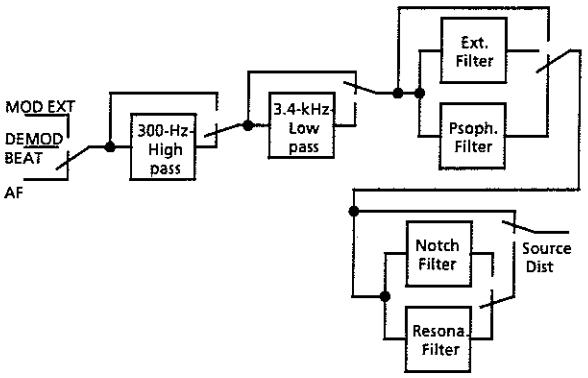


Fig. 2.4-17 Signal paths

2.5 Receiver Test (RX-Test)

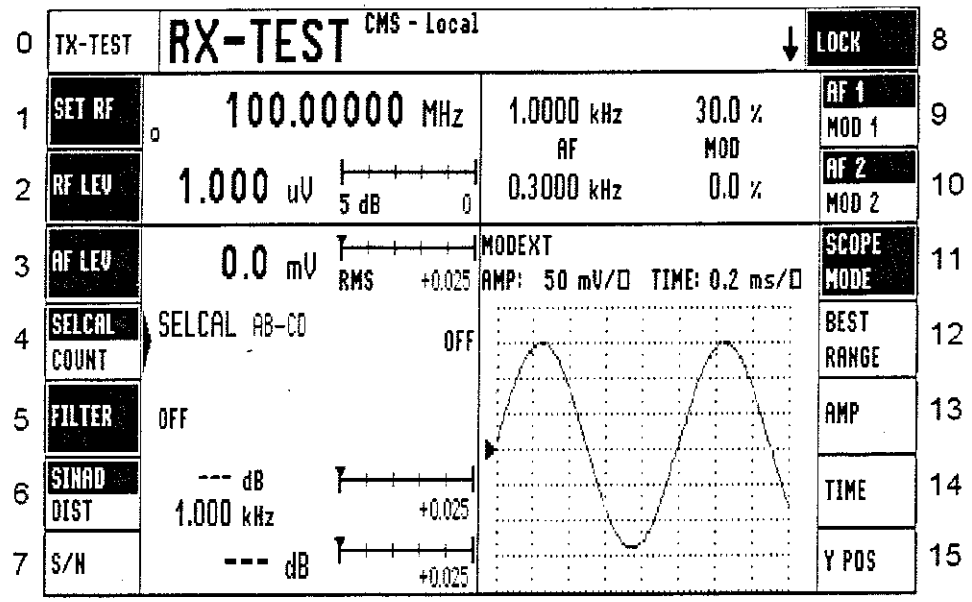


Fig. 2.5-1 Main menu RX-Test

Starting with the main menus of the selection menu, the main menu RX-TEST (receiver test) can be reached by pressing the softkey RX-TEST.

It contains all controls required to carry out a standard receiver test. Almost every function contains submenus. These contain controls which can be used for more seldom receiver test functions.

Softkey 0 can be used to directly branch to the main menu for the transmitter test (TX-TEST).

2.5.1 RF Setting

SET RF Function

The signal generator frequency of the instrument can be set using the SET RF function. This function is entered by means of sequence SET RF/number/dimension or ENTER.

The signal generator frequency setting can be varied using the VAR function and the VAR spinwheel.

The signal generator frequency setting can also be made in relative mode.

The reference frequency is entered using softkey SET/REF/ENTER, if the current frequency is to become the reference frequency, or using softkey SET REF/number/dimension or ENTER if another frequency is to be set as the reference frequency.

SET RF Function: Submenu

The SET RF function has a submenu which is output in the display fields next to softkeys 3 to 7.

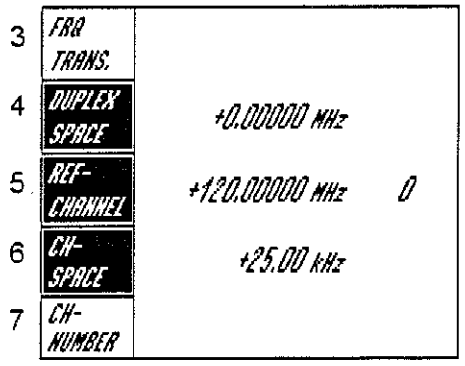


Fig. 2.5-2 SET RF submenu

Softkey 3: FRQ TRANS
(Frequency transfer function)

Actuating this softkey switches the frequency transfer function on or off.
An activated transfer function has the following effects:

- At the point of switchover from TX→RX, the RX RF frequency is calculated from the RF frequency set or counted in the TX test and the duplex spacing.
- At the point of switchover from RX→TX, the TX RF frequency is calculated from the RF frequency set in the RX test and the duplex spacing, if the RF counter in the TX test is off.
- When the RX RF frequency in the duplex menu is changed, the TX RF frequency continuously follows displaced by the duplex spacing, if the RF counter is off.
- When the TX RF frequency is changed (by RF counter or setting), the RX RF frequency follows displaced by the duplex spacing.

Softkey 4: DUPLEX SPACE

The duplex spacing is entered by sequence `sign/ number/(dimension` or `ENTER`).
Values between -500MHz and +500MHz are possible.
The duplex spacing is positively counted if the RX RF frequency is larger than the TX RF frequency.

Softkeys 5, 6 and 7 serve to define the channel numbers.

Softkey 5: REF-CHANNEL (Reference channel)

The reference channel is entered by `number/ ENTER`.
Values between 0 and 9999 are possible.
Entries are permissible only if the channel number mode is off (softkey 7).
This entry establishes reference between frequencies and channel numbers. In addition to the reference channel entry, also the respective reference frequency is displayed.
At a duplex spacing not equal to zero, the reference frequency in the TX and RX test is different. In the DX test, the reference frequency is always referred to the RX frequency.

Softkey 6: CH-SPACE
(Defining of channel spacing)

The channel spacing is entered by sequence `sign/ number/(dimension` or `ENTER`).
Values between -1MHz and +1MHz are possible.
Entries are permissible only if the channel number mode is off (softkey 7).
A positive sign means that higher channel numbers correspond to higher frequencies.

Softkey 7: CH NUMB. (Channel number)

Actuating softkey 7 switches the channel number mode on or off.
When channel number mode is on, frequencies are only displayed as channel numbers plus offset. Reference between channel numbers and frequencies is made when the reference channel is entered.

If the channel number mode is activated in the RX or DX test, the RX RF frequency is assigned to the reference channel selected by softkey 5. The TX channel number is calculated from the TX RF frequency and the duplex spacing and displayed if present in the menu.

If the channel number mode is activated for the TX test, the TX RF frequency is assigned to the reference channel selected by softkey 5.

With VAR spinwheel variations, the frequencies are also varied in the channel number mode. This gives the offset to the channel number.
Offset also occurs if the RF counter counts frequencies that are not exactly in line with the channel spacing.

Frequencies with channel numbers below 0 or above 9999 are not indicated as channel number plus offset, but by normal frequency display.

2.5.2 RF Level Setting

RF LEV Function

The signal generator level can be set using the RF LEV function. The entry is made using softkey 2/number/dimension or ENTER. If a number is not entered, this sequence can be used to convert the dimension of the set level.

The RF level can be switched off temporarily using softkey 2/OFF. The previously valid level can be switched on again using softkey 2/ON.

Whereas directly entering parameters or varying parameters using the VAR spinwheel are simply different methods of operation which lead to the same result, adjustment of the RF level using keys or the VAR spinwheel leads to different results.

The interrupt-free electronic level fine variation is used for varying the level to smaller values by means of the VAR spinwheel. The level can be reduced interruption-free by 19.9 dB in FM and ϕM modes, and by 4.9 dB in AM mode. The range used by the electronic level fine variation for the reduction in level is indicated in the analog display (in the field next to softkey 2) by a marker leading from right to left. On the other hand, setting the level using the digital keypad mainly uses the mechanical attenuators (audible switching).

Note:
Frequent level variations in automatic test systems might reduce the life utility of the attenuator. It is therefore recommended to carry out the level settings in few steps only, using the electronic level variation if possible.

Application:

The interrupt-free electronic level fine variation is used to search for the squelch point and the squelch hysteresis of the radio receiver. On the other hand, entering the level on the digital keypad always results in the optimum broadband S/N ratio of the CMS signal generator, increased level accuracy and a reduced AM distortion factor.

The variation increment can be set using softkey SET RF/VAR/number/dimension or ENTER (see function-based hardkeys (VAR), Section 2.3.2.2.1 and spinwheel, Section 2.3.2.3).

The signal generator level setting can also be made in relative mode.The reference level can be entered using softkey SET/REF/ENTER if the current level is to become the reference level, or using softkey SET/REF/number/dimension or ENTER if a different level is to be set as the reference level.

RF LEV Function: Submenu

The RF LEV function has a very important submenu which contains the automatic test routines of the receiver test. The RF LEV submenu is output in the display fields next to softkeys 3 to 5 and 7.

It is important with the automatic test routines to ensure that the radiotelephone is completely connected to the CMS. The connectors RF IN/OUT and AF/SCOPE are used for this purpose.

Since the automatic test routines may require a lengthy period of time, they can be aborted during the measurement by pressing the RF/LEV softkey.

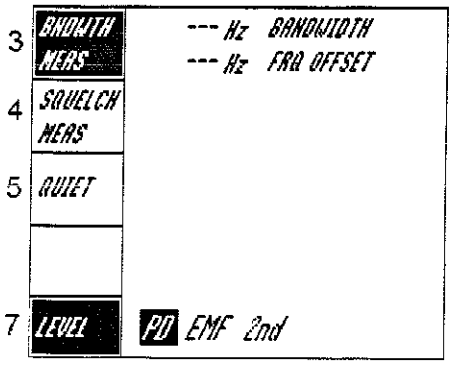


Fig. 2.5-3 RF LEV submenu

Softkey 3: BNDWTH MEAS
(bandwidth measurement)

Softkey 3 starts the bandwidth measurement.

The measurement is run as follows:

1. Initial setting: RF frequency = nominal receiver center frequency. The receiver squelch is switched off.
2. Definition of the AF noise level with RF level switched off.
3. Increase in RF level until the AF noise level has decreased by 10 dB. Storage of AF noise level.
4. Increase in RF level by further 6 dB.

5. Offset of RF frequency to higher frequencies until the AF noise level of point 3 is obtained again.
6. Offset of RF frequency to lower frequencies until the AF noise level of point 3 is obtained again.
7. The receiver band limits defined under points 5 and 6 serve for determining the receive bandwidth and the center frequency offset. These two values are displayed.

Softkey 4: SQUELCH MEAS
(squelch measurement)

Softkey 4 starts the squelch measurement.

The measurement is run as follows:

1. Initial setting: The RF level is set to the minimal value. The receiver squelch is switched on.
2. The RF level is increased interrupt-free until the AF level is switched on on the radiotelephone. This is the squelch switch-off point.
3. The RF level is decreased until the AF level on the radiotelephone is switched off again. The squelch hysteresis is the difference between the two RF levels.
4. Squelch inset and squelch hysteresis are displayed.

Softkey 5: QUIET
(quieting measurement)

The quieting measurement is initiated via `Softkey 5/number/dimension dB or ENTER`. The number in dB corresponds to the quieting criterion.

The measurement is run as follows:

1. Initial setting: RF frequency = receiver center frequency. RF level = off. The receiver squelch is switched off.
2. The AF noise level is measured.
3. The RF level is increased until the AF noise level has decreased by the number specified as the quieting criterion.
4. This RF level is displayed as result.

Softkey 7: LEVEL
(EMF-PD switchover)

Softkey 7 can be used to select whether the output RF voltage is to be displayed as a no-load voltage (EMF) or as a terminal voltage (PD) accross a 50-Ω load.

2.5.3 AF Level Measurement

AF LEV Function

The AF level measurement is selected by pressing softkey 3. The dimension can be selected by subsequently pressing a dimension key; the dimensions mV, W, dBµV and dBm are possible. Measurements in W and dBm are usually based on a load resistance of 600 Ω. This can be changed, however, in the definition menu for special functions. (Section 2.9).

Tolerance markers can be set in the analog display using `softkey 3/TOL/number/dimension` or `ENTER`.

The currently measured value is used to define the full-scale value on the analog display using `softkey 3/RANGE/dimension` or `ENTER`. The value corresponding to the number is used to define the full-scale value using `softkey 3/RANGE/number /dimension` or `ENTER`.

The current measured value is defined as the reference value using `softkey 3/REF/dimension` or `ENTER`, and the subsequent measurements are made in dB referred to this value. A reference value can be defined using `softkey 3/REF/number/dimension` or `ENTER`. An integer multiplier, which is then part of the AF-LEV result, can be specified using `Softkey 3/number/ENTER`.

AF LEV Function: Submenu

The AF LEV function has a submenu which is output in the fields in the display next to softkeys 4 to 7.

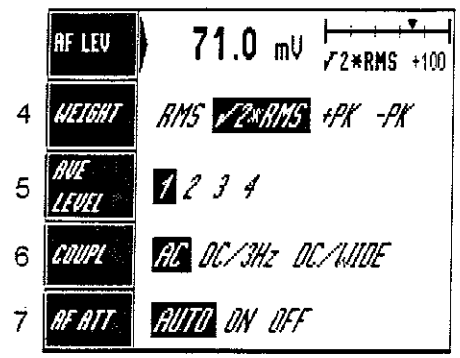


Fig. 2.5-4 AF LEV submenu

Softkey 4: WEIGHT

Softkey 4 can be used to select four different types of weighting.

RMS: Real RMS weighting

√2 * RMS: Real RMS weighting multiplied by 1.41.

This weighting is used if the peak value is to be determined when modulating with sinewave signals, and the integrating effect of the RMS detector is to be used at the same time (e.g. with noisy signals).

+ PK: Positive peak weighting

- PK: Negative peak weighting

Softkey 5: AVE LEVEL (averaging factor)

Softkey 5 can be used to select an averaging factor for RMS and √2 * RMS weighting. Four averaging possibilities are provided.

1: One measurement determines the result.

2: The result is the average of two measurements.

3: The result is the average of three measurements.

4: The result is the average of four measurements.

Each single measurement corresponds to the average of 5 AD measurements.

In IEC bus operation, the single measurements are repeated with high changes in signal level following a delay time.

Application:

A higher averaging factor results in more reproducible results compared to a single measurement especially in the case of noisy signals. An average measurement takes longer, however. The AF voltmeter is often used in the receiver test to measure the AF noise of the receiver which is not supplied with an RF signal. The reproducibility of these noise measurements is improved by averaging.

Averaging is not carried out for peak weighting.

Softkey 6: COUPL (AC/DC coupling)

Softkey 6 can be used to couple the detectors to the signal source in three different manners:

AC coupling: Only AC voltages ≥ 50 Hz are measured.

DC / 3Hz: Pure DC measurement. AC components above 3 Hz are suppressed.

DC / WIDE: AC and DC components are RMS or peak weighted together.

Softkey 7: AF ATT (input divider)

The CMS has a selectable input voltage divider in order to expand the dynamic range of the measurement points at higher values. This is usually switched on or off automatically depending on the measured value.

If the automatic feature does not meet all requirements, it can be switched off (e.g. to save time).

Selection is possible using softkey 7 between:

AUTO: Automatic adaptation to measured value

ON: A dynamic range of 24 dB is lost at small measured values.

OFF: Top limit of measuring range approx. 1.4 V.

2.5.4 Code, Count

Softkey 4 is assigned two functions:
SELCAL (SELCAL outputs)
COUNT (AF frequency counting)

The first or second function is selected using the SHIFT key.

SELCAL Function

An already stored selective call can be sent to the radiotelephone via the RF path using `softkey 4/ENTER`.

A new call number can be entered and sent using `softkey 4/number/ENTER`. The digits can be 0 to 9 and A to F, and also * and # with dual-tone sequences. A sequence with up to 30 digits can be entered.

A tone sequence can be incorporated in a continuous tone of constant modulation or output as a modulation burst. Section 2.5.9 describes the setting of the two modes.

SELCAL Function: Submenu 1

The SELCAL function has two submenus which are output in the fields in the display next to softkeys 3 to 7.

These submenus are used for the most significant configurations in conjunction with SELCAL transmissions.

Other configurations which are required less often, but then for longer periods, are set up in the "Definition menu for tones" (Section 2.8).

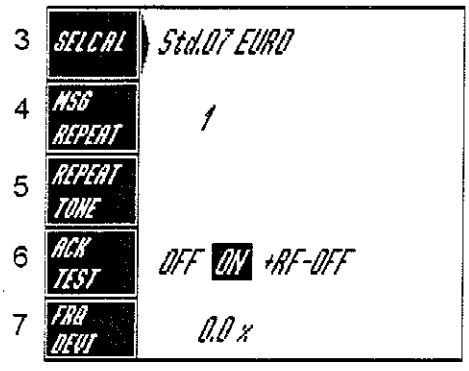


Fig. 2.5-5 SELCAL submenu 1

Softkey 3: SELCAL (selection of standard)

One of 12 standards can be selected using `softkey 3/number/ENTER`. A number is assigned to each standard.

Section 2.4.4 explains the meaning of the numbers in more detail.

Function SELCAL CDCSS (Standard 15)

After activating softkey SELCAL, a 3-digit octal number which has to correspond to one of the 83 CDCSS codes can be entered. Prefix # has to be put in front of the octal number for inverted codes. Acknowledgement using the ENTER key effects a cyclic transmission of the CDCSS code via modulation generator 2 whose deviation can be selected as already known.

Pressing key CLEAR effects the generation of the turn-off code and the subsequent cutting off of the RF power (cf. submenu 2).

For further explanations refer to Section 2.8.

Softkey 4: MSG REPEAT (Message Repeat)

`Softkey 4/number/ENTER` is used to define how often the message is to be repeated. A value of 1 corresponds to the normal setting.

Larger numbers are entered if the response sensitivity of a radiotelephone to the telegram is to be determined. The RF level is then varied whilst the telegrams are sent until the receiver responds. Uninterrupted repetition of telegrams can be stopped by pressing the OFF key.

Softkey 5: REPEAT TONE

The digit repeat function can be switched on or off using softkey 5.

With the digit repeat switched on, the second digit of a double digit is replaced by the repeat digit (E). With the digit repeat switched off, the second digit is repeated, which usually leads to an extra-long tone. The digit repeat of the decoder is coupled to this function (see Section 2.4.4).

Softkey 6: ACK TEST (acknowledgement test)

The automatic sequence "Acknowledgement call test" is started by pressing softkey 6; it is then started by activating softkey 4 SELCAL in the main menu RX-test. The sequence comprises the following steps:

1. Transmission of previously selected tone sequence.
2. Following the last tone in the sequence, the CMS is transferred to the transmitter test with all settings belonging to this test. Note in particular that the transmitter test operating frequency must still be set in the transmitter test to the frequency at which the reply from the radiotelephone is expected. In the position + RF OFF the RF-carrier of the CMS is additionally switched off after the last tone of the tone sequence, since some radiotelephones only reply without input signal.
3. The result of the acknowledgement test is the decoded tone sequence and the modulation.

Softkey 7: FRQ DEVI (frequency deviation)

In order to carry out frequency limit tests on the selective call evaluator, a relative frequency deviation of up to ±10 % can be selected uniformly for all tones in the sequence.

This is entered using `softkey 7/number` with or without `sign/ENTER`. The number corresponds to the frequency deviation in %.

SELCAL Function: Submenu 2

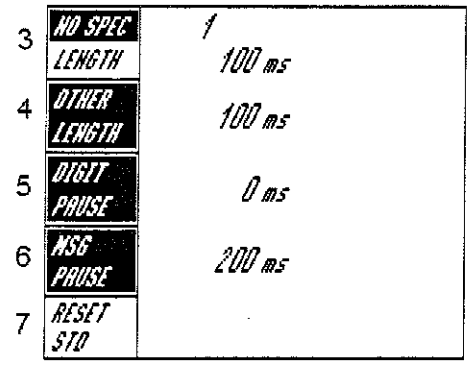


Fig. 2.5-6 SELCAL submenu 2

Softkey 3 is assigned two functions. The SHIFT key is used for selecting first or second function.

Softkey 3: NO SPEC

This function is used to select a tone of the selective-call sequence which is to be subjected to extended tone duration. This is normally the first tone of extended duration compared to the other tones. The entry is made using `Softkey 3 (NO SPC)/number (tone duration in ms)/ENTER`.

Softkey 3: LENGTH

Softkey 3 is assigned two functions. The SHIFT key is used for selecting first or second function. Certain selective call principles can also address receivers with sleep mode. An extended tone in the selective call sequence then bridges the "sleeping pause" of the receiver. The duration of the first tone can be set using `softkey 3 LENGTH/number/ENTER` and corresponds to the number in ms.

Softkey 4: OTHER LENGTH (duration of other tones)

The duration (in ms) of the following tones can be uniformly set by entering `softkey 4/number/ENTER`.

Softkey 5: DIGIT PAUSE

Pauses can be defined between the tones (in ms) uniformly for a tone sequence by entering `softkey/5/ number/ENTER`.

The tone and pause durations need only be selected if values different from the standard are required. These values are components of the standard and can be assigned to the individual standards in the "Definition menu for tones" (Section 2.8).

Softkey 6: MSG PAUSE (message pause)

The pause (in ms) between two messages is defined by entering `softkey 6/number/ENTER`.

Softkey 7: RESET STD

The original parameters, modified by softkeys 3 to 6 can be reset using this softkey.

Das Untermenü 2 hat für Standard 15 (ATIA) keine Bedeutung.

Im Fall des Standard 15 hat das Untermenü 2 ein verändertes Aussehen:

CDCSS: Submenu 2
Softkey TRN-OFF-SELCAL can be used to set the length of the turn-off code effecting the turn off of the squelch function of the test object connected.

Softkey TRANSM END serves to set the time between the start of the turn-off code and the cutting off of the transmitter.

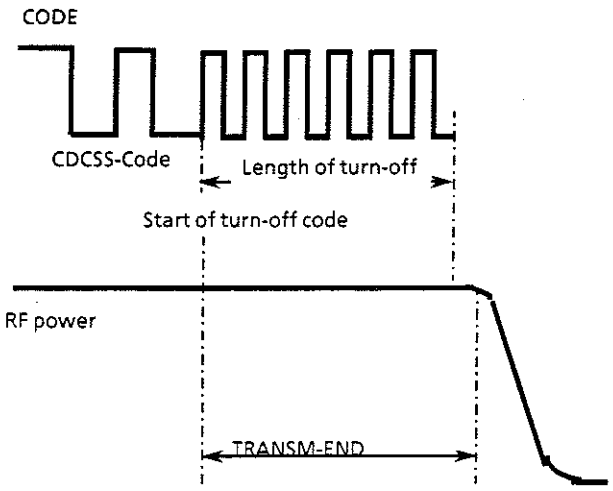


Fig. 2.5-8

COUNT Function

This function is used to determine the frequency of the signal connected to the AF/SCOPE connector ***24***.

A reference frequency can be entered using `softkey 4/REF/number/dimension` or `ENTER` and is always subtracted from the absolute counter result. The currently measured frequency is set as the reference frequency using `softkey 4/REF/dimension` or `ENTER`.

COUNT Function: Submenu

The COUNT function has a submenu which is output in the display field next to softkey 5.

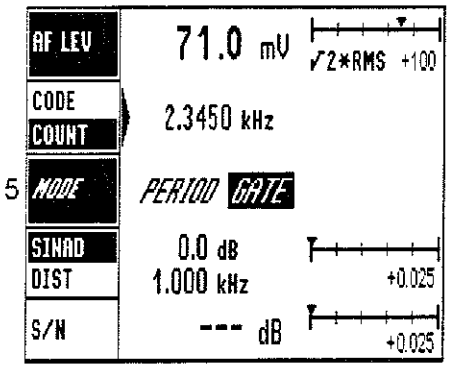


Fig. 2.5-9 COUNT submenu

Softkey 5: MODE (operating mode and resolution of counter)

Selection between 2 modes is possible:

Period counting
Gate time counting 1 Hz

Period counting has a resolution of 0.1 Hz up to 100 kHz; the resolution is 1 Hz at frequencies exceeding this value. Period counting is fast but requires a signal without noise.

Gate time counting is less sensitive to noisy signals.

2.5.5 Filter Selection

FILTER Function

Various AF filters can be switched on or off using `softkey 5/ON` or `OFF`. The AF filters and their characteristic frequencies can be selected in two submenus.

FILTER Function: Submenu 1

The FILTER function has two submenus. The first submenu is output in the display fields next to softkeys 4 and 7, the second submenu in the fields next to softkeys 4 to 5.

Die Bedienung der Softkeys 4 bis 7 ist analog zur Betriebsart Sendertest im Kapitel 2.4.5.

The FILTER submenu 2 is called by pressing the MENU ↓ (DOWN) key.

FILTER Function: Submenu 2

Die Bedienung der Softkeys 4 & 5 ist analog denen der Betriebsart Sendertest und ist bereits in 2.4.5 beschrieben worden. Softkeys 6 & 7 werden jedoch nicht angezeigt.

2.5.6 SINAD and Distortion Measurements

Softkey 6 is assigned two functions:

SINAD (S/N measurement)
DIST (distortion measurement)

The SHIFT key is used to select either the first or second function.

SINAD/DIST Function

Both measurements are performed using the same method. The result is displayed in dB for SINAD and in % for distortion.

Test frequency

The test frequency is defined via `softkey 6/number/dimension Hz` or `kHz`. It is possible to select in the submenu whether the modulation generator is to be set to this frequency or not.

Automatic search routine

The automatic search routine is started using `softkey 6/number/dimension %` (distortion) or `dB` (SINAD). The routine is run as follows:
The RF level is modified until the measured value corresponding to the number is reached. The RF level obtained at the end of the search routine corresponds to the receiver sensitivity. The search routine can be aborted by pressing softkey 6.

The full-scale value can also be influenced in the analog display for the SINAD or DIST measurement.

When `softkey 6/RANGE/% or dB or ENTER` are pressed, the currently measured value is used for defining the full-scale value.

When `softkey 6/RANGE/number/% or dB or ENTER` are pressed, the entered number is used for defining the full-scale value.

Tolerance markers can be set in the analog display using the same syntax: `softkey 6/TOL/number/% or dB or ENTER`.

SINAD/ DIST Function: Submenu

A submenu is available for the SINAD/DIST function, which is output in the display fields next to softkeys 3 to 5 and 7. Softkey 6 remains assigned to the main menu.

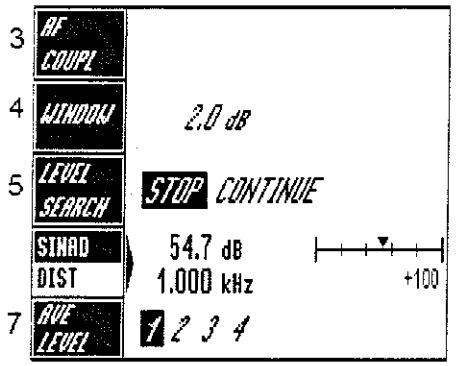


Fig. 2.5-10 SINAD/DIST submenu

Softkey 3: AF COUPL (test frequency)

Softkey 3 can be used to define whether the test frequency selected for the distortion is also to define the frequency of the modulation generator 1 or not.

Application:

Coupling usually has advantages. The modulation generator supplies the signal, which is to be measured by the distortion meter or the SINAD meter following the device-under-test. However, if the radio receiver has a scrambler, the coupling is switched off and the modulation generator signal is set independently of the distortion/SINAD test frequency.

Softkey 4: WINDOW (abort window)

Softkey 4 can be used to define a criterion for aborting the automatic search routine. The range around the target value to be measured is determined by entering `softkey 4/number/dB or %`. The entered number defines the magnitude in % or dB around the target value as the abort window. When a measured value from this range is reached in the search routine for the first time, the search routine is aborted.

Softkey 5: LEVEL SEARCH (Stop/continue search routine)

Softkey 5 selects whether the RF level variation is to be stopped when the abort window is reached or not.

Application:

If the receiver sensitivity is to be determined by a measurement, the "stop" position is selected. The "continue" position is selected if the receiver sensitivity is to be set to a maximum during the search routine.

Softkey 7: AVE LEVEL (averaging factors)

Four averaging factors are available to be selected via softkey 7.

1: One measurement determines the result.

2: The result is the average of two measurements.

3: The result is the average of three measurements.

4: The result is the average of four measurements.

Each single measurement corresponds to the average of 5 AD values.

In IEC bus operation, the single measurements are repeated with large changes in signal level following a delay time.

2.5.7 S/N Measurement

S/N Function

The S/N measurement is very similar to the distortion or SINAD measurement except that the wanted modulation is switched off during the noise measurement and not eliminated by a filter.

Dimension

The S/N ratio is displayed either in % or dB by entering `softkey 7/dimension %` or `dB`.

The full-scale value can also be influenced in the analog display for the S/Nmeasurement.

The currently measured value is used to define the full-scale value by entering `softkey 7/RANGE/%/` or `dB` or `ENTER`.

The number is used to define the full-scale value by entering `softkey 7/RANGE/number/%/` or `dB` or `ENTER`.

Tolerance markers can be set in the analog display with the same syntax: `softkey 7/TOL/number/%` or `dB` or `ENTER`.

Automatic search routine

An automatic search routine is initated via softkey 7/number/dimension % or dB. The routine is executed as follows:

The RF level is modified until the measured value corresponding to the number is reached. The RF level at the end of the search routine corresponds to the receiver sensitivity.

The search routine can be aborted by pressing softkey 7.

S/N Function: Submenu

A submenu is available for the S/N function, which is output in the display fileds next to softkeys 3 to 7.

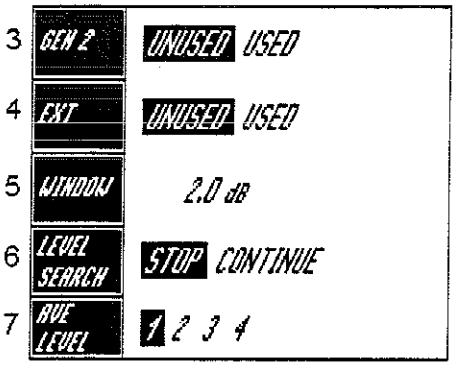


Fig. 2.5-11 S/N submenu

Softkey 3: GEN 2 (modulation generator 2)

The modulation is switched on and off by modulation generator 1. Softkey 3 can be used to select whether the modulation generator 2 is to follow this rythm or not.

Softkey 4: EXT (external modulation)

Softkey 4 can be used in the same manner as described above to select whether the external modulation applied to the MOD EXT connector ***26*** is to follow this rythm or not.

Softkey 5: WINDOW (abort window)

Softkey 5 can be used to define a criterion for aborting the automatic search routine. The range around the target value to be measured is determined by entering `softkey 5/number/dB or %`.The entered number determines the magnitude in % or dB around the target value as the abort window. When a measured value from this range is reached in the search routine for the first time, the search routine is aborted.

Softkey 6: LEVEL SEARCH (stop/continue search routine)

Softkey 6 selects whether the RF level variation is to be stopped when the abort window is reached or not.

Application:

If the receiver sensitivity is to be determined by a measurement, the "stop" position is selected. The "continue" position is selected if the receiver sensitivity is to be set to a maximum during the search routine.

Softkey 7: AVE LEVEL (averaging factors)

Four averaging factors can be selected using softkey 7:

1: The result is the average of one signal measurement and two noise measurements.

2: The result is the average of one signal measurement and three noise measurements.

3: The result is the average of two signal measurements and four noise measurements.

4: The result is the average of two signal measurements and five noise measurements.

Each single measurement corresponds to the average of five AD measurements.

In local and IEC bus mode, the single measurements are repeated following a delay time in case of large changes in signal level. (Different S/N ratios (measurement times) may result.)

2.5.8 Lock

LOCK Function

Softkey 8 is assigned the function of a simple changeover key.

If the LOCK mode is active, TX test can only be reached by operation in the RX test. With the LOCK function deactivated the switchover from RX test to TX test is only possible by applying an RF power to the RF IN/OUT socket ***29.*** The RX test is automatically actuated again by an RF voltage drop. This return to RX test can, however, be eliminated when switching to the TX test via keys or by calling a submenu in the TX test.

Application:
The LOCK status is used if discontinuous transmitter tests are carried out, e.g. power pulses of limited duration with superimposed modulated data messages. The LOCK function prevents the CMS from returning to the receiver test following each pulse. A typical example is a acknowledgement call. The LOCK function is switched on automatically in this case and with certain other measurements such as e.g. cellular radio.

2.5.9 Modulation Generators

Softkey 9 is assigned all functions of the first modulation generator, softkey 10 those of the second modulation generator. Each softkey is assigned the frequency as first function and the modulation as the second. Switching between the two functions is possible by entering `SHIFT/softkey 9` or `10`.

AF1/AF2 Function

The frequency is entered using `softkey 9` or `10/number/dimension` or `ENTER`. The modulation generator is switched off by entering `softkey 9` or `10/OFF`. This switch-off function for the level when making a frequency entry has the following function:

The modulation of tone sequences generated naturally by modulation generators are set using the MOD function. If the modulation generator is not switched off using the above-mentioned method, the valid continuous tone is output before and after the tone sequence. The modulation generator can be switched on again using softkey 9 or 10/ON.

Variation function

The variation increment for the VAR spinwheel can be entered using softkey 9 or 10/VAR/number/dimension or ENTER. In contrast to usual operation, VAR/0/ENTER does not set the minimum increment but leads to variation with the fixed frequency series (see VAR function, Section 2.3.2.2.1 and definition menu for tones, Section 2.8).

Reference function

The selected frequency is defined to be the reference by entering REF/number/dimension or ENTER. The set frequencies are to be understood as a difference from the reference frequency (see REF function, Section 2.3.2.2.1).

MOD1/MOD2 Function

The modulation is entered using softkey 9/number/dimension or ENTER. The operating mode of the instrument is determined by the dimension selected for the 1st modulation generator.
Selection of the dimension % sets the CMS to AM mode, selection of the dimension kHz or Hz to FM mode and selection of the dimension rad to ϕM mode.

The modulation mode of the 2nd modulation generator follows that of the 1st (dual-tone modulation).

(An external modulation source is used for dual-tone modulation.)

The modulation can be switched off using softkey 9 or 10/OFF, and the previously valid modulation can be switched on again using softkey 9 or 10/ON.

MOD1/MOD2 Function: Submenu

There is a submenu for the MOD1/MOD2 function which is output in the fields in the display next to softkeys 11 to 14. This submenu can be selected by means of softkey 9 or softkey 10.

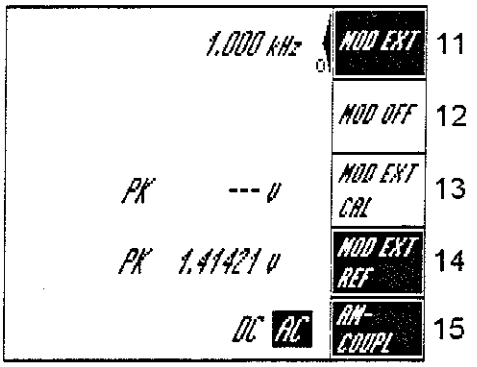


Fig. 2.5-12 MOD1/MOD2 submenu

Softkey 11: MOD EXT (external modulation)

An external modulation signal can be connected to the MOD EXT connector and can be entered using softkey 11/number/dimension or ENTER. Modulation mode AM (multi-tone) is possible via the external input if the instrument is in AM mode. The dimensions used are %, kHz or Hz.

Further FM modulation (multi-tone) is possible via the external input if the instrument is in FM mode.

Softkey 12: MOD OFF (switching off modulation)

All modulation is switched off by pressing softkey 12; the modulation modes are retained.

Softkey 13: MOD EXT CAL (external calibration)

Softkey 13 should be pressed if the voltage applied to the MOD EXT connector is unknown. The instrument then measures this voltage (output in the display) and takes it into account when setting the modulation. (Subsequent changes in voltage are not taken into account.)

Softkey 14: MOD EXT REF (input of modulation voltage)

`Softkey 14/number/dimension` or `ENTER` can be used to inform the instrument of the voltage applied to the MOD EXT connector which is to be used as the basis for the external modulation setting. The number corresponds to the peak voltage; input ranges between 50 mV and 2 V with dc coupling and between 5 mV and 2 V with ac coupling can be taken into account, otherwise a message is output in the display.

Softkey 15: AM-COUPL

This softkey is used to select AC or DC coupling with external AM modulation.
DC coupling is selected when the RF signal amplitude is to be varied using an external DC voltage, e.g. for simulation of a fading signal.

2.5.10 Oscilloscope / DC Measurement

Operation and use of the oscilloscope and the DC measurement feature are analogous to that as described in Section 2.4.10 for the transmitter test.

2.6 SSB-Transmitter Test (TX-SSB)

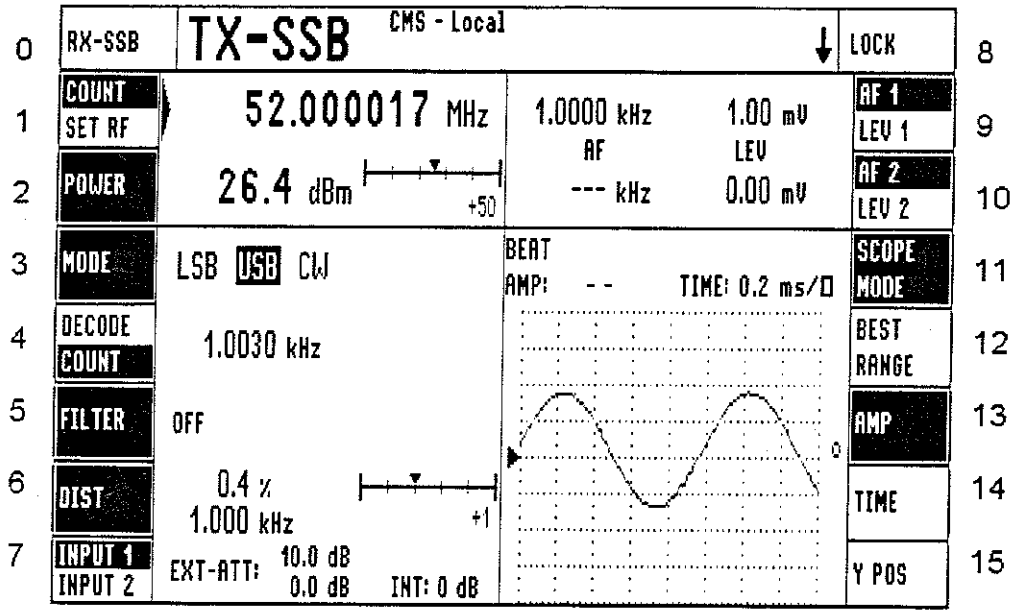


Fig. 2.6-1 Main menu TX-SSB

Starting with the main SSB mens accessible from the selection menu, the main menu TX-SSB (transmitter test) can be entered by pressing the softkey SSB. In SSB mode the CMS is switched to. Beat mode and AM modulation permanently.

This menu contains all controls required to carry out a single side band transmitter test. Almost every function offers submenus. These provide controls for additional transmitter test functions that are required less often.

Softkey 0 may be used to branch to the receiver test (RX-SSB) main menu.

2.6.1 RF Count Measurement

By simple transmitter tests (only one RF frequency present), the instrument will show the frequency of the suppressed carrier. If the device under test outputs several strong rf frequencies, the receiver frequency should be preset by toggling to SET RF.

COUNT Function

The count function is constantly active if the COUNT field is shown in inverted form.

The normal count function only operates at the connector RF IN/OUT.

The count measurement is executed in BEAT mode only.

The carrier frequency value shown depends on

- the measured rf frequency
- the value of the chosen AF frequency and
- the setting of the ssb mode toggle (LSB, USB, CW).

In case of LSB and USB a suppressed carrier is assumed. Depending on the operating mode the following formulas apply:

LSB (lower side band): $F_{sc} = F_m + F_{af}$

USB (upper side band): $F_{sc} = F_m - F_{af}$

CW (continuous wave): $F_c = F_m$

with F_{sc}, F_c being the value of the (suppressed) carrier, Fm the measured rf frequency. Faf represents the setting of either AF1 or AF2 (please refer to description of softkey 9 or 10 for further details). In case AF1 and 2 are active simultaneously, a warning is issued; the value for Faf will correspond to AF1 in that case.

The local oscillator is set to Fsc in case of LSB and USB. In continuous wave mode, however, the LO frequency is as follows:

$F_{lo} = F_m - ITF$

where ITF is the international telegraph standard frequency of 800 Hz.
The counter resolution can be set using the following input sequence: `softkey COUNT/number 1 to 10/terminating key Hz` or `ENTER`. Thus 1 Hz (slow) or 10 Hz (fast) is selected as the counter resolution.

Relative counting

There are two possibilities for selecting a reference frequency for relative counting.

Input of softkey `COUNT/REF/ENTER` declares the frequency just measured as the reference frequency; input of `softkey COUNT /REF /number /unit key` or `ENTER` declares the entered frequency; as the reference frequency.

A sign in front of the result indicates that a relative frequency count is being carried out. Absolute frequency counting can be reselected by entering `softkey COUNT/REF/OFF`.

The dimensions MHz, kHz or Hz can be selected for direct or relative counting, e.g. `softkey COUNT/Hz`.

COUNT Function: Submenu

The function COUNT has a submenu which is output in the display fields next to softkeys 3, 4 and 5.

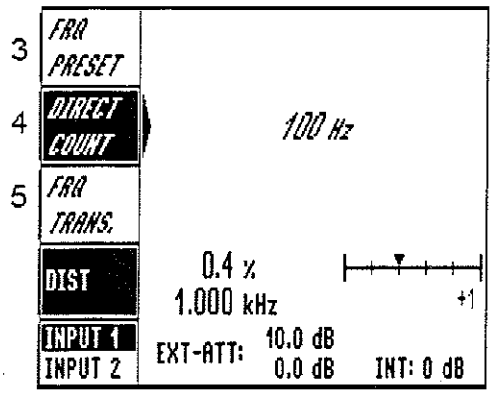


Fig. 2.6-2 COUNT submenu

The normal count function comprises a coarse direct broadband count and a subsequent exact AF count.

Softkey 3: FRQ PRESET (IF count)

This setting is of no consequence in SSB mode, since the IF section is not employed with BEAT demodulation.

Softkey 4: DIRECT COUNT

Switch-on: `Softkey 4/number 100 or 1000/ dimension Hz or ENTER`. Direct counting is carried out with a resolution of 100 or 1000 Hz.

Switch-off: `Softkey 4/OFF`

Softkey 5: FRQ TRANS (Transfer function)

Actuating this softkey once transfers the measured frequency as CMS receiver frequency.

In the main menu, this action switches from the COUNT function to SET RF.

Application:

Softkey 5 facilitates operation with regard to entry of multi-digit or unknown trans-mitter frequencies as CMS receiver frequency.

SET RF Function

The receiver frequency of the instrument is fixed using the SET RF function. It is not based on the counter result. If the SET RF function is not already active (displayed in inverted form), it can be activated by entering SHIFT/softkey SET RF. The CMS receiver frequency is usually entered and displayed as a frequency value using softkey SET RF/number/dimension or ENTER.

The receiver frequency setting can be varied using the VAR function and the VAR spinwheel. The receiver frequency setting can also be relative.

The reference frequency can be entered using sofkey SET RF/REF/ENTER if the current frequency is to become the reference frequency, or using the softkey SET RF/REF/number/dimension or ENTER if a reference frequency is to be set to a different value.

SET RF Function: Submenu

This submenu has been described in the TX-Test section of this manual. Please refer to section 2.4.

2.6.2 Power Measurement

POWER Function

The broadband RF power measurement can only be performed at the RF IN/OUT socket; the selective RF power measurement can also be carried out at the RF IN 2 socket (input 2). The dimensions of the broadband RF power measurement are W or dBm, those of the selective RF power measurement are mV, W, dBµV or dBm.

A logarithmic relative display based on a reference value may be selected. Tolerance markers can be set on the analog bar for the dimensions mentioned above; Autorange or Range Hold for the full-scale value can be selected on the analog display.

POWER Function: Submenu

This submenu has been described in the TX-Test section of this manual. Please refer to section 2.4.

2.6.3 MODE Function

MODE Function

The DUT's SSB transmission mode is set using softkey 3. Three different settings may be selected:

LSB (Lower Side Band)

USB (Upper Side Band)

CW (Continuous Wave).

In order to correctly measure the frequeny of the suppressed carrier, it is necessary to supply the SSB transmission mode employed.

2.6.4 AF Measurement

Please see 2.4 for information on the decode function.

COUNT Function

The frequency of the demodulated signal or the beat signal is counted by pressing softkey 4.

A relative measurement can be made in two different manners:

- The currently measured frequency is selected as the reference frequency by entering softkey 4/REF/ENTER.
- An arbitrary frequency value is selected as the reference frequency by entering REF/number/dimension or ENTER.

The relative result is the difference to the reference frequency. Relative measurements are identified by a sign in front of the result.

COUNT Function: Submenu

The COUNT function has a submenu which is output in the field of the display next to softkey 6.

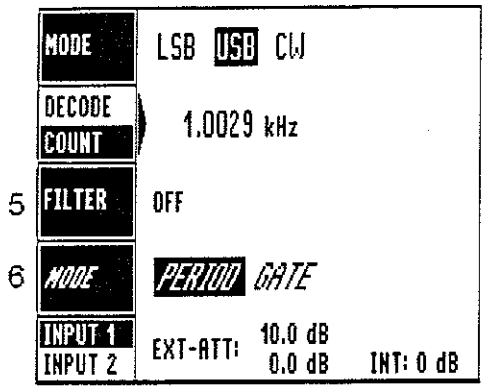


Fig.2.6-3 COUNT submenu

Softkey 6: MODE (Operating mode and resolution of counter)

There are two alternatives:

- Period counting
- Gate time counting

Period counting has a resolution of 0.1 Hz up to 100 kHz; the resolution is 1 Hz at frequencies above this value. Period counting is fast but requires a signal without noise.

Gate time counting is slower but less sensitive to noisy signals.

2.6.5 Filter Selection

FILTER Function

Various AF filters can be switched on or off using softkey `5/ON` or `OFF`. The AF filters and their characteristic frequencies can be selected in two submenus.

FILTER Function: Submenu 1

This submenu has been described in the TX-Test section of this manual. Please refer to section 2.4.

FILTER Function: Submenu 2

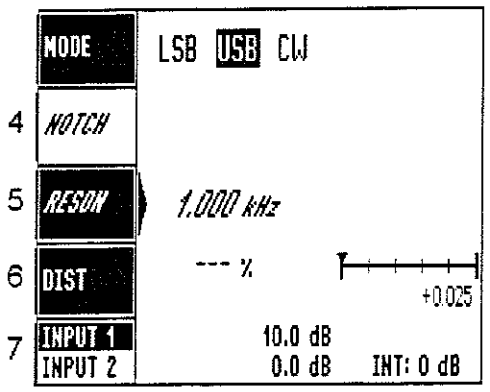


Fig. 2.6-4 FILTER submenu 2

Softkey 4: NOTCH (notch filter)

The notch filter is switched on using softkey `4/ON` and off using `softkey 4/OFF`.

Stop frequency of notch filter:
The stop frequency of the notch filter is also selected using softkey 4. The entry is made using softkey `4/number/dimension` or `ENTER`.

Since the frequencies cannot always be set exactly as required, the frequency actually set is output in the display.

Softkey 5: RESON (resonance filter)

The resonance filter is switched on using `softkey 5/ON` and off using `softkey 5/OFF`.

Resonance frequency of resonance filter:
Softkey 5 is used to select the resonance frequency of the filter. The entry is made using `softkey 5/number/dimension` or `ENTER`. The actually set frequency is displayed as with the notch filter.

Filter combinations

For better understanding all filters can be envisaged as a series connection of three filter groups:

- Highpass filter - lowpass filter
- Psophometric filter - external filter
- Notch filter - resonance filter

Highpass and lowpass filters can be combined independently into four different filter configurations.

The psophometric filter and the external filter cannot be combined, the same applies to the notch filter and the resonance filter. Since the notch filter is used for distortion and SINAD measurements, the last filter group cannot be used for evaluation during a distortion or SINAD measurement.

Notch filter and resonance filter are also being switched off when quitting or selecting RX-test and TX-test, since in this case SINAD or DIST measurements automatically continue to run.

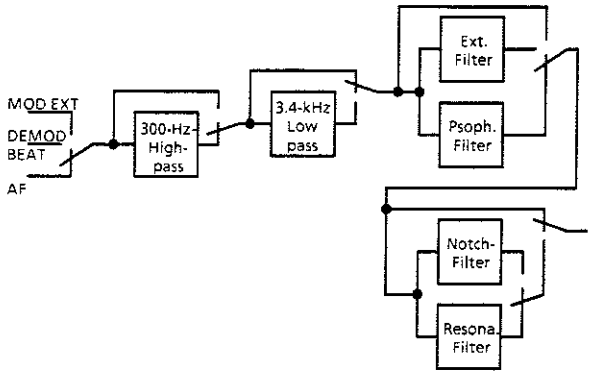


Fig. 2.6-5 Signal paths

Distortion Measurement

DIST Function

This funciton has been described in the TX-Test section of this manual. Please refer to section 2.4.

Input Switchover

INPUT 1/INPUT 2 Function

This function has been described in the TX-Test section of this manual. Please refer to section 2.4.

Lock

LOCK Function

This function has been described in the TX-Test section of this manual. Please refer to section 2.4.

Modulation Generators

AF 1/AF2 Function

LEV1/LEV2 Function

This function has been described in the TX-Test section of this manual. Please refer to section 2.4.

Oscilloscope / DC Measurement

The scope mode is activated by means of the soft-key SCOPE MODE. If the active cursor is located at this position, a submenu may be called for handling the signal sources for the scope and activating the DC measurement.

SCOPE MODE Function

This function has been described in the TX-Test section of this manual. Please refer to section 2.4.

2.7 SSB-Receiver Test (RX-SSB)

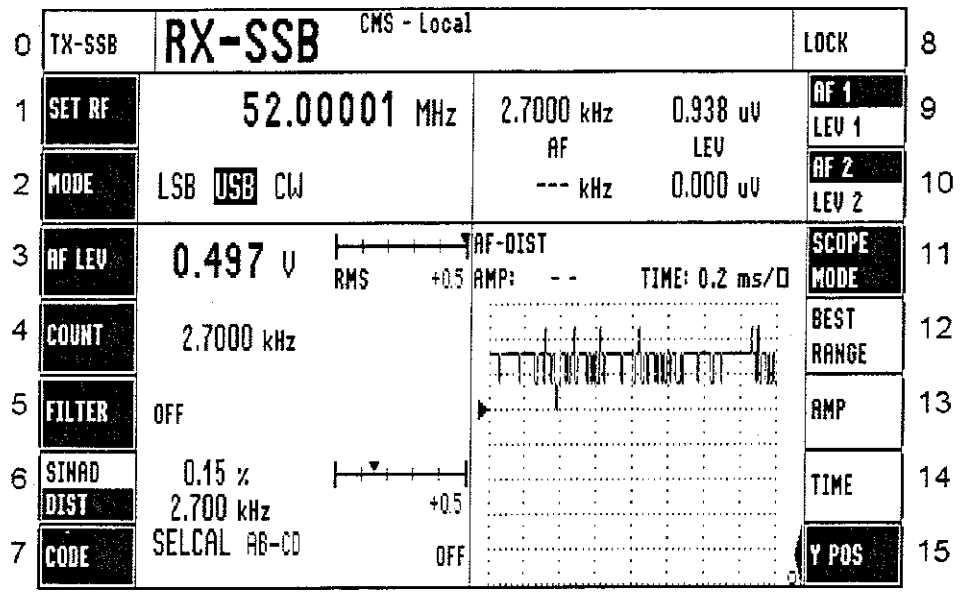


Fig. 2.7-1 Main menu RX-SSB

The main menu RX-SSB (receiver test) can be accessed by pressing the softkey RX-SSB in the upper left corner of the SSB transmitter test menu TX-SSB.

It contains all controls required to carry out a single side band receiver test. Almost every function contains submenus. These contain controls which can be used for more seldom receiver test functions.

Softkey 0 may be used to branch to the main menu for the transmitter test (TX-SSB).

Notes on modulation in SSB mode:

In SSB mode, single or two-tone modulation is permissible. The kind of modulation depends on the number of AF generators used. To swith off an AF-Gen, depress the OFF key after selecting the frequency of either AF1 or AF2.

Input of LEV1/OFF or LEV2/OFF has no influence on single/two-tone modulation.

a) **Single tone**
In case modulation is supplied by a single tone, complete carrier and residual side band suppression is employed.

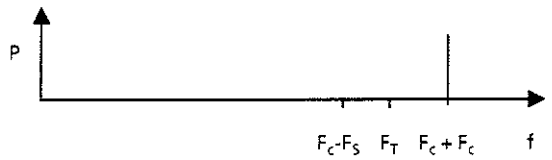


Fig. 2.7-2

Example:
USB-Mode (Upper Side Band): Complete absence of carrier Fc and residual side band Fc-Fs (lower side band in this example).

b) Two-tone
In case of two-tone modulation, CMS will not suppress the spurious spectral components. Instead, the carrier as well as the modulation signals will be offset by 10 kHz, respectively. As a result, unwanted spectral components will come to rest in a position further away from the side band under analysis and thus not influence measurement results.

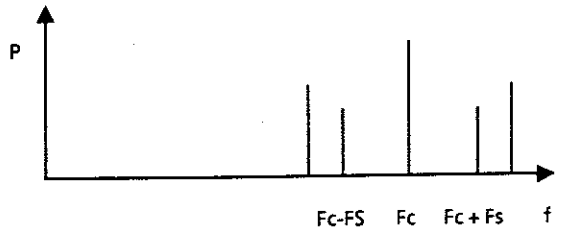


Fig 2.7-3 Spectral components of an unmodified AM-signal

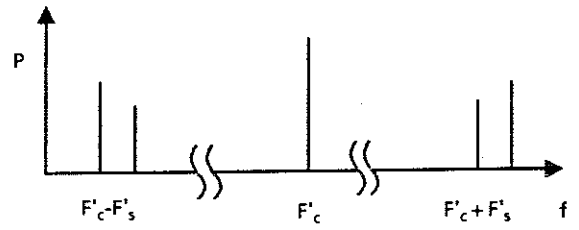


Fig. 2.7-4 Spectral components of the modified AM-signal

Example: Mode USB, modified AM-signal

F'c = Fc - 10kHz
F's = Fs + 10kHz

By simultaneous modifiation of the carrier's and unwanted side band's frequency, the wanted side band's frequency (USB in above example) remains unaffected while the possibly disturbing components are moved out of harm's way.

Note: *Since the frequency offset of both carrier and unwanted side band is achieved through the AF-Gen, the upper frequency limit of AF1 and AF2 is lowered to 20kHz. For the same reason, the frequency output at the MOD GEN socket is 10 kHz higher then displayed.*

2.7.1 RF Setting

Please refer to corresponding section 2.5 (RX-Test).

2.7.2 Mode Function

MODE Function

The DUT's SSB transmission mode is set using softkey 3.

Three different settings may be selected:

- LSB (Lower Side Band)
- USB (Upper Side Band)
- CW (Continuous Wave).

With settings LSB and USB carrier and residual side band will either not appear or be shifted into a more distant frequency range depending on type of modulation (single or two-tone).

In CW mode, the carrier that is typically suppressed in SSB will be transmitted; this carrier is defined by the frequency value supplied by the SET RF function and the RF level displayed next to softkey LEV1.

Both AF generators are switched off in CW mode, entry of AF frequency values is not possible.

2.7.3 AF Level Measurement

AF LEV Function

Please refer to corresponding section 2.5 (RX-Test).

2.7.4 AF Count Measurement

COUNT Function

This function has been described in the RX-Test section of this manual. Please refer to section 2.4.

2.7.5 Filter Selection

FILTER Function

Please refer to corresponding section 2.4 (RX-Test).

2.7.6 SINAD and Distortion Measurements

SINAD/DIST Funktion

Please refer to corresponding section 2.4 (RX-Test).

2.7.7 Code

CODE Function

An already stored selective call can be sent to the radiotelephone via the RF path using softkey 7/ENTER. On entry into the SSB-RX menu code standard 13 with be pre-selected.

A new call number can be entered and sent using softkey 7/number/ENTER. The digits can be 0 to 9 and A to F, and also * and # with dual-tone sequences. A sequence with up to 30 digits can be entered. Depending on the tone standard selected, tone sequences of differing length may be issned; the keypad may assume different meanings (see RX-Test function CODE and ATIS/CDCSS supplement).

A tone sequence can be incorporated in a continuous tone of constant modulation or output as a modulation burst. Section 2.5.9 describes the setting of the two modes.

Code Function: Submenu 1

Please refer to corresponding section 2.4 (RX-Test).

CODE Function: Submenu 2

This functionhas been described in the RX-Test section of this manual. Please refer to section 2.4.

2.7.8 Lock

LOCK Function

This function has been described in the RX-Test section of this manual. Please refer to section 2.4.

2.7.9 Modulation Generators

Softkey 9 is assigned all functions of the first modulation generator, softkey 10 those of the second modulation generator. Each softkey is assigned the frequency as first function and RF Level as the second. Switching between the two functions is possible by entering SHIFT/softkey 9 or 10.

AF1/AF2 Function

The frequency is entered using softkey 9 or 10/number/dimension or ENTER. The modulation generator is switched off by entering softkey 9 or 10/OFF. The modulation generator can be switched on again using softkey 9 or 10/ON.

Variation function

The variation increment for the VAR spinwheel can be entered using softkey 9 or 10/VAR/number/dimension or ENTER. In contrast to usual operation, VAR/0/ENTER does not set the minimum increment but leads to variation with the fixed frequency series (see VAR function, Section 2.3.2.2.1 and definition menu for tones, Section 2.8).

Reference function

The selected frequency is defined to be the reference by entering REF/number/dimension or ENTER. The set frequencies are to be understood as a difference from the reference frequency (see REF function, Section 2.3.2.2.1).

LEV1/LEV2 Function

Input of rf levels (determined by build-in modgen) may be accomplished through softkeys 9 or 10/number/unit or ENTER. If unit dBm is selected, power refers to 50 Ohms PD. Using softkey 9 or 10 followed by OFF will switch off the rf output attributed to LEV1 or LEV2, respectively. Softkey 9 or 10/ON switches on the level set previously (a method to switch on or off rf level and change between single and two-tone modulation as well is described with function AF1 and AF2).

Variation function

Please refer to corresponding section 2.5 (RX-Test).

Reference function

Please refer to corresponding section 2.5 (RX-Test).

2.7.10 Oscilloscope / DC Measurement

Operation and use of the oscilloscope and the DC measurement feature are analogous to that as described in Section 2.4.10 for the transmitter test.

2.8 RF Spectrum Analyzer

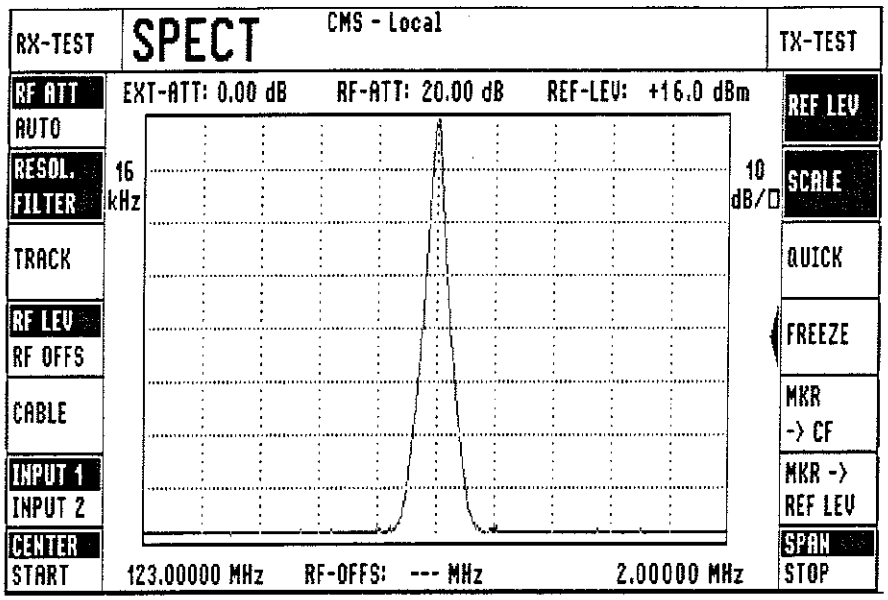


Fig. 2.8-1 Main Menu Spectrum Analyzer

From the select menu, the main menu of the RF spectrum analyzer can be selected by pressing the SPECT key.

In this menu, the CMS permits to display modulation spectra within one or a few channels as well as observe the complete frequency spectrum in the range from 10 MHz to 1 GHz with a span of 50 MHz.

The softkey RX-Test permits to branch directly into the main menu for the receiver test, softkey TX-Test into the main menu for the transmitter test.

In operating mode RF Spectrum analyzer, all RF functions of the instrument are made use of, even if the duplex synthesizer is installed. Thus no duplex operation is possible. To achieve highest sensitivity for measurements, use Input 2 with 6 kHz resolution filter and a reference level smaller than -35 dBm.

2.8.1.1 Functions of the Main Menu

Function RF Att/Auto

For measurements via the connector RF IN/OUT, the spectrum analyzer is provided with switchable input attenuator pads in the range from 0 to 112.5 dB. This input attenuation can be selected manually, or it is set automatically depending on the power measured by the power meter and on the reference level set. The set value is indicated in the upper display area.

Changing from automatic setting to manual setting and vice versa is effected by pressing softkey 1.

For measuring small voltages via the sensitive input connector RF IN 2, RF level matching is not possible. The functions RF ATT and AUTO are insignificant in this case.

Manual attenuation setting:

In the position RF ATT, the user can set the attenuation himself in the range from 0 to 112.5 dB. Since the total attenuation is obtained by series-connection of single attenuator pads of fixed attenuation, not all values can be implemented. The CMS therefore rounds the entry to the next possible value. Note that a 20-dB power attenuator pad is automatically cut in when a high RF power (approx. >13 dBm) is applied.

Automatic attenuation setting:

In the AUTO position, the power at the connector RF IN/OUT is measured internally in the CMS prior to each build-up of the display, which permits the optimum setting of the input attenuation to be determined automatically.

Function Resolution Filter

This key is used to select the bandwidth of the resolution filter via which the frequency spectrum is weighted. The CMS provides 7 resolution filters with bandwidths from 150 Hz to 3 MHz. The set filter bandwidth is indicated opposite to the key.

Since, depending on the settings of the frequency span, not all filters allow for a useful display, their selection is restricted

Table 2.8-1 Settable resolution filters depending on the frequency span set

Span	Settable resolution filters				
2.4 kHz ... 30 kHz	150 Hz	6 kHz	16 kHz	50 kHz	1 Mhz
30 kHz ... 1,2 MHz	6 kHz	16 kHz	50 kHz	30 kHz	3 Mhz
1,2 MHz ... 3.2 MHz	16 kHz	50 kHz	300 kHz	1 MHz	
3,2 MHz ... 10 MHz	50 kHz	300 kHz	1 MHz	3 MHz	
10 MHz ... 50 MHz	300 kHz	1 MHz	3 MHz		

Function INPUT 1 / INPUT 2

This key permits to select the RF input via the connectors RF IN/OUT or RF IN 2. An external attenuation in the range from 0 to 100 dB can be entered for the two inputs. The numerical value is indicated in the upper display area with EXT ATT: -- dB.

Funktion CENTER / START / SPAN / STOP

These keys permit to define the RF frequency range, in which the RF input signal is analyzed.

The user may select between display with center and span frequency or with start and stop frequency. Switchover is possible by actuating one of the two keys CENTER / START or SPAN / STOP.

If entries are made for one of these functions, the CMS automatically selects a resolution filter depending on the set span so as to guarantee useful recording.

Table 2.8-2 Selection of the optimum resolution filter depending on the frequency span entered

Span	Resolutionfilter
1.2 kHz ... 30 kHz	150 Hz
30 kHz ... 1.2 MHz	6 kHz
800 kHz ... 3.2 MHz	16 kHz
2.5 MHz ... 10 MHz	50 kHz
8 MHz ... 50 MHz	300 kHz

In order to avoid unintentional, frequent variation of the resolution filters, Table 1.2 features hysteresis. A resolution filter setting is maintained as long as the frequency span is within the range of a row.

2.8.2 Settling the Reference Level

Function REFLEV

The reference level indicates the level of the upper edge of the display. Thus, the level of the recorded signal can easily be determined at any point.

The limit values for the numerical entries of the reference level are dependent on the selection of the RF input.

If signals are recorded via the connector RF IN/OUT, the reference level can be set at will in the range from -47 dBm to + 50 dBm.

For RF input 2, the reference level can be set in the range from -67 dBm to -27 dBm.

Possible units for the reference level are W, V and dBUV.

Function SCALE

This function permits to vary the scale in the y-direction. Settings of 2, 5 and 10 dB/graticule are possible. The set value is indicated to the left of the key.

2.8.3 Freeze Mode

Function FREEZE

By pressing softkey 12 the Freeze-Mode will be switched on and off.

The Freeze function permits to stop the continuous build-up of the display. After pressing the key, the current build-up is finished and the curve then "freezed". A marker shaped as a cross appears at the maximum point of the curve. The frequency and level of the marker are indicated in the display.

The marker can then be moved at will on the curve using the rotary knob VAR.

During Freeze mode, FM-modulated signals can be demodulated at the frequency defined by the marker.

The settings for AM, FM, ϕM demodulation, IF filter (WIDE/NARROW), the demodulator status (ON/OFF/SQUELCH), and the setting of the loudspeaker (AMP softkey) are taken from the TX test.

A reference marker can be set at the position of the marker positioned before using keys SHIFT REF ENTER. The active cursor must be on the FREEZE key.

The reference marker is displayed in the form of a vertical line. If the reference marker is activated, the marker frequency and the marker level are displayed as a deviation from the reference position.

The reference marker function can be deactivated by keys SHIFT REF CLEAR. It is also cancelled with every new build-up of the display. The marker frequency displayed can be defined as centre frequency by way of softkey 13 (MKR → CF). Softkey 14 (MKR → REFLEV) serves to turn the indicated marker level into the reference level.

Thus the user is allowed to position a part of the recorded curve that is important to him into the middle of the picture with only a few keystrokes.

Both keys can only be operated if FREEZE has been activated. Pressing of these keys initiates a new build-up of the display.

Both actions lead again to a sweep in order to indicate the modified display.

2.8.4 Spectrum Analyzer in IEC-bus Mode

All functions of the RF spectrum analyzer an also be executed by a controller via IEC-bus commands.

The spectrum analyzer menu can be entered using the command:

DISPLAY:MENU 6.0".

In IEC-bus mode, the CMS is able to receive commands as well as to send back settings and measurement results to the controller.

The command SPECTRUM:MARKER permits to read in the entire curve point for point into the controller, however, FREEZE has to be activated before (SPECTRUM:FREEZE ON).

Example:

The controller sends the command:

"SPECTRUM:MARKER? 120MHZ".

Then the marker is set to position 120 MHz and the CMS sends the string:

"SPECTRUM:MARKER <marker level (W)>,<marker frequency (Hz)>".

The unit of the result returned by the CMS can be selected using the command

"UNIT <unit>".

The following table shows an overview of all IEC-bus commands in spectrum analyzer operation with the settings that can be sent back pointed out.

2.9 Definition Menu for Tones

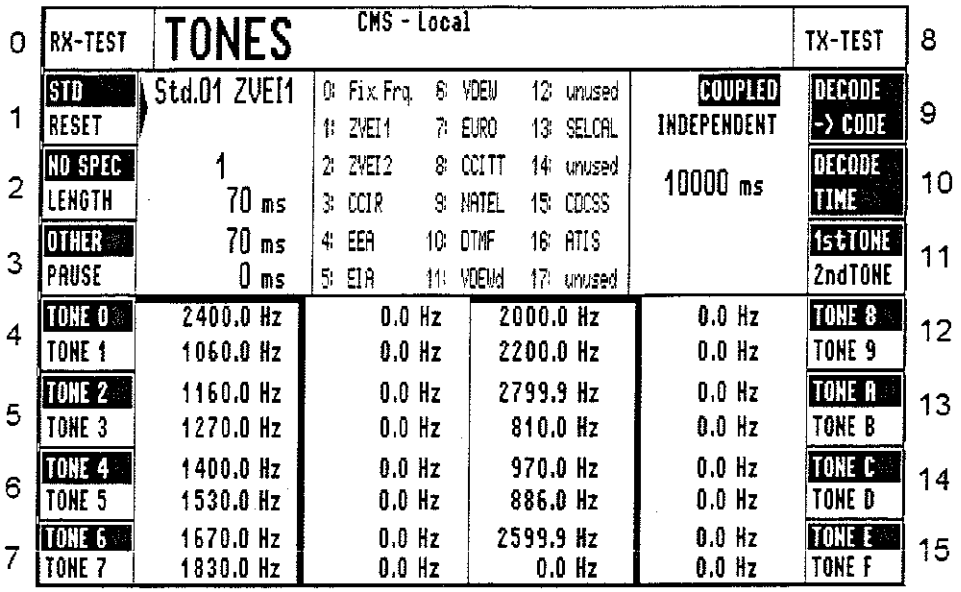


Fig. 2.9-1 Main menu TONES

Starting with the main menus of the selection menu the main menu TONES (definition menu for tones) is reached by pressing the softkey TONES.

It contains all controls required to define parameters such as frequency, tone duration, pause duration and further parameters for output of the tone sequence and evaluation. The parameters are used in the transmitter and receiver test menus.

Softkey 0 allows for direct branching to the main menu for the receiver test and softkey 8 for branching to the transmitter test.

2.9.1 Selection of Standard

STD/RESET Function

The standards are named and called by numbers. These can be used according to the original standard or be modfied as required.

Number (= Std.No.)	unmodified	modified
0	Std.0 Fixed Frequencies	Std.0
1	Std.1 ZVEI 1	Std.1
2	Std.2 ZVEI 2	Std.2
3	Std.3 CCIR	Std.3
4	Std.4 EEA	Std.4
5	Std.5 EIA	Std.5
6	Std.6 VDEW	Std.6
7	Std.7 EURO	Std.7
8	Std.8 CCITT	Std.8
9	Std.9 NATEL	Std.9
10	Std.10 DTMF	Std.10
11	VDEWd	
12	unused	
13	SECAL	

Standards 1 to 9 represent the usual single-tone sequences. For differentiation of unmodified and modified tone sequences the CMS displays standard number and name for unmodified tone sequences, but only the standard number for modified tone sequences.
The assignment of frequencies to numbers is displayed in the main menu for tones and can be modified. Standard 0 reacts like a completely normal tone sequence standard. In this case the frequencies are the fixed frequencies for the AF generators. Standard 10 is the dual-tone standard; it cannot be modified for evaluation purposes.

Softkey 1 allows for calling any standard in order to modify it (STD) or to reset the original parameters for the selected standard (RESET).. The SHIFT key is used to select between these two possibilities.

The standard is called by entering softkey 1(STD)/number/ENTER. A standard is reset to the original state by entering softkey 1(RESET)/number/ENTER.

Note: *Std. 11 (VDEW d) consists of the data records of Std. 1 (ZVEI 1) and STD. 10 (DTMF) and therefore can not be selected in this menu, but only from the CODE submenu 1 or DECODE submenu 2.*

2.9.2 Tone Duration

NO SPC/LENGTH Function

Softkey 2 is assigned two functions. The SHIFT key is used to select the first or second function.

Softkey 2: NO SPEC

This function is used to define, which tone of the selective-call sequence is to be subjected to special tone duration.

Normally this is the first tone of extended tone duration compared to the other tones. The entry is made using softkey 2 (No SPC)/number (tone duration in ms)/ENTER.

Softkey 2: LENGTH

Each individual standard is assigned a tone duration, which can, however, also be influenced using softkey 2 (LENGTH). The duration can be selected independent of the other tones. It is entered using softkey 2 (LENGTH)/number (tone duration in ms)/ENTER.

2.9.3 Pause

OTHER/PAUSE Function

Softkey 3 is assigned two functions. The SHIFT key is used for selecting the first or second function.

Softkey 3: OTHER

This softkey is used for determining the tone duration of the other tones by entering softkey 3 (OTHER)/number (tone duration in ms)/ENTER.

Softkey 3: PAUSE

The pause duration between the tones defined by entering softkey 3 (PAUSE)/number (tone duration in ms)/ENTER.

2.9.4 Frequency Definition

TONE Function

The complete lower half of the screen is available for definition of frequencies. 8 softkeys with dual function (4 to 7, 12 to 15) are provided for the entry of 16 different frequencies or frequency pairs. The tone numbers correspond to the numbers (incl. A to F) of the "dialling number". The digits * and# are used for standard 10 (DTMF) instead of E and F. Again, SHIFT/softkey.. is used for switching between first and second function of a softkey.

A frequency or frequency pair can be entered for each digit, i.e. standards can consist of single or dual tones or even be mixed of single and dual tones. Single tones are produced by selecting 0 in the right softkey column. The selection of right or left column is made by pressing softkey 11. Again, SHIFT/softkey 11 is used to select the first function (left softkey column) or the second function (right softkey column) or vice versa.

The frequencies are entered by softkey../ number/ENTER. The frequencies are displayed in Hz.

The range for standard 0 is 100 Hz to 20 kHz and for standards 1 to 10 it is 300 Hz to 4 kHz.
The frequencies thus defined are valid for standards 0 to 10 (modified or unmodified) for output of tone sequences. For evaluation the frequencies of the first softkey column apply (modified or unmodified), however, only for standards 0 to 9. The lower tone number (digit) is decoded in case of frequency repeats. With standard 10 selected, the double tones of the unmodified standard are decoded.

2.9.5 Coupling of Standards

DECODE → CODE Function

Softkey 9 is used to determine, whether coder and decoder work with the same standard or not. In the first case a change of standard for the coder automatically leads to a change of standard with the decoder and vice versa (normal operation). In the other case coder and decoder can be set individually.

2.9.6 Decoding Time

DECODE TIME Function

This function is especially of interest in automatic operation (IEC/IEEE bus and autorun control). The decoding time set here causes abortion of decoding after this time elapsed, independent of tones following or not.

The decoding time is entered using `softkey 10/number (decoding time in ms)/ ENTER`.

Application:

With acknowledgement call operation the CMS sends out a call, then evaluates the reply. Or the transceiver first sends a call; starting with this call the CMS first waits until the decoding time set via softkey 10 has passed, then continues the program by a reply selective call or any other action. This function is required for the signalling operation within the Swiss mobile telephone system NATEL B.

2.10 Definition Menu for Special Functions

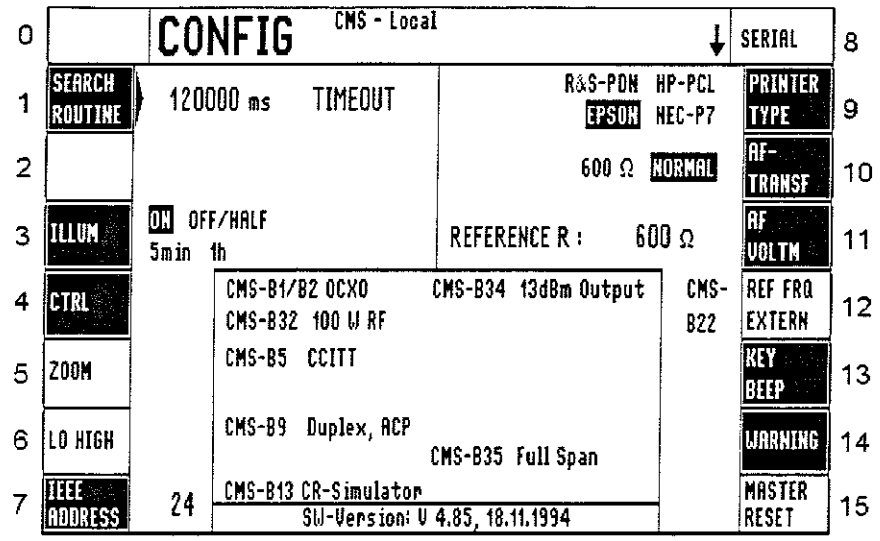


Fig. 2.10-1 Main menu CONFIG (special functions)

Starting with the main menus of the selection menu the main menu CONFIG (definition menu for special function) is entered by pressing the softkey CONFIG.

2.10.1 Search Routines

SEARCH ROUTINE Function

The timeout value can be determined for the search routines using this function.

SEARCH ROUTINE Function: Submenu

A submenu is available for the SEARCH ROUTIN function, which is output in the display fields next to the softkeys 2 to 7.

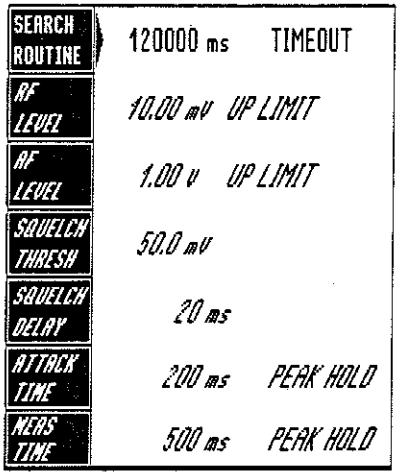


Fig. 2.10-2 SEARCH ROUTIN submenu

Softkey 2: RF LEVEL

Softkey 2 can be used to define the upper RF level limit with search routines.

Softkey 3: AF LEVEL

Softkey 3 can be used to define the upper AF level limit with search routines.

Softkey 4: SQUELCH THRESH

Softkey 4 can be used to define the threshold value for squelch on or squelch off with AF level measurements.

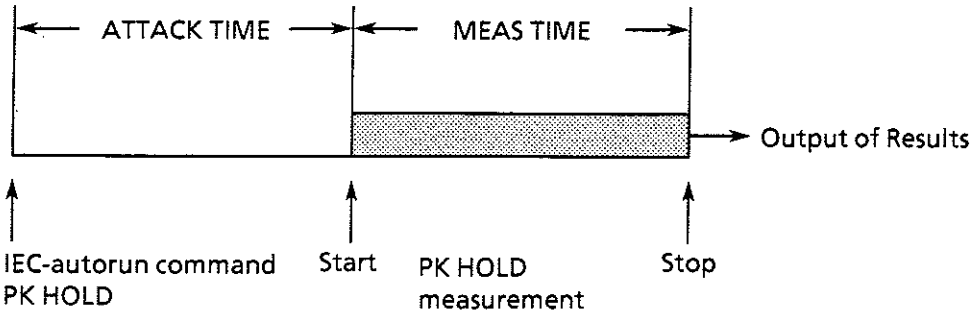
Softkey 5: SQUELCH DELAY

Using softkey 5, the delay time for slowing down the test cycle with the squelch measurement can be defined.

Softkey 6/7: ATTACK TIME/MEAS TIME

In IEC-bus or autorun mode the PK HOLD measurement is a single, time-limited process.

MEAS TIME means the time during which the peak value meter evaluates all the voltage peaks occurring. ATTACK TIME is the time by which evaluation is delayed after command execution.



2.10.2 Display Illumination

ILLUM Function

Illumination of the display can be switched on and off using softkey 3 (ILLUM).

ON: Illumination of the CMS remains activated.

OFF/HALF: Illumination of the CMS is deactivated or switched to half brightness.

5 min:
1 h: After 5 min/1 h the CMS switches illumination off or to half brightness, if no key was activated during this time.

2.10.3 TTL Interface

(Cf. also Fig. 2.9-4: pin assignment of the CONTROL connector)

CTRL Function

Pressing the CTRL softkey calls the submenu CTRL.

CTRL Function: Submenu

The CTRL function has a submenu, which is output in the display fields next to softkeys 2 to 7.

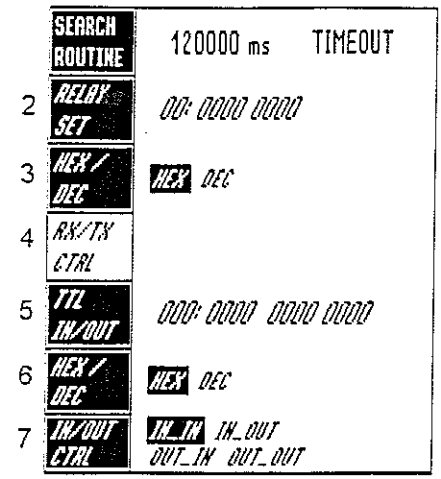


Fig. 2.10-3 CTRL submenu

Softkey 4: RX / TX CTRL

When softkey 4 is pressed, the most significant relay is switched off with menu changeover to the RX-Test, and switched on with menu changeover to the TX-Test. An RX-TX switchover with the RF power does not change the relay.

Softkey 5: TTL IN / OUT

Softkey 5 can be used to have the TTL interface read and/or written to. All TTL lines can be set and reset individually or jointly. The three less significant hexadecimal positions and the respective programming of the TTL interface by softkey 7 determine which TTL lines are influenced.

Example f or TTL IN/OUT (IN/OUT CTRL = OUT_OUT)

1. Setting all TTL lines: range of values between 0 and 4095 (0 and FFF Hex)

   All TTL lines are set irrespective of the previous setting in accordance with the binary value.

   e. g.: setting all TTL lines.

previous setting:	255 Hex	=	0010 0101 0101 B
entered value:	0 00F Hex	=	0000 0000 1111 B
new setting:	25F Hex	=	0000 0000 1111 B

   TTL lines are set

   TTL lines are to be set

2. Setting individual TTL lines: range of values between 0 and 4095 + 4096 (1000 and 1FFF Hex)

   All indicated TTL lines with the binary number "1" are set, TTL lines with binary value "0" are not influenced.

   e. g.: setting all less significant 4 TTL lines, leaving all more significant lines unaffected.

previous setting:	255 Hex	=	0010 0101 0101 B
entered value:	1 00F Hex	=	0000 0000 1111 B
new setting:	25F Hex	=	0010 0101 1111 B

   TTL lines are set

   TTL lines not influenced

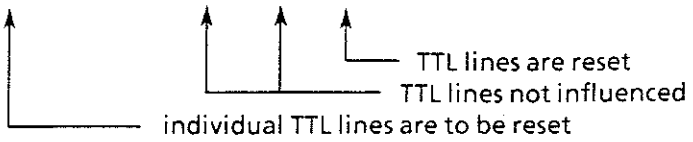
   individual TTL lines are to be set

3. Resetting individual TTL lines: range of values between 0 and 4095 + 8192 (2000 and 2FFF Hex)

All indicated TTL lines with the binary number "1" are reset, TTL lines with binary value "0" are not influenced.

e. g.: resetting all less significant 4 TTL lines, leaving all more significant lines unaffected.

previous setting:	255 Hex	=	0010 0101 0101 B
entered value:	2 00F Hex	=	0000 0000 1111 B
new setting:	25F Hex	=	0010 0101 0000 B



Softkey 6: HEX / DEC

Softkey 6 can be used to select whether the TTL lines are to be entered in decimal or hexadecimal form.

Softkey 7: IN / OUT CTRL

This functions sets the TTL interface to input or output.

IN_IN: All TTL lines are set to input. 12 external TTL lines are read.

IN_OUT: The upper four TTL lines are set to input and are read, the internal eight TTL lines are written to.

OUT_IN: The upper four TTL lines are set to output and are written to, the lower eight TTL levels are read.

OUT_OUT: All TTL lines are set to output and are written to.

The four TTL lines above can be used to control AUTOTEST programs when they are in position IN-IN or IN-OUT, the line at B12 has the symbolic name "BCD-3", D9 "BCD-0".

Note: Not all CMS option carriers have 12 TTL lines. If less than 12 lines are used, the ones not available are marked with an X. In this case, the lines D1 to D4 (in position IN-IN as well as OUT-IN) can be used to control AUTOTEST events BCD-0 (D1) to BCD-3 (D4).

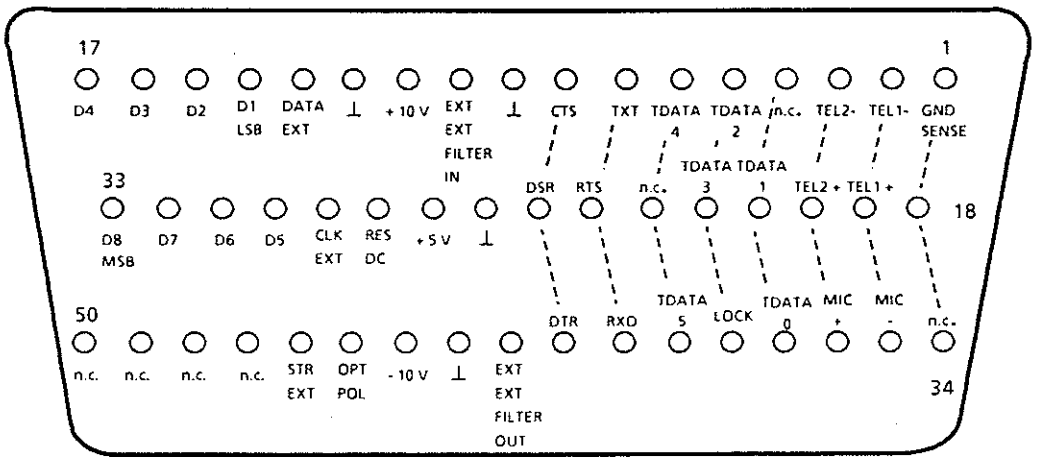


Fig. 2.10-4 Pin assignment of connector CONTROL

2.10.4 ZOOM

ZOOM Function

The ZOOM function is switched on (light characters on a dark background) and off (dark characters) using softkey 5 (ZOOM). With the ZOOM function switched on, analog indications in the TX-test menu and RX-test menu are shown in magnified display; the oscilloscope is switched off in this operating mode.

2.10.5 LO Frequency LO/HIGH

LO HIGH Function

This softkey is used to set the LO frequency for conversion into the internal IF frequency of 455 kHz above or below the carrier frequency (LO HIGH invers: LO frequency below carrier frequency).

2.10.6 IEC/IEEE Bus

IEEE ADRESS Function

This function is used to select the IEC/IEEE-bus address. The address range is between 0 to 30. The entry is made using `softkey 7/ number/ ENTER`. Standard setting is address 24.

2.10.7 Serial Interface

This main menu is described in section 2.13.

2.10.8 Selection of Printer

PRINTER TYPE Function

Various printer types may be selected on actuation of softkey 9 (toggle function).

2.10.9 AF Voltmeter (Reference Resistance)

AF VOLTM Function

The AF level measurement normally refers to a load resistance of 600 Ω.

Another load resistance can be selected using this function. The entry is made using `softkey 9/number/ENTER`, the number representing the reference resistance in Ω.

2.10.10 External Reference Frequency

REF FRQ EXTERN Function

Actuating softkey 10 switches off the internal 10-MHz reference frequency. This means that all frequencies of the CMS are inaccurate if option CMS-B22 is not fitted or no 10-MHz input signal is available.

2.10.11 Acoustic Acknowledgement

KEY BEEP Function

The softkey KEY BEEP is used for selecting whether each keystroke is to be acoustically acknowledged or not.

2.10.12 Warnings

WARNING Function

The WARNING softkey is used to select whether warning messages are displayed by the CMS or not. These warning messages are hints to possible erroneous operation. Hints at real conflicts are always indicated in the status line.

2.10.13 Master Reset

MASTER RESET Function

The instrument is set to the factory setting using the softkey MASTER RESET and pressing ENTER.

2.11 Remote Control

The IEC/IEEE bus interface corresponds to the IEC 625-1 or IEEE 488.1 standard and to IEEE 488.2 also approved of by the IEC commission. This standard describes data transfer formats and common commands etc.

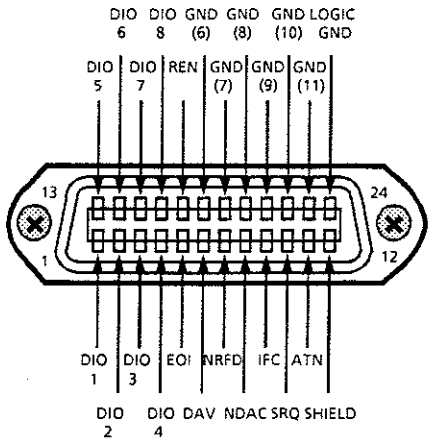


Fig. 2.11-1 Pin assignment of socket ***51***

The bus connection socket ***51*** is fitted to the rear of the instrument. The instrument is equipped with the 24-contact socket according to the IEEE 488 standard. The interface contains three groups of bus lines:

1. **Data bus with 8 lines DIO 1 to DIO 8**
   Data transmission is bit-parallel and byte-serial with the characters in ISO 7-bit code (ASCII code).

   DIO 1 represents the least significant bit and DIO 8 the most significant bit.

2. **Control bus with 5 lines**
   This is used to transmit control functions:

   ATN (Attention)
   becomes active Low when addresses, universal commands or addressed commands are transmitted to the connected devices.

   REN (Remote Enable)
   enables the device to be switched to the remote status.
   SRQ (Service Request)
   enables a connected device to send a Service Request to the controller by activating this line.

   IFC (Interface Clear)
   is activated by the controller in order to set the IEC interfaces of the connected devices to a defined status.

   EOI (End or Identify)
   is used to identify the end of data transfer and is used with a parallel poll.

3. **Handshake bus with 3 lines**

   Used to control the data transfer timing.

   NRFD (Not Ready For Data)
   an active Low on this line signals to the talker/controller that one of the connected devices is not ready to accept data.

   DAV (Data Valid)
   is activated by the talker/controller shortly after a new data byte has been applied to the data bus.

   NDAC (Not Data Accepted)
   is held at active Low by the connected device until it has accepted the data present on the data bus

Detailed information on the data transfer timing is available in the IEC 625-1 standard.

According to the IEC 625-1 standard, devices controlled via the IEC bus can be equipped with different interface functions. Table 2-10-1 lists the interface functions applicable to the instrument:

Table 2.11-1 Interface functions

Control characters	Interface function
SH1	Source Handshake function, complete capability
AH1	Acceptor Handshake function, complete capability
L4	Listener function,complete capability, unaddress if MTA
T6	Talker function,complete capability, capability to reply to serial poll, unaddress if MLA
SR1	Service Request function, complete capability
PP1	Parallel Poll function, complete capability
RL1	Remote/Local switchover function, complete capability
DC1	Device Cleart function, complete capability
DT0	Device Trigger function, no Device Trigger
C0	Controller function, no controller function

2.11.1 Setting the Device Address

The device address can be set in the CONFIG menu using the IEEE ADRESS function. The address between 0 and 30 is entered using the numeric keys and remains stored when the device is switched off. The instrument is factory-set to address 24.

The address is the decimal equivalent of bits 1 to 5 of the Talker or Listener address. This form is also used with the IEC-bus command of the controller.

2.11.2 Local/Remote Switchover

The device is in the Local state (manual mode) when switched on.

If the instrument is addressed as a Listener by a controller, it enters the Remote state in line with the standard and remains in this state after data transfer has been completed. All controls on the front panel except the STOP(LOCAL) key are desabled.

There are two methods to return to the "Local" state:

- by the addressed command GTL (Go to Local) from the controller
- by pressing the STOP key. Data output from the controller to the instrument should be stopped before pressing the STOP key for otherwise the instrument will immediately enter the Remote stat again. The function of the STOP key can be disabled by the controller by sending the universal command LLO (Local Lockout).

The other device settings are not changed when switching from Remote to Local state or vice versa.

When the CMS is switched to the Local state, the respective main menu of the current operating mode is indicated.

2.11.3 Interface Messages

Interface messages (according to IEC 625-1/IEEE 488 stadard) are transmitted to the device on the data lines where the Attention line ATN is active (low).

2.11.3.1 dUniversal Commands

The universal commands have codes between 10 and 1F hexadecimal (see Table 2.10-4). They act, without previous addressing, on all devices connected to the bus.

Table 2.11-2 Universal commands

Command	Basic command with R&S controllers	Function
DCL (Device Clear)	IECDCL	Aborts processing of the currently received commands and sets the command processing software to a defined initial status. The device setting is not changed.
LLO (Local Lockout)	IECLLO	The STOP key is disabled.
SPE (Serial Poll Enable)	IECSPE *	Ready for serial poll.
SPD (Serial Poll Disable)	IECSPD *	End of serial poll.

* The BASIC command "IECSPL adr, status" contains the commands "IECSPE" and "IECSPD" and additionally reads the status of the device with address "adr" and stores this in the integer variablw "status".

2.11.3.2 Addressed Commands

The addressed commands have codes between 00 and 0F hexadecimal (see Table 2.10.-4). They only act on devices addressed as Listeners (by the BASIC command "IECLAD addr").

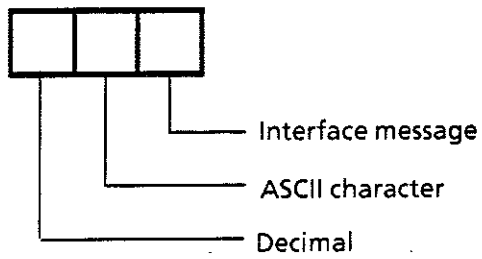
Table 2.11-3 Addressed commands

Command	Basic command with R&S controllers	Function
SDC (Selected Device Clear)	IECSDC	Aborts processing of the currently received commands and sets the command processing software to a defined initial status. The device setting is not changed.
GTL (Go To Local)	IECGTL	Change to Local state (manual operation)

Table 2.11-4 ASCII/ISO and IEC-character set

Control characters						Numbers and special characters				Upper-case letters				Lower-case letters			
0	NUL		16	DLE		32	SP	48	0	64	@	80	P	96	`	112	p
1	SOH	GTL	17	DC1	LLO	33	!	49	1	65	A	81	Q	97	a	113	q
2	STX		18	DC2		34	"	50	2	66	B	82	R	98	b	114	r
3	ETX		19	DC3		35	#	51	3	67	C	83	S	99	c	115	s
4	EOT	SDC	20	DC4	DCL	36	$	52	4	68	D	84	T	100	d	116	t
5	ENQ	PPC	21	NAK	PPU	37	%	53	5	69	E	85	U	101	e	117	u
6	ACK		22	SYN		38	&	54	6	70	F	86	V	102	f	118	v
7	BEL		23	ETB		39	'	55	7	71	G	87	W	103	g	119	w
8	BS	GET	24	CAN	SPE	40	(	56	8	72	H	88	X	104	h	120	x
9	HT	TCT	25	EM	SPD	41	)	57	9	73	I	89	Y	105	i	121	y
10	LF		26	SUB		42	*	58	:	74	J	90	Z	106	j	122	z
11	VT		27	ESC		43	+	59	;	75	K	91	[	107	k	123	{
12	FF		28	FS		44	,	60	<	76	L	92	\	108	l	124	|
13	CR		29	GS		45	-	61	=	77	M	93	]	109	m	125	}
14	SO		30	RS		46	.	62	>	78	N	94	^	110	n	126	~
15	SI		31	US		47	/	63	? / UNL	79	O	95	-	111	o	127	DEL
Addressed commands			Universal commands			Listener addresses				Talker addresses				Secondary addresses and commands			

Code:



2.11.4 Device Messages

Device messages (in line with IEC 625-1) are transmitted on the data lines, in which case the Attention line is High, i.e. not active. The ASCII code (ISO 7-bit code) is used (see Table 2.10-4).

As can be seen in Table 2.10-5, the device messages can be grouped according to two different aspects.

Table 2.11-5 Grouping of device messages

Type of commands	Direction of transfer	
	Messages received by the CMS	Messages sent by the CMS
Common device-independent commands (in line with the IEEE 488.2 standard)	cf. Table 2.10-6	cf. Table 2.10-7
Device-specific commands (dependent on the device characteristics)	cf. Table 2.10-8	cf. Table 2.10-8

In the following text, device messages received by the CMS are referred to as commands.

Commands with a "?", such as "COUNT:RF?" request the CMS to output a measured value where the same format is used as in the command table. For the given example, this is:

"COUNT:RF 20 000 000",

when always the basic unit applies (Hz in this case).

Commands with a "?" and subsequent data give a specific setting value to the CMS and request the CMS to output the measured value. In the case of a search routine, this would be:

S_N:RX TEST? 20 DB

2.11.4.1 Commands Received by the CMS in Listener Mode (Controller to Device Messages)

Input buffer:

All commands received are buffered in a memory of max. 256 bytes; it is also possible to process command lines which are longer. In this case, the part of the command line which was first received is already processed in the device.

Command syntax:

Fig. 2.10-2 shows the syntax of a command line (program message). Every command line must end with a terminator.

Terminators:

- New line (ASCII code 10 decimal)
- End (EOI line active) together with the last useful character of the command line or the new line character.

Since the carriage return character (ASCII code 13 decimal) is permissible as a filler without effect before the terminator, the combination of carriage return + new line is permissible.

All IEC-bus controllers from Rohde & Schwarz send terminators accepted by the device as standard. A command line may require more than one line on the controller screen since it is only limited by the terminator. The terminator is automatically added to the end of command text with most IEC-bus controllers.

Separators:

A command line may contain several commands (program message units) separated by semicolons (;).

Command structure:

A command may consist of the following parts:

- Only a header
  Example: **RST*

- Header and question mark
  (Query)
  Example: *POWER:RF?*

This combination requests the CMS to transfer the desired data to an output buffer in order to transfer them via the IEC bus as soon as it is addressed as a Talker (see Section 2.10.4.2).

- Header and number

  Examples: *FREQUENCY:RF:TXTEST 20E6*
  FREQUENCY:RF:TXTEST 20 MHz

To remain in accordance with the IEEE 488.2 standard, the header and number(s) must be separated by at least one space (ASCII code 32 decimal). In the case of device-specific commands, the number can be supplemented by a unit.

- Header and string

  Example: *FREQUENCY:AF:I1 ON*

The headers and their meanings are explained in Sections 2.10.4.3 and 2.10.4.4.

Lower case/upper case letters:

Lower case letters are permissible and are equivalent to the corresponding upper case letters. Thus units can be used in the usual form (e.g.: dBm) instead of the notation using upper case letters which is also permissible (e.g. DBM).

Spaces:

Additional spaces may be inserted at the following points:

- before a header;
- between header and number;
- before and after commas (,) and semicolons (;)
- before the terminator.

Decimal numbers:

The following notations are permissible for decimal numbers:

- With and without sign
  e. g. *5, +5, -5*

- With and without decimal point, any position of decimal point is permissible.
  e. g. *1.234, -100.5, .327*

- With or without exponent to base 10, "E" or "e" is used as the exponent character.

  e. g. *.451, 451E-3, +4.51e-2*

- The exponent is permissible with or without a sign, also a space is permissible instead of the sign.
  e. g. *1.5E+3, 1.5E-3, 1.5E 3*

- Leading zeros are permissible in the mantissa and exponent.
  e. g. *+0001.5, -01.5E-03*

- The length of the number, including the exponent, may be up to 30 characters. The number of digits for the mantissa and exponent is only limited by this condition. Digits which exceed the resolution of the device are rounded up or down; they are always considered for the order of magnitude (power of ten).
  e. g. *150000000, 0.00000032*

If two numeric entries are permissible with one command, they are separated by comma, e.g. DISPLAY: MENU 2,0

Note: Specification of the exponent alone (e.g.: E-3) is not permissible, 1E-3 is correct).

Hexadecimal and binary numbers:

Hexadecimal numbers and binary numbers are permissible only without exponent and unit, the following notations are permissible:

Hexadecimal number
e.g. #H12ffab, #h12FFAB, #HFf19a

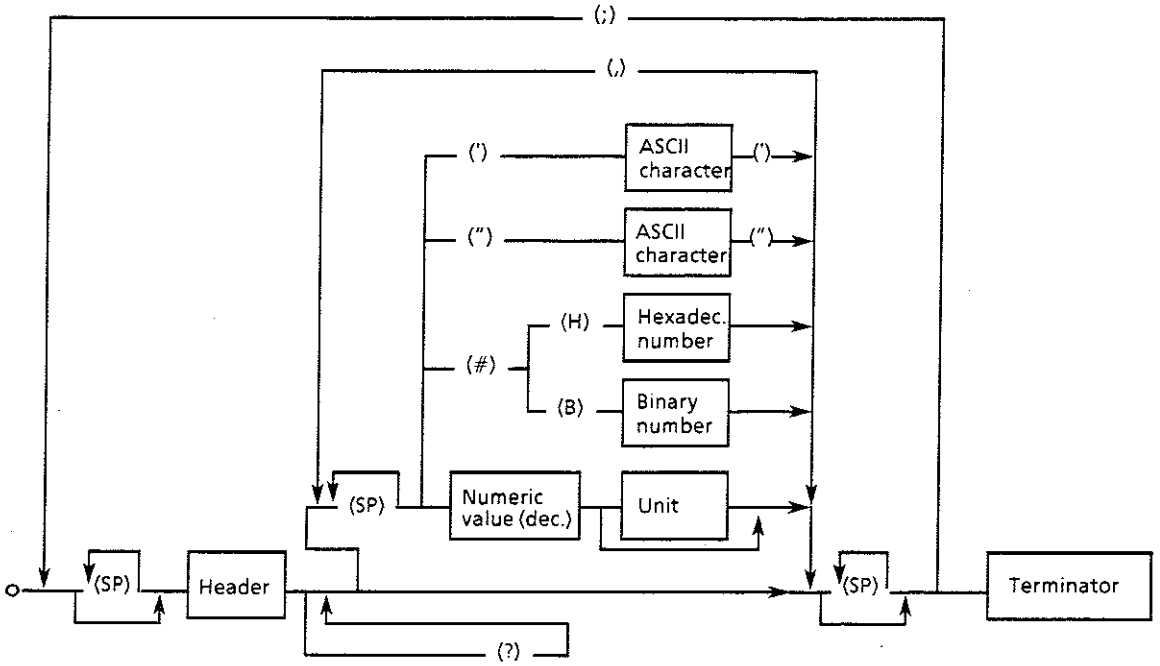
Binary number
e.g. #b101011, #B11001

String entries:

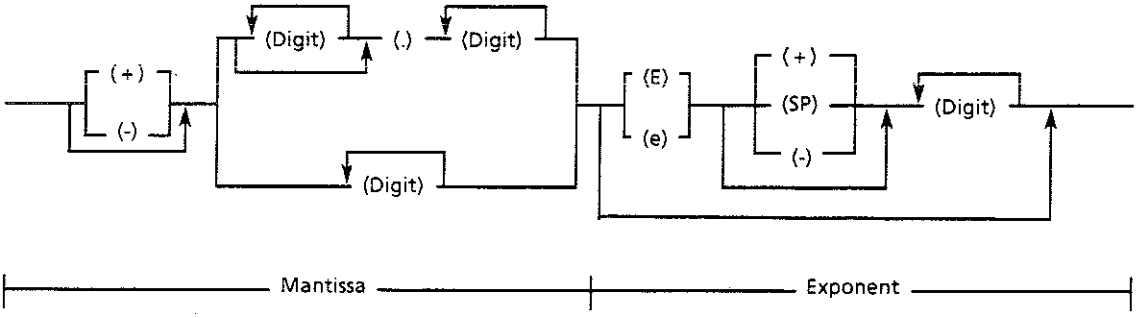
The following notations are permissible for string entries:

e.g. CODE '01234567890abcdef'
CODE '0123456789abCDEF'
CODE "01234567890abcdef"
CODE "0123456789AbcdEF"

Command line



Numeric value (decimal)



SP: Any character with ASCII code 0 to 9 and 11 to 32 decimal, especially space.

Fig. 2.11-2 Syntax diagram of a command line

2.11.4.2 Messages Sent by the CMS in Talker Mode (Device to Controller Messages)

The CMS sends messages via the IEC bus if it

- has been requested to provide data in its output buffer by one or more query messages with a question mark within one command line,
- indicates by setting bit 4 (message available) in the status byte that the requested data are now present in the output buffer (see also Section 2.11.5), and
- has been addressed as a talker

Note that the command line with the data request must be transmitted directly before the talker is addressed. If another command line is present in between, the output buffer is cleared.

The maximum length of the output buffer is 256 bytes.

A query message is formed by adding a question mark "?" onto the header of Table 2.11-8, e.g. "COUNT: RF?".

If the CMS is addressed as a Talker directly after the query message, the bus handshake is disabled until the requested data are available. This simple synchronization procedure is certainly meaningful with the CMS if the execution of a query message can take place independent of the execution and termination of a test run.

The syntax of the messages sent by the CMS is shown in Fig. 2.11-3. The syntax is similar to that for commands received by the CMS.

A new line (ASCII code 10 decimal) together with end (line EOI active) is used as terminator.

The transmission of "header and numbers" makes it possible that the messages sent by the CMS can again be returned to the CMS in the same form, without any amendments as setting commands. Thus a setting made on the keyboard can be read, stored in the controller and repeated later via the IEC bus.

- If the CMS receives several query messages, it also returns several messages within one line separated by semicolons (;).
- Several numbers can be sent as a reply to certain query messages, they are separated by commas (,).
- Header and numbers are always separated by spaces.
- Headers only consist of upper-case letters and the characters ":", "_" and "*".
- The syntax of the numbers is described in Fig. 2.11-3. The exact form of the numbers of each message is described in Tables 2.11-7 and 2.11-8.
- Messages sent by the CMS do not contain units. In the case of physical variables, the numbers are referred to the basic unit of the units specified in Table 2.11-8 (V, A, W, OHM, S, Hz, RAD, PCT, DB).

Special Cases in the Talker Mode

In the Talker mode one result is usually output. There are however the following exceptions, where several values separated by commas are output:

- Demodulation: DEMODULATION?

  Two results are output. However, the second result makes only sense with peak weighting of the demodulated signal. Otherwise a zero is output as second result.

- Search Routines

  In the case of all search routines two results in accordance with the following table are output.

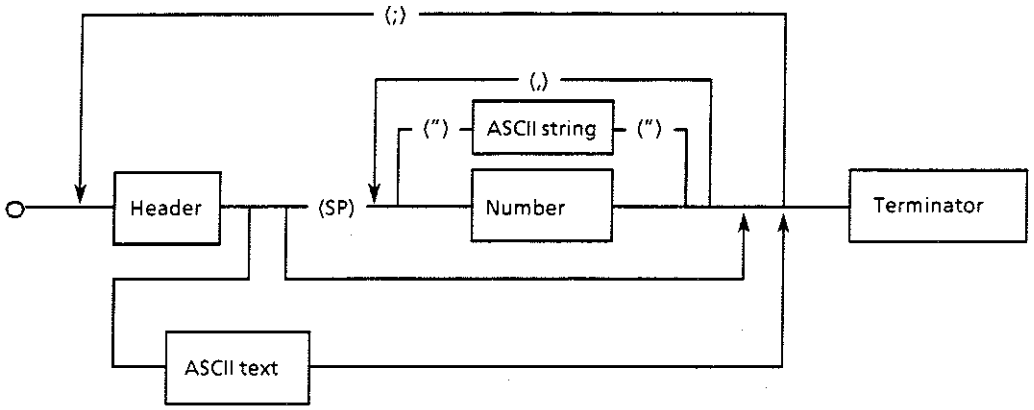
Search R2utine	1st Result	2nd Result
Bandwidth Measurement	Actual value of bandwidth	Actual value of delta frequency
Squelch	Act. value of Switch Off RF	Actual value of Squelch Hysteresis
Quieting	Actual value of Quiet	Actual value of RF Level
Sinad/Dist/SN	Actual value of Sinad/SN	Actual value of RF Level
Modulation Sensitivity	Nominal value of Demod	Actual value of AF Level1

- Read out contents of decoded telegram: DECODE:NUMBER?

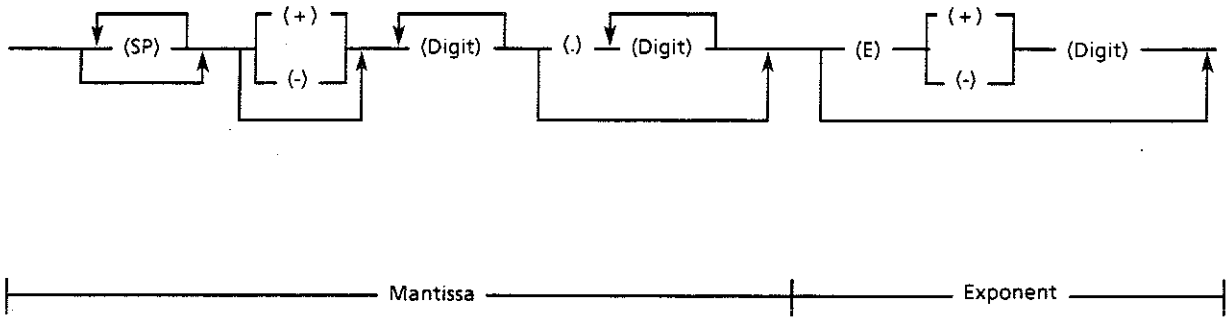
  The contents of the decoded telegram can be output using DECODE:NUMBER? 0 to 40. The number specifies which entry in the measurement buffer is to be output. Each entry in the buffer consists of three values:

  1st Time in second2
  2nd Frequency in Hz
  3rd Deviation in percent from the nominal value

Output message line



Number



SP: Space (ASCII code 32 decimal)
ASCII text: Reply to command *IDN? (see table 2.10-7)

Fig. 2.11-3 Syntax diagram of messages sent by the CMS

2.11.4.3 Device-independent Commands (Common Commands)

These commands are listed in Tables 2.10-6 and 2.10-7 and can be split up into the following groups:

- Commands which refer to the Service Request function with the associated status and mask registers
- Commands for device identification
- Commands which refer to the Parallel Poll function
- Commands for device-internal sequences (reset, calibrate) and for synchronizing sequences.

These are taken from the IEEE 488.2 standard, which ensures that these commands have the same effect in different devices.

The headers of these commands consist of a star (*) followed by three letters.

Table 2.11-6 Device-independent commands (common commands) received by the CMS

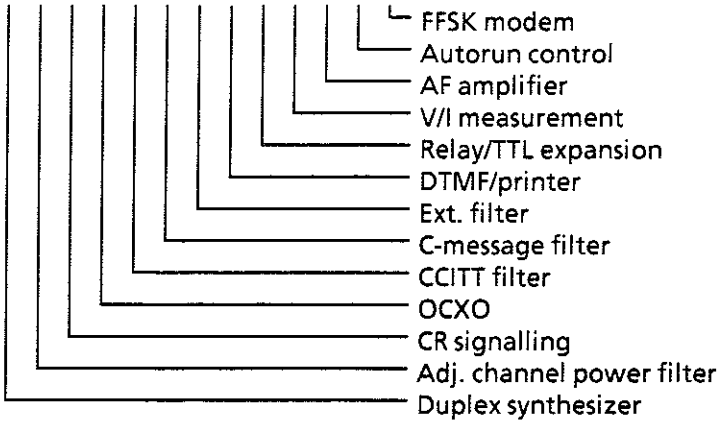
Command	Number, range	Meaning
*RST	---	**Reset** Acts on the instrument setting like the RESET key. This command does not change the status of the IEC-bus interface, the set IEC-bus address, the mask register of the Service Request function and the output buffer. A current Service Request is only reset if it has not been produced by a message in the output buffer.
*PSC	0 to 65535	**Power On Status Clear** (reset on power-up) If >0: with power-up, the Service Request Enable mask register (SRE) and the Event Status Enable mask register (ESE) are cleared in addition. If 0: the above-mentioned registers retain their contents when the device is switched on and off. This enables a Service Request when the device is switched on.
*OPC	---	**Operation Complete** (ready signal) Sets bit 0 (Operation Complete) in the ESR, if all previous commands have been processed (see Section 2.11.7).
*CLS	---	**Clear Status** • Sets the status registers (ESR and STB) to zero. The mask registers of the Service Request function (ESE and SRE) are not changed. • Clears the output buffer. A present Service Request is cleared (see Section 2.11.5).
*ESE	0 to 255	**Event Status Enable** The ESE mask register is set to the specified value which is interpreted as a decimal number (see Section 2.11.5).
*SRE	0 to 255	**Service Request Enable** The SRE mask register is set to the specified value which is interpreted as a decimal number (see Section 2.11.5).
*PRE	0 to 255	**Parallel Poll Enable** The Parallel Poll Enable mask register is set to the specified value which is interpreted as a decimal number (see Section 2.11.5).
*WAI	---	**Wait To Continue** Only process the subsequent commands when all previous commands have been completely executed (see Section 2.11.7).

Table 2.11-7 Device-independent commands sent by the CMS

Command	Output message Data value		Meaning
	No. of digits	Range	
*IDN?	23	alphanumeric	**Identification Query** The following identification text is sent via the IEC/IEEE bus as a reply to the IDN? command. Example: Rohde&Schwarz, CMS,0,X.XX Rohde&Schwarz = manufacturer CMS = model 0 = reserved for serial number, (not used with CMS) X.XX = firmware version (e.g. V1.00)
*PSC?	1	0 or 1	**Power On Status Clear Query** To read the status of the Power On Clear Flags, see *PSC in Table 2.11-6
*OPC?	1	1	**Operation Complete Query** (ready message) The message "*OPC 1" is entered into the output buffer and bit 4 (message available) set in the status byte if all previous commands have been completely executed. Bit 0 (operation complete) is also set in the ESR (see Section 2.11.7).
*ESR?	1 to 3	0 to 255	**Event Status Register Query** The contents of the ESR are output in decimal form and the register then set to zero.
*ESE?	1 to 3	0 to 255	**Event Status Enable Query** The contents of the ESE mask register are output in decimal form.
*STB?	1 to 3	0 to 255	**Status Byte Query** The contents of the status byte are output in decimal form.
*SRE?	1 to 3	0 to 255	**Service Request Enable Query** The contents of the SRE mask register are output in decimal form.
*TST?	1	0 to 255	**Self-Test Query** The output value "0" indicates the duly completion of the self-test.
*IST?	1	0 or 1	For reading the actual instrument status (see section 2.11.5)

Command	Output message Data value		Meaning
	No. of digits	Range	
*PRE?	1 to 3	0 to 255	The contents of the Parallel Poll Enable register are output in decimal form.
*OPT?	2	0 to 255 (alphanume-ric)	**Option Identification Query** The following text is sent via IEC bus in response to the OPT? command (see table below)

ROHDE&SCHWARZ, CMS, x, x, x, x, x, x, x, x, x, x, x, x



x = 1: option fitted
x = 0: option not fitted

2.11.4.4 Device-specific Commands

All CMS functions which can be set using the keyboard can also be controlled via the IEC bus. The effect of the setting commands is the same as the corresponding entry via the keyboard.

According to the output in the display, the values of all setting parameters can also be read out via the IEC bus, especially the marker frequency and marker level values.

Table 2.11-8 shows the setting commands and the data request commands with the associated messages sent by the CMS.

The headers are the same as the key designations or similar to them. This results in easy-to-read (self-documenting) programs.

The headers can be abbreviated by omitting any characters at the end. The shortest possible notation is shown in Table 2.11-8 in bold print.

Many headers consist of several parts separated by colons (:). The abbreviations can be used in each part of the header (e.g. FR:R:TX instead of FREQUENCY:RF:TXTEST).

Certain headers contain the underline character (ASCII code 95 decimal) to facilitate reading.

All setting commands which must be assigned values are listed in Table 2.11-8 in the column "Data". Certain commands may also have a character string as the data, e.g. FREQUENCY:RF: TXTEST ON.

A unit can be added directly to the numbers in the setting commands. The permissible units are listed in Table 2.11-8. They may also be abbreviated and written with lower-case or upper-case letters. If no unit is used, the respective default unit applies (V, A , OHM, S, HZ, RAD, PCT, DB).

Table 2.11-8 Device-specific setting commands

IEC-bus commands for common device functions

Command	Data	Units	Meaning
X:VARIATION	no. **ON OF**F	---	Step size of set values
X:REFERENCE	no. **ON OF**F	---	Measured or set value becomes reference
X:TOLERANCE:**U**PPER **X:TO**LERANCE:**L**OWER	no. **ON OF**F	---	Output of tolerance markers in the analog display
X:RANGE	no. **ON OF**F	---	Full-scale value of analog display
RESET	---	---	Reset to original state
PRESET	---	---	Reset to a defined state
STORE:**S**TATE	number (1-3)	---	Storing of device state
STORE:**F**REQUENCY	number (10-29)	---	Storing of RF frequency
RECALL:**S**TATE	number (1-3)		Recall of device state
RECALL:**F**REQUENCY	number (10-29)		Recall of RF frequency
HARDCOPY	---	---	Hardcopy of screen contents
DISPLAY:**M**ENU	number number	---	Direct selection of a menu. The first number selects the main menu, the second number the associated submenu (see table below).
HEADER	**ON OF**F	---	The output of the IEC bus header is switched on or off.

Main menu		Submenu			
Index	Name	Index	Name	Index	Name
0	Selection menu	0	no submenu	20	RX-CODE 1
1	TX-Test menu	1	TX-SET-RF	21	RX-CODE 2
2	RX-Test menu	2	TX-POWER	22	RX-FILTER 1
3	Duplex-Test	3	TX-COUNT	23	RX-FILTER 2
4	TONES menu	4	ACP1 (ACP)	24	RX-SINAD
5	TONES AF1/AF2	6	DEMOD	25	RX-S/N
6	SPECTRUM menu	7	TX-AF-COUNT	26	RX-MOD 1
7	CONFIG menu	8	DECODE1	28	CONFIG search routine
13	SELFCHECK menu	9	DECODE2	29	VSWR
14	CR-SEL menu	10	TX-FILTER 1	30	CONFIG Control
15	CR main menu	11	TX-FILTER 2	66	VOR/ILS/SCOPE
16	Modem menu	12	DISTORTION		
17	VOR	13	TX-S/N		
18	ILS-LOC	14	TX-LEVEL		
19	ILS-GS	15	TX-SCOPE		
20	Marker Beacon	17	RX-RF-LEVEL		
21	R232	18	RX-AF-LEVEL		
22	R232 Config.	19	RX-AF-COUNT		

IEC-bus commands for TX and RX test

Command	Data	Units	Function
FREQUENCY:RF:TXTEST	number	MHZ KHZ HZ	RF frequency input in TX-Test
FREQUENCY:RF:TXTEST:VARIATION	number ON OFF	MHZ KHZ HZ	
FREQUENCY:RF:TXTEST:REFERENCE	number ON OFF	MHZ KHZ HZ	
FREQUENCY:RF:RXTEST		MHZ KHZ HZ	RF frequency input in RX-Test
FREQUENCY:RF:RXTEST:VARIATION	number ON OFF	MHZ KHZ HZ	
FREQUENCY:RF:RXTEST:REFERENCE	number ON OFF	MHZ KHZ HZ	
FREQUENCY:RF:TRANSFER	ON OFF		Channel numbering
FREQUENCY:RF:DUPLEXSPACE	number	MHZ KHZ HZ	
FREQUENCY:RF:REFCHANNEL	number		
FREQUENCY:RF:CHANNELSPACE	number	MHZ KHZ HZ	
FREQUENCY:RF:NUMBERING	ON OFF		
FREQUENCY:AF:I1	number ON OFF	MHZ KHZ HZ	AF frequency of modulation generator 1
FREQUENCY:AF:I1:VARIATION	number ON OFF	MHZ KHZ HZ	
FREQUENCY:AF:I1:REFERENCE	number ON OFF	MHZ KHZ HZ	
FREQUENCY:AF:I2	number ON OFF	MHZ KHZ HZ	AF frequency of modulation generator 2
FREQUENCY:AF:I2:VARIATION	number ON OFF	MHZ KHZ HZ	
FREQUENCY:AF:I2:REFERENCE	number ON OFF	MHZ KHZ HZ	
COUNT:RF	number	MHZ KHZ HZ	Counting of RF frequency
COUNT:RF:REFERENCE	number ON OFF	MHZ KHZ HZ	
COUNT:RF:TOLERANCE:UPPER	number ON OFF	MHZ KHZ HZ	
COUNT:RF:TOLERANCE:LOWER	number ON OFF	MHZ KHZ HZ	
COUNT:RF:PRESET	number ON OFF	MHZ KHZ HZ	Presetting RF frequency for counting
COUNT:RF:DIRECTCOUNT	number ON OFF	MHZ KHZ HZ	Direct coarse RF counting
COUNT:RF:TRANSFER	---	---	Transfer of counted frequency as working frequency
COUNT:AF:TXTEST	number	MHZ KHZ HZ	Counting of AF frequency in TX-Test
COUNT:AF:TXTEST:REFERENCE	number ON OFF	MHZ KHZ HZ	
COUNT:AF:TXTEST:SOURCE	DEMOD BEAT	---	Selection of Demod or Beat
COUNT:AF:TXTEST:TOLERANCE:LOWER	ON OFF	MHZ KHZ HZ	
COUNT:AF:TXTEST:TOLERANCE:UPPER	ON OFF	MHZ KHZ HZ	
COUNT:AF:TXTEST:PERIOD	PERIOD GATE	---	Operating mode of AF counter

Command	Data	Units	Function
COUNT:AF:RXTEST		MHZ KHZ HZ	Counting the AF frequency of the AF voltmeter
COUNT:AF:RXTEST:REFERENCE	number ON OFF	MHZ KHZ HZ	
COUNT:AF:RXTEST:TOLERANCE:LOWER	ON OFF	MHZ KHZ HZ	
COUNT:AF:RXTEST:TOLERANCE:UPPER	ON OFF	MHZ KHZ HZ	
COUNT:AF:RXTEST:PERIOD	PERIOD GATE	---	Operating mode of the AF counter
POWER:RF		W DBM	Power measurement
POWER:RF:TOLERANCE:UPPER	number ON OFF	W DBM	
POWER:RF:TOLERANCE:LOWER	number ON OFF	W DBM	
POWER:RF:REFERENCE	number ON OFF	W DBM	
POWER:RF:RANGE	number ON OFF	W DBM	
POWER:RF:PEP	ON OFF		
DEMODULATION	number	PCT MHZ KHZ HZ RAD	Selection of demodulation type DEMOD measurement and search routine
DEMODULATION:TOLERANCE:UPPER	number ON OFF	PCT MHZ KHZ HZ RAD	
DEMODULATION:TOLERANCE:LOWER	number ON OFF	PCT MHZ KHZ HZ RAD	
DEMODULATION:RANGE	number ON OFF	PCT MHZ KHZ HZ RAD	
DEMODULATION:REFERENCE	number ON OFF	PCT MHZ KHZ HZ RAD	
DEMODULATION:DEEMPHASIS	NORMAL SEL_750	---	Deemphasis: no deemphasis or 750 µs
DEMODULATION:WEIGHTING	AUTO PK RMS RMS_SQRT 2 PK2	---	Weighting: peak, RMS RMS·√2, average of pos. and negative peak
DEMODULATION:AVERAGING	SEL_1 SEL_2 SEL_3 SEL_4	---	Averaging
DEMODULATION:CONTROL	SQUELCH ON OFF	---	Demodulation: Squelch on, off
PEAKHOLD		PCT MHZ KHZ HZ RAD	Selection of demodulation mode and retaining max. value
PEAKHOLD:TOLERANCE:UPPER	number ON OFF	PCT MHZ KHZ HZ RAD	
PEAKHOLD:TOLERANCE:LOWER	number ON OFF	PCT MHZ KHZ HZ RAD	
PEAKHOLD:REFERENCE	number ON OFF	PCT MHZ KHZ HZ RAD	
PEAKHOLD:RANGE	number ON OFF	PCT MHZ KHZ HZ RAD	
AUDIO_IF:CONNECTION	SEL_UNBALANCED SEL_BALANCED		
AUDIO_IF:IMPEDANCE:BALANCED	SEL_150_OHM SEL_300_OHM		
AUDIO_IF:INPUT:AF	TELEGRAM_1 TELEGRAM_2		
AUDIO_IF:IMPEDANCE:MEASUREMENT TOLERANCE:LOWER TOLERANCE:UPPER RANGE REFERENCE	OFF ON		
AUDIO_IF:IMPEDANCE:MATCH			

Command	Data	Units	Function
DECODE	---	---	Decoding of selective call
DECODE:**ST**ANDARD	number	---	Selection of standard (see Section 2.4.4)
DECODE:**D**IGITREPEAT	**ON OF**F	---	Digit repeat
DECODE:**B**ANDWIDTH	number	**P**CT	Evaluation bandwidth
DECODE:**P**AUSE	number	**S M**S **U**S	Tolerable pause
DECODE:**SO**URCE	**D**EMOD **A**FVOLT	---	Selection of source
DECODE:**N**UMBER	number	---	Tone number
CODE	string	---	Transmitting of selective call
CODE:**ST**ANDARD	number	---	Selection of standard (see Section 2.4.4)
CODE:**MSGR**EPEAT	number	---	Number of telegrams to be transmitted
CODE:**REP**EATTONE	**ON OF**F	---	Tone repetition
CODE:**A**CKTEST	**ON OF**F **RF_OF**F	---	Acknowledgement test
CODE:**F**R_TUNE	number	**P**CT	Frequency deviation
CODE:**SP**ECIAL:**N**UMBER	number	---	Selection of extra tone
CODE:**SP**ECIAL:**L**ENGTH	number	**S M**S **U**S	Length of extra tone
CODE:**O**THER:**L**ENGTH	number	**S M**S **U**S	Duration of other tones
CODE:**D**IGITPAUSE	number	**S M**S **U**S	Time elapsing between the tones
CODE:**MSGP**AUSE	number	**S M**S **U**S	Time elapsing between the telegrams
CODE:**RES**ET	---	---	Resetting the original prameters
FILTER:**T**XTEST	**ON OF**F	---	Switching on/off the selected filters in TX-Test
FILTER:**T**XTEST:**H**P	**ON OF**F	---	High pass filter in TX-Test
FILTER:**T**XTEST:**L**P	**ON OF**F	---	Low pass filter in TX-Test
FILTER:**T**XTEST:**P**SOPHOMETRIC	**ON OF**F	---	Psophometric filter in TX-Test
FILTER:**T**XTEST:**N**OTCH	number **ON OF**F	**M**HZ **K**HZ **H**Z	Notch filter in TX-Test
FILTER:**T**XTEST:**R**ESONANCE	number **ON OF**F	**M**HZ **K**HZ **H**Z	Resonance filter in TX-Test
FILTER:**T**XTEST:**E**XTERNAL	**ON OF**F	---	External filter in TX-Test
FILTER:**T**XTEST:**I**F	**WI**DE **NA**RROW	---	IF filter

Command	Data	Units	Function
FILTER:RXTEST	ON OFF	---	Switching on/off the selected filters in RX-Test
FILTER:RXTEST:HP	ON OFF	---	High pass filter in RX-Test
FILTER:RXTEST:LP	ON OFF	---	Low pass filter in RX-Test
FILTER:RXTEST:PSOPHOMETRIC	ON OFF	---	Psophometric filter in RX-Test
FILTER:RXTEST:NOTCH	number ON OFF	MHZ KHZ HZ	Notch filter in RX-Test
FILTER:RXTEST:RESONANCE	number ON OFF	MHZ KHZ HZ	Resonance filter in RX-Test
FILTER:RXTEST:EXTERNAL	ON OFF	---	External filter in RX-Test
ATTENUATION:IF	ON OFF AUTO	---	Attenuation of IF control
DISTORTION:TXTEST	number	PCT MHZ KHZ HZ DB	Distortion measurement of demodulated signal
:TOLERANCE:UPPER	number ON OFF	PCT MHZ KHZ HZ DB	
:TOLERANCE:LOWER	number ON OFF	PCT MHZ KHZ HZ DB	
:RANGE	number ON OFF	PCT MHZ KHZ HZ DB	
DISTORTION:TXTEST:AFCOUPLED	ON OFF	---	
DISTORTION:TXTEST:AVERAGING		---	The frequency of the modulation generator is identical with the distortion measurement frequency.
	SEL_1 SEL_2 SEL_3 SEL_4		Averaging
DISTORTION:RXTEST	number	PCT MHZ KHZ HZ DB	Distortion measurement of the signal applied to the AF voltmeter
:TOLERANCE:UPPER	number ON OFF	PCT MHZ KHZ HZ DB	
:TOLERANCE:LOWER	number ON OFF	PCT MHZ KHZ HZ DB	
:RANGE	number ON OFF	PCT MHZ KHZ HZ DB	
SINAD:RXTEST	number	PCT MHZ KHZ HZ DB	SINAD measurement of the signal applied to the AF voltmeter
SINAD:RXTEST:TOLERANCE:UPPER	number ON OFF	PCT MHZ KHZ HZ DB	SINAD search routine
SINAD:RXTEST:TOLERANCE:LOWER	number ON OFF	PCT MHZ KHZ HZ DB	
SINAD:RXTEST:RANGE	number ON OFF	PCT MHZ KHZ HZ DB	
SINAD_DISTORTION:AFCOUPLED	ON OFF	---	The frequency of the modulation generator is identical with the measurement frequency.
SINAD_DISTORTION:AVERAGING	SEL_1 SEL_2 SEL_3 SEL_4	---	Averaging
SINAD_DISTORTION:WINDOW	number	PCT DB	Window of SINAD search routine

Command	Data	Units	Function
S_N:TXTEST	number	PCT DB	S/N measurement of demodulated signal
S_N:TXTEST:TOLERANCE:UPPER	number ON OFF	PCT DB	
S_N:TXTEST:TOLERANCE:LOWER	number ON OFF	PCT DB	
S_N:TXTEST:RANGE	number ON OFF	PCT DB	
S_N:TXTEST:GEN2	USED UNUSED	---	2nd modulation generator is also used for S/N measurement
S_N:TXTEST:AVERAGING	SEL_1 SEL_2 SEL_3 SEL_4	---	Averaging
S_N:RXTEST	number ON OFF	PCT DB	S/N measurement of the signal applied to the AF voltmeter
S_N:RXTEST:TOLERANCE:UPPER	number ON OFF	PCT DB	S/N search routine
S_N:RXTEST:TOLERANCE:LOWER	number ON OFF	PCT DB	
S_N:RXTEST:RANGE	number ON OFF	PCT DB	
S_N:RXTEST:EXTERNAL	USED UNUSED	---	External modulation is also used
S_N:RXTEST:AVERAGING	SEL_1 SEL_2 SEL_3 SEL_4	---	Averaging
S_N:RXTEST:GEN2	USED UNUSED	---	2nd modulation generator is also used
S_N:RXTEST:WINDOW	number	PCT DB	Window of SINAD search routine
INPUT:ONE	number	DB	Selection of input and external attenuation
INPUT:TWO	number	DB	Selection of input and external attenuation
MODE:TXRX:LOCK	ON OFF	---	LOCK function
LEVEL:RF	number ON OFF	MV UV DBUV DBM	Level setting of RF synthesizer
LEVEL:RF:VARIATION	number ON OFF	V MV UV DB	
LEVEL:RF:REFERENCE	number ON OFF	MV UV DBUV DBM	
LEVEL:RF:FINE	number ON OFF	MV UV DBUV DBM	Level setting via fine level variation
LEVEL:RF:BANDWIDTH	---	---	Bandwidth measurement
LEVEL:RF:SQUELCH	---	---	Squelch routine
LEVEL:RF:QUIETING	number	DB	Quieting measurement
LEVEL:RF:RXTEST:LEVEL	PD EMF	---	Level output

Command	Data	Units	Function
LEVEL:AF:I1	number ON OFF	MV UV DBUV DBM	Level setting of first modulation generator
LEVEL:AF:I1:VARIATION	number ON OFF	V MV UV DB	
LEVEL:AF:I1:REFERENCE	number ON OFF	MV UV DBUV DBM	
LEVEL:AF:I2	number ON OFF	MV UV DBUV DBM	Level setting of second modulation generator
LEVEL:AF:I2:VARIATION	number ON OFF	V MV UV DB	
LEVEL:AF:I2:REFERENCE	number ON OFF	MV UV DBUV DBM	
LEVEL:AF:RXTEST	number	MV UV W DBUV DBM	Level setting of AF voltmeter
:TOLERANCE:UPPER	number ON OFF	MV UV W DBUV DBM	
:TOLERANCE:LOWER	number ON OFF	MV UV W DBUV DBM	
:REFERENCE	number ON OFF	MV UV W DBUV DBM	
:RANGE	number ON OFF	MV UV W DBUV DBM	
LEVEL:AF:RXTEST:WEIGHTING	PLUS_PK MINUS_PK RMS RMS_SQRT2	---	Weighting the AF voltmeter: pos. peak, neg. peak, RMS, RMS · √2, average of pos. and neg. peak
LEVEL:AF:RXTEST:AVERAGING	SEL 1 SEL_2 SEL_3 SEL_4	---	Averaging
LEVEL:AF:RXTEST:COUPLING	AC DC3HZ DCWIDE	---	Cut-off frequency of the AF voltmeter
LEVEL:AF:RXTEST:ATTENUATION	AUTO ON OFF	---	Internal attenuator
MODULATION:AF:I1	number ON OFF	PCT MHZ KHZ HZ RAD	Modulation of the RF signal generator with the first modulation generator
MODULATION:AF:I1:VARIATION	number ON OFF	PCT MHZ KHZ HZ RAD	
MODULATION:AF:I1:REFERENCE	number ON OFF	PCT MHZ KHZ HZ RAD	
MODULATION:AF:I2	number ON OFF	PCT MHZ KHZ HZ RAD	Modulation of the RF signal generator with the second modulation generator
MODULATION:AF:I2:VARIATION	number ON OFF	PCT MHZ KHZ HZ RAD	
MODULATION:AF:I2:REFERENCE	number ON OFF	PCT MHZ KHZ HZ RAD	
MODULATION:EXTERNAL	number ON OFF	PCT MHZ KHZ HZ	External modulation of the RF signal generator
:VARIATION	number ON OFF	PCT MHZ KHZ HZ	
:REFERENCE	number ON OFF	PCT MHZ KHZ HZ	
:CALIBRATION	---	---	Modulation: ext. calibration
:VOLTAGE	number	V MV UV	Input of external modulation voltage

IEC-bus-command for the SCOPE mode

Command	Data	Units	Function
SCOPE:CONTINUE	ON OFF	---	ON: Activation of the scope OFF: FREEZE mode
SCOPE:CONTINUE:AUTO	---	---	Automatic selection of source
SCOPE:CONTINUE:SOURCE	MODEXT DEMOD_BEAT AF	---	Defined selection of source
SCOPE:CONTINUE:DISTORTION	---	---	Selection of source: notch filter, resonance filter
SCOPE:BESTRANGE	ON OFF	---	Selection of best measuring range
SCOPE:AMPLITUDE	number	---	Amplitude setting
SCOPE:TIME	number	---	Time setting
SCOPE:YPOSITION	number	---	Y position

IEC-bus-command for the SERIAL mode

Command	Data	Function
SERIAL:NULINE	AUTO CR CRLF OFF	Selection of string terminator
SERIAL:RX:TIMEOUT	number	Waiting period in ms after reception of the last character until abortion of the SEND function
SERIAL:RX:DISABLE	ON OFF	Disabling reception of data
SERIAL:PARITY	OFF SEL_0 SEL_1 EVEN ODD	Selection of parity bit with transmission and reception
SERIAL:BAUD:RATE	SEL_19200 BD SEL_9600 BD SEL_4800 BD SEL_2400 BD SEL_1200 BD SEL_600 BD SEL_300 BD SEL_150 BD	Setting the baud rate
SERIAL:ECHO:CANCEL	ON OFF	Activating/Deactivating the ECHO CANCEL function
SERIAL:BITS	SEL_8_1 SEL_8_2 SEL_7_1 SEL_7_2	Determination of the data format for transmission
SERIAL:SEND SERIAL:SEND?	String String	Send string via the serial interface Same function as above including read-in of the received string
SERIAL:SEND:IMMEDIATELY	ON OFF	Setting: Send individual characters
SERIAL:HARDWARE:HANDSHAKE	OFF ETX_ACK XON_XOFF	Selection of hardware-handshake protocol
SERIAL:SOFTWARE:HANDSHAKE	OFF SEL_2_WIRE SEL_4_WIRE	Selection of software-handshake protocol

IEC-bus commands for selective call generation

Command	Data	Units	Function
TONES:STANDARD	number	---	Calling of standard (see Section 2.8)
TONES:RESET	number	---	Resetting of original parameters
TONES:SPECIAL:NUMBER	number	---	Selection of extra tone
TONES:SPECIAL:LENGTH	number	S MS US	Duration of extra tone
TONES:OTHER:LENGTH	number	S MS US	Duration of other tones
TONES:DIGITPAUSE	number	S MS US	Time elapsing between the tones
TONES:COUPLING:STANDARDS	COUPLED INDEPENDENT	---	Coupling of standards
TONES:DECODE:TIME	number	S MS US	Decoding time
TONES:SELECT:FREQUENCY:ONE	---	---	Selection of tones for generator 1
TONES:SELECT:FREQUENCY:TWO	---	---	Selection of tones for generator 2
TONES:TONE0	number	MHZ KHZ HZ	Assignment of tones to frequencies
TONES:TONE1	number	MHZ KHZ HZ	
TONES:TONE2	number	MHZ KHZ HZ	
TONES:TONE3	number	MHZ KHZ HZ	
TONES:TONE4	number	MHZ KHZ HZ	
TONES:TONE5	number	MHZ KHZ HZ	
TONES:TONE6	number	MHZ KHZ HZ	
TONES:TONE7	number	MHZ KHZ HZ	
TONES:TONE8	number	MHZ KHZ HZ	
TONES:TONE9	number	MHZ KHZ HZ	
TONES:TONEA	number	MHZ KHZ HZ	
TONES:TONEB	number	MHZ KHZ HZ	
TONES:TONEC	number	MHZ KHZ HZ	
TONES:TONED	number	MHZ KHZ HZ	
TONES:TONEE	number	MHZ KHZ HZ	
TONES:TONEF	number	MHZ KHZ HZ	
TONES:AF:I10	number	MHZ KHZ HZ	Assignment of tones to frequencies for standard 0 (variation series for modulation generators 1 and 2)
TONES:AF:I11	number	MHZ KHZ HZ	
TONES:AF:I12	number	MHZ KHZ HZ	
TONES:AF:I13	number	MHZ KHZ HZ	
TONES:AF:I14	number	MHZ KHZ HZ	
TONES:AF:I15	number	MHZ KHZ HZ	
TONES:AF:I16	number	MHZ KHZ HZ	
TONES:AF:I17	number	MHZ KHZ HZ	
TONES:AF:I20	number	MHZ KHZ HZ	
TONES:AF:I21	number	MHZ KHZ HZ	
TONES:AF:I22	number	MHZ KHZ HZ	
TONES:AF:I23	number	MHZ KHZ HZ	
TONES:AF:I24	number	MHZ KHZ HZ	
TONES:AF:I25	number	MHZ KHZ HZ	
TONES:AF:I26	number	MHZ KHZ HZ	
TONES:AF:I27	number	MHZ KHZ HZ	

IEC-bus commands for configuration

Command	Data	Units	Function
CONFIGURATION:AF:TRANSFORMER		SEL_600_OHM	NORMAL
CONFIGURATION:R_REFERENCE	number	OHM	Reference resistance of AF voltmeter
CONFIGURATION:KEYBEEP	ON OFF	---	Acoustic key acknowledgement
CONFIGURATION:WARNING	ON OFF	---	Warning in case of erroneous operation
CONFIGURATION:CLOCK:EXTERNAL	ON OFF	---	Switching to ext. reference
CONFIGURATION:PRINTER:TYPE	NECP6,7 EPSON PDN CM-Z22	---	Printer type
CONFIGURATION:SCREEN: LIGHTING	ON OFF SEL_5_MIN SEL_1_H		Lighting of the CMS is switched on/off or switched on for 5/60 min
CONFIGURATION:ROUTINE:LIMIT:TIMEOUT	number	S MS US	Timeout value for search routines
CONFIGURATION:ROUTINE:LIMIT:DELAY	number	S MS US	Wait time for slowing down the test cycle with squelch measurement
CONFIGURATION:ROUTINE:LIMIT:THRESHOLD	number	MV UV W DBUV DBM	AF level (measurement): threshold value for squelch on/off
CONFIGURATION:ROUTINE:LIMIT:AF LEVEL	number	MV UV W DBUV DBM	Upper AF level limit for search routines
CONFIGURATION:ROUTINE:LIMIT:RF LEVEL	number	MV UV W DBUV DBM	Upper RF level limit for search routines
CONFIGURATION:ROUTINE:LIMIT:MEASURE	number	S MS US	Measuring time
CONFIGURATION:ROUTINE:LIMIT:ATTACKTIME	number	S MS US	Wait time until meas. start
CONFIGURATION:CONTROL:TTL CONFIGURATION:CONTROL:TTL:VARIATION	number number	--- ---	Input and/or output of the TTL interfaces
CONFIGURATION:CONTROL:TTL:RELAYS CONFIGURATION:CONTROL:TTL:RELAYS :VARIATION	number number	--- ---	Programming of the relays
CONFIGURATION:CONTROL:INOUT	IN_IN IN_OUT OUT_IN OUT_OUT	---	Programming of the TTL interface
CONFIGURATION:CONTROL:RX TX	ON OFF	---	Setting most significant relays via RX - TX switchover
LANGUAGE	ENGLISH SWEDISH DEUTSCH ITALIAN FRENCH SPANISH	---	Language switchover
CONFIGURATION:LO:HIGH	ON OFF	---	LO frequency

IEC-bus commands for the SPECTRUM operation

Command	Data	Units	Function
SPECTRUM:**AT**TENUATION	Number	DB	<Attenuation dB>
SPECTRUM:**AU**TOATTENUATION			
SPECTRUM:**FI**LTER	SEL__150HZ		
	SEL__6KHZ		
	SEL__16KHZ		
	SEL__50KHZ		
	SEL__300KHZ		
	SEL__1MHZ		
	SEL__3MHZ		
SPECTRUM:**Q**UICK	ON OFF		
SPECTRUM:**CE**NTER	Number	MHZ KHZ HZ	
SPECTRUM:**SP**AN	Number	MHZ KHZ HZ	<CenterFreq Hz>
SPECTRUM:**STA**RT	Number	MHZ KHZ HZ	<SpanFreq Hz>
SPECTRUM:**STO**P	Number	MHZ KHZ HZ	<StartFreq Hz>
SPECTRUM:**R**EFERENCE:**L**EVEL	Number	UV MV V W	<StopFreq Hz>
		DBUV DBM	<RefLevel W>
SPECTRUM:**SC**ALE	SEL__2DB		
	SEL__5DB		
	SEL__10DB		
SPECTRUM:**FR**EEZE	ON OFF		
SPECTRUM:**MA**RKER	Number	MHZ KHZ HZ	
SPECTRUM:**MA**RKER:**R**EFERENCELEVEL	ON OFF		<MKr Level W> <MkrFreq Hz>
SPECTRUM:**MA**RKER:**C**ENTERFREQUENCY	ON OFF		

IEC-bus commands for the self-test

Command	Data	Units	Function
SERVICE:**B**ATTERY	**ON OF**F		Battery voltage measurement
CALIBRATION:**PO**WER	---	---	Calibration of power meter
CALIBRATION:**PE**AK	---	---	Calibration of peak meter
CALIBRATION:**C**YCLIC	**ON OF**F	---	Cyclic calibration
CALIBRATION:**D**ISTORTION	---	---	Distortion calibration
CALIBRATION:**DE**TECTOR:**R**MS	---	---	Calibration of RMS detector
CALIBRATION:**M**ODULATION:**F**ILTER	---	---	Calibration of AF synthesizer filters
CALIBRATION:**M**ODULATION:**G**ENERATOR	---	---	Calibration of offset and amplitude of the AF synthesizers
CALIBRATION:**S**YNTHESIZER	---	---	Calibration of synthesizer deviation
SERVICE:**B**ATTERY	---	---	Battery voltage

Function Keyboard Lock

The CMS permits to lock the keyboard using an IEC-bus command. This serves to prevent an unauthorized user from intervening in the measurement or changing preset parameters.

The IEC-bus command for locking the keyboard reads as follows:

"KEYBOARD:LOCK ON".

The following message appears in the first status line:

"REMOTE with Lockout"

If an IEC-interface command (goto local - GTL) is used to switch to manual operation, the keyboard is locked as well. The message

"CMS - Local with Lockout"

is displayed in the first status line.

This state permits observing measurement sequences (e.g. with zoom function activated) at the display without settings at the CMS being able to be changed.
This state can only be canceled by sending the unlocking command via the IEC-bus controller or by switching off/on the CMS.

The IEC-bus command for unlocking the keyboard reads as follows:

"KEYBOARD:LOCK OFF".

The following message appears in the first status line:

"REMOTE-Local by <STOP>".

Remark: After switching on the CMS, the keyboard is always unlocked.

2.11.5 Service Request and Status Registers

The following Fig. shows the status registers and the effective links between them. To remain in accordance with the IEEE 488.2 standard, the Status Byte (STB) and its associated mask register (SRE), which are also present with older devices, have been supplemented by the Event Status Register (ESR) and its Event Status Enable Mask Register (ESE).

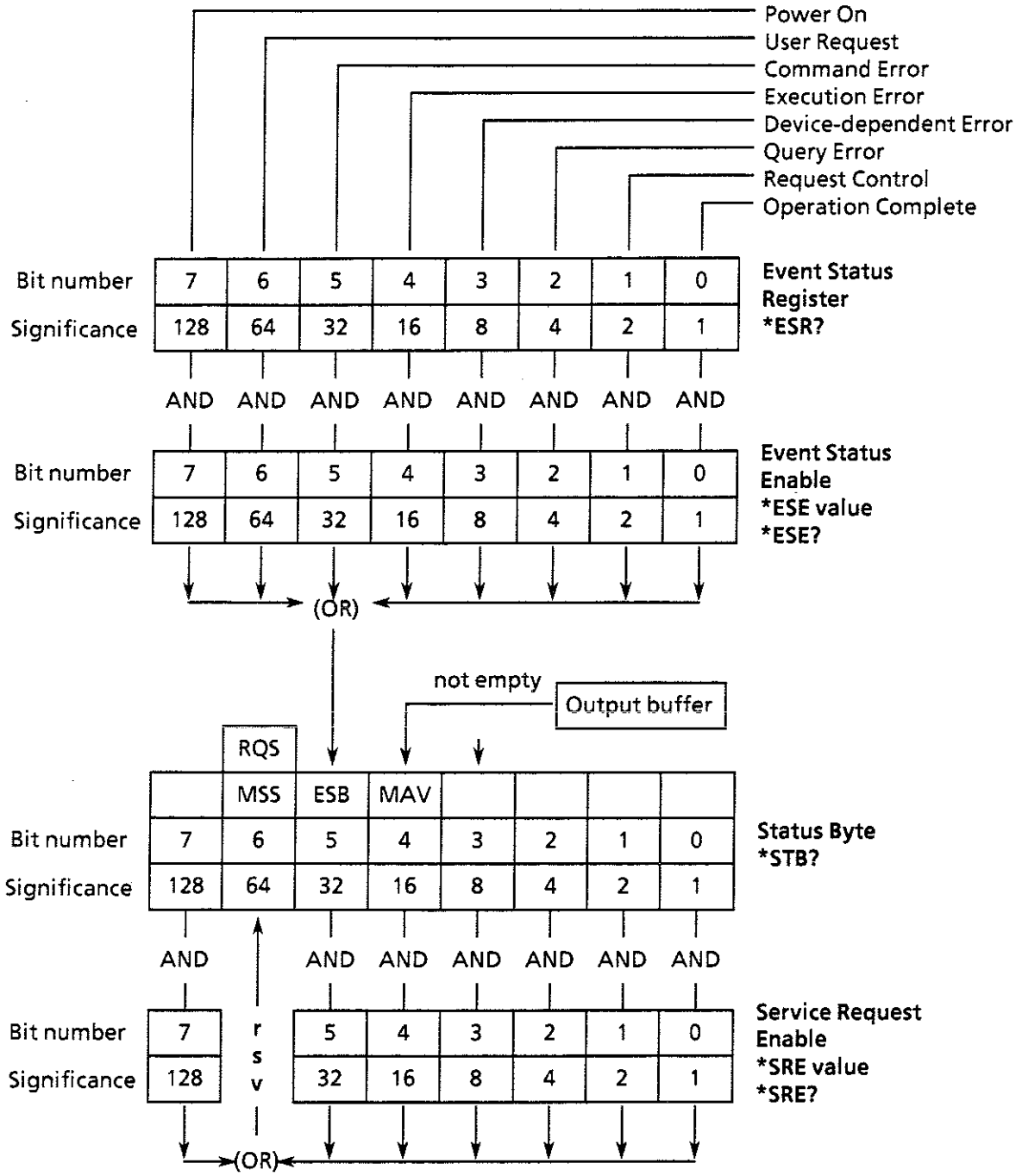


Fig. 2.11-4 Status registers

A bit is set to "1" in the ESR in the case of certain events (e.g. fault, ready signal), see Table 2-10-10. These bits remain set until they are cleared by reading the ESR (by the command *ESR?) or by the following conditions:

- The commands *RST or *CLS
- Switching on the AC supply (the power-on bit is, however, set in this case).

Using the ESE mask register, the user can select the bits in the ESR which also set the sum bit ESB (bit 5 in the status byte) via which a service request can be triggered. The sum bit is therefore only set if at least one bit in the ESR and the corresponding bits in the ESE are set to "1". The sum bit is automatically cleared again if the previous condition is no longer fulfilled, e.g. if the bits in the ESR have been cleared by reading the ESR or if the ESE has been modified.

The ESE mask register is written by the command "*ESE value" ("value" is the contents in decimal form) and can be read again by the command *ESE?. It is set to "0" when the AC power is switched on if the power on status clear flag is "1" (*PSC1).The ESE mask register is not changed by other commands or interface messages (DCL, SDC).

The bits listed in Table 2.11-9 are used in the status byte (STB):

Table 2-11-9 Bit allocation of status byte

Bit number	Bus line	Designation	Meaning
4	DIO 5	MAV	Message Available Indicates that a message, which can be read, is present in the output buffer. The bit is "0" if the output buffer is empty.
5	DIO 6	ESB	Sum bit of the Event Status Register
6	DIO 7	RQS	Request Service

Note that the status register bits are numbered from 0 to 7 in compliance with the standard, but the bus data lines are designated DIO1 to DIO8.

Table 2.11-10 Bit allocation of ESR

Bit Number	Meaning
7	**Power On** Is set when the instrument is switched on or if the power returns following a failure.
6	**User Request** This function is not implemented in the CMS.
5	**Command Error** Is set if one of the following faults is detected in the received commands: • Syntax error • Illegal unit • Illegal header • A number has been combined with a header where no number is allowed.
4	**Execution Error** Is set if one of the following errors was detected during execution of the received commands • A number is outside the permissible range (for the respective parameter). • A received command is not compatible with the current device setting.
3	**Device-dependent Error** Is set if functional errors occur.
2	**Query Error** This bit is set: • If the controller wishes to read data from the CMS but no query message has previously been output. • If the data present in the output buffer of the CMS have not been read out and a new command was sent to the instrument instead. The output buffer is cleard in this case.
1	**Request Control** This function is not implemented in the CMS.
0	**Operation Complete** This bit is set by the commands *OPC and *OPC? if all previous commands have been executed.

Using the SRE mask register, the user can determine whether the ESB, and/or MAV bits of the status byte are set, and whether a Service Request is sent to the controller by activating the SRQ line. Since each bit in the SRE mask register is assigned to the corresponding bit in the status byte, the following possibilities result (see Table 2.11-11), and the combinations thereof.

Table 2.11-11 Bit allocation of the SRE

Contents of SRE (decimal)	Set bit No. in SRE	Effect
0	--	No Service Request
16	4	Service Request if MAV bit is set (message in output buffer)
32	5	Service Request if ESB bit is set (at least 1 bit set and not masked in the ESR)

The Service Request Enable mask register (SRE) is written by the command "*SRE value" ("value" is the contents in decimal form) and can be read again by the command *SRE?. It is set to "0" when the AC power is switched on, if the power-on clear flag is "1"; the Service Request function of the CMS is thus disabled. The SRE mask register is not changed by other commands or interface messages (DCL, SDC).

Several devices can trigger a Service Request simultaneously, the open collector drivers generate an OR function on the SRQ line. The controller must read the status bytes of the devices in order to identify the device which has triggered the Service Request. A set RQS bit (bit 6/DIO7) indicates that the device is sending a Service Request.

The status byte of the CMS can be read in the following manner:

- By the command *STB?.

  The contents are then output in decimal form. The status byte is not changed by reading out, and the Service Request is not cleared.

- By a Serial Poll.

  The contents are transferred in binary form as one byte. The RQS bit is then set to "0" and the Service Request becomes inactive; the other bits of the status byte are not changed.

The status byte is cleared:

- By the command *CLS.

  This command clears the ESR and the output buffer; the ESB and MAV bits in the status byte are also set to "0". This in turn clears the RQS bit and the Service Request.

- By reading the ESR (*ESR? command) or setting the ESE mask register to "0" (*ESE command) and by reading the contents of the output buffer.

2.11.6 Resetting of Device Functions

The following table lists the various commands and events which cause individual device functions to be reset.

Table 2.11-12 Resetting of various device functions

Event	Power on		DCL, SDC (Device Clear, Selected Device Clear)	Commands	
	Power-on-clear flag			*RST	*CLS
	0	1			
Basic device setting	--	--	--	Yes	--
Set Event Status Register ESR to zero	Yes	Yes	--	Yes	Yes
Set mask registers ESE and SRE to zero	--	Yes	--	--	--
Clear output buffer	Yes	Yes	Yes	--	Yes
Clear Service Request	Yes	1)	2)	3)	Yes
Reset command processing and input buffer	Yes	Yes	Yes	--	--

1) Yes, but "Service Request on power on" is possible.
2) Yes, if only caused by message in output buffer.
3) Yes, if not caused by message in output buffer.

2.11.7 Command Processing Sequence and Synchronization

The commands received by the CMS are first stored in an input buffer which can accommodate up to 256 characters. Once the terminator has been received, the commands are processed in the sequence in which they were sent. During this time, the IEC bus can be used for communication with other devices. Command lines which exceed the capacity of the input buffer are processed in several sections. The bus is occupied during this time.

OPERATION COMPLETE:

The commands *OPC and *OPC? (operation complete) are used as feedbacks to inform on the time at which processing of the received commands was terminated and a measurement (if any) has been completely performed.

*OPC sets bit 0 in the ESR, and a Service Request can then be triggered if all previous commands have been executed.

*OPC? additionally provides a message in the output buffer and sets bit 4 (MAV) in the status byte.

WAIT:

The synchronization can be established within a command line by the command "*WAI", i.e. all subsequent commands are only executed when the previous commands have been completely executed. This may be favourable in the case of very short measuring times.

Program example:

A program example of an RF counter measurement is given in the following, where a Service Request is triggered in the case of error. The type of error generated is specified in detail.

(The command set of the IEC-bus controllers PCA is used; the IEC bus address of the CMS has been taken as 24.)

```
10 IEC TERM 10                                          : REM input terminator LF
20 ON SRQ1 GOSUB 300
30 IEC OUT 24, "*CLS; *ESE 60; *SRE 32"
40 REM
50 REM                                                  for Service Request in case
60 REM                                                  of error
70 IEC OUT 24, "HEADER ON"                              : REM header output as well
80 REM
90 IEC OUT 24, "DISPLAY: ME 1,0"                        : REM TX-Test menu
100 REM
110 IEC OUT 24, "COUNT : RF?"                           : REM counting of RF
120 IEC IN 24, HFCOUNT$
130 PRINT HFCOUNT$
140 END
300 REM ------------------------------------------------
310 REM              SERVICE REQUEST ROUTINE
320 REM ------------------------------------------------
330 IEC SPL 24,S%                                       : REM Serial Poll
340 IF (S% AND 64) = 0 THEN GOTO 420                    : REM SRQ not from CMS?
350 IEC OUT 24, "*ESR?"                                 : REM Event Status Register
360 IEC IN 24, X$                                       : REM read
370 B = VAL (X$)
380 IF (B AND 032) <>0 THEN PRINT "COMMAND ERROR"
390 IF (B AND 016) <>0 THEN PRINT "EXECUTION ERROR"
400 IF (B AND 008) <>0 THEN PRINT "DEVIVE DEPENDENT ERROR"
410 IF (B AND 004) <>0 THEN PRINT "QUERY ERROR"
420 ON SRQ1 GOSUB 300
430 RETURN
500 REM ------------------------------------------------
510 REM      SERVICE REQUEST FROM OTHER DEVICE
520 REM ------------------------------------------------
530 REM....
540 REM....
620 ON SRQ1 GOSUB 300
630 RETURN
```

2.11.8 Error Handling

All errors detected by the CMS in connection with operation via the IEC bus are indicated in the ESR by setting a bit (bit 2, 4 or 5, see Table 2.12-10). Function faults are signalled by setting of bit 3. These bits remain set until the ESR is read or is cleared by the commands *RST or *CLS. This is in line with the standard IEEE 488.2 and enables triggering of a Service Request and program-controlled evaluation of the type of error.

2.12 IMPED Ω Menu

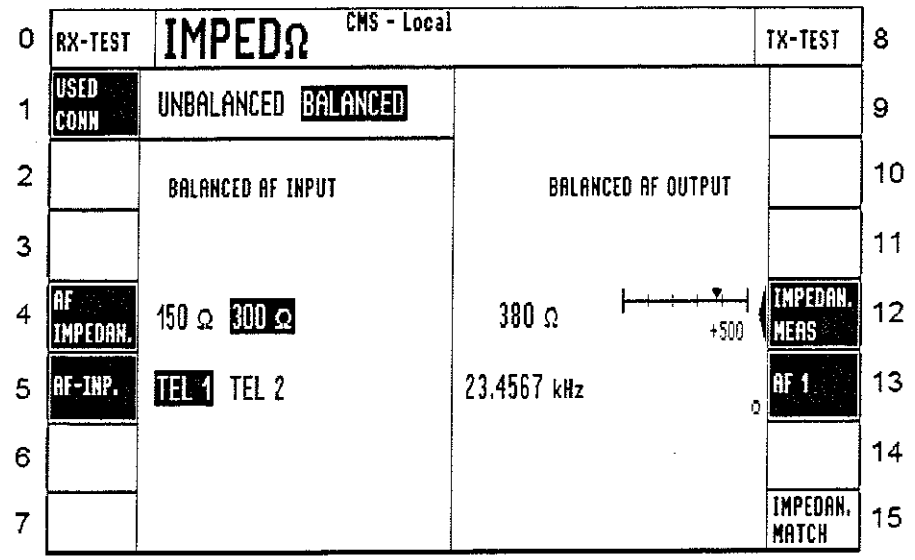


Fig. 2.12-1 Main Menu IMPED Ω

USED CONN

This softkey selects the connectors for the AF measurements

BALANCED: MIC/TEL1, TEL2 selection on rear panel (or battery poack).

UNBALANCED: BNC front panel connectors are selected.

AF IMPEDAN.

Selection for the input impedance for Tel1 and Tel2. 150 Ω and 300 Ω are available.

AF-INP.

Selection of TEL1 and TEL2 for the AF-voltage measurements.

IMPEDAN. MEAS

By pressing this softkey the impedance measurement will be activated. This function works only with the MIC Tel1 socket on the rear. The test voltage is 5 mV and the test frequency is selected by entering the frequency with softkey AF1. The last measurement result before leaving this menu is taken for all impedance matching activities in the TX-Test and TX-SSB menu.

AF 1

Selection of the desired frequency for the impedance measurement.

AF-INP.

ON/OFF switching of the impedance matching system for LEVEL1 and LEVEL2 in the TX-Test and TX-SSB menu. The correction of the real output after the AF transformers takes place every time when a new level is entered.

2.13 Serial Interface

2.13.1 Using the Interface

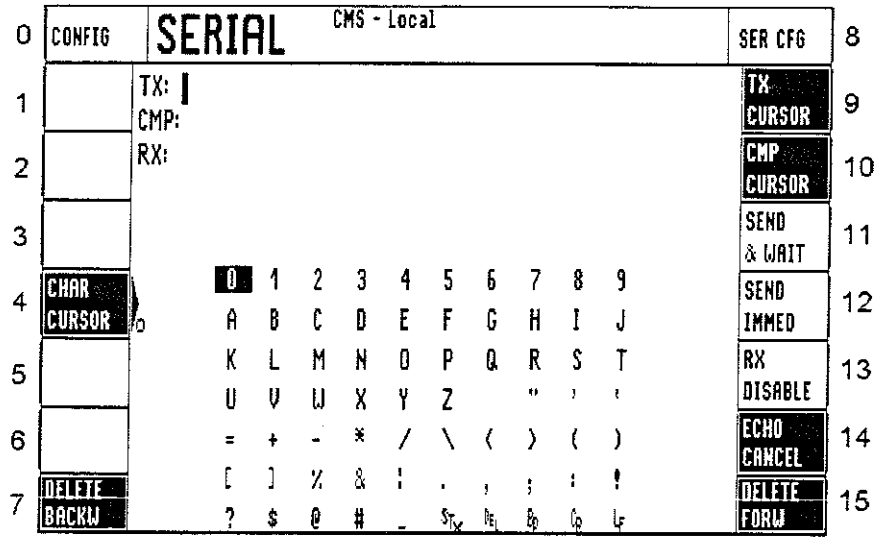


Fig. 2.13- 1 Main menu SERIAL

When the option CMS-B30 is installed, the SERIAL menu allows for transmitting and receiving ASCII texts. It is recommended to call the menu SER CFG (= SERIAL CONFIGURATION) before starting communication since RS232 interfaces provide a variety of configurations.

Transmitting and Receiving Text Strings

The display provides the lines TX: (Transmit Text) and CMP: (Compare Text) for input of a text string. The string which is received via the interface is displayed in the line RX: (Received Text). If the number of received characters to be displayed exceeds the RX: line, the whole text is shifted to the left by sufficient positions to accomodate the entire string.

Softkey 11: SEND & WAIT (Send TX String)

The text string entered in the TX: line is output via the serial interface by actuating the softkey 11 SEND & WAIT. This procedure can be repeated as required. The softkey is displayed in reversed form and thus remains until all characters will have been sent. If the SEND & WAIT softkey remains displayed in reversed form with the software or hardware handshake switched on, the handshaking was not completed. It should be checked, whether the handshake protocols of the CMS and the external device are identical.

Attention! *Please note that in an autorun program. This command may not be the last command before the "Stop" command.*

Softkey 12: SEND IMMED (Send each character immediately)

When the softkey 12 SEND IMMED (toggle function) is activated, each individual character entered in the TX: line via the ENTER key is immediately output via the interface.

Softkey 13: RX DISABLE (Disable data reception)

The softkey 13 RX DISABLE (toggle function) is used for disabling the receiver function of the interface. The interface thus only allows for data transmission. The text in line RX: is deleted simultaneously.

Softkey 14: ECHO CANCEL

When the softkey 14 ECHO CANCEL (toggle function) is active, the received text is compared to the transmitted string. If the transmitted string is identical with the string immediately received after pressing the SEND & WAIT softkey, it is ignored. Only the subsequent characters are displayed and evaluated. The same applies for each letter with the input when the SEND IMMED softkey is active. This procedure prevents the ECHO sent by certain devices for acknowledgement of reception from being evaluated.

Entering a Text

First, the respective line (TX: or CMP:) is selected via the softkeys TX CURSOR or CMP CURSOR for entering a text. IF the softkey CHAR CURSOR is pressed then, the cursor can be set to the required character (which then becomes bright on dark background) by rotating the VAR spinwheel. It is entered into the selected line by pressing the ENTER key.

Only capital letters can be entered.
The keypad also allows for input of texts by entering two numeric characters. The first one indicates the line number, the second one indicates the column. The character at this location is then entered into the TX: or the CMP: line by pressing the ENTER key.

Example: The key sequence 3 + 7 + ENTER causes the letter Q to be entered.

BEEP is inserted whenever a line or column number beyond the character area is entered.

For modification of the entered text (deletion and insertion) the respective line is selected by means of the softkeys 9 TX CURSOR or 10 CMP CURSOR and the cursor is set to the required position using the VAR spinwheel. The characters to the left and to the right of the marked location can then be deleted by pressing the softkeys 7 and 15 DELETE BACKW/DELETE FORW. The CLEAR softkey deletes the whole text.

For inserting a text, softkey 4 CHAR CURSOR is pressed again and the respective characters are entered.

Operating the Interface with Autorun Control

The editor softkeys CHAR CURSOR, DELETE BACKW, TX CURSOR and DELETE FORW are only intended to be used in the LEARN mode of the AUTORUN control. They cannot be stored.

Pressing CMP CURSOR together with STORE saves the text in the CMP: line. When the autorun control processes the SEND & WAIT command the received string is compared to the previously stored text. If no character of the CMP: line was stored, no comparison is made. If the two strings are not identical, this is indicated by OUT. OUT corresponds to the tolerance limit TOL HIGH. The terminators set (e.g. CR or LF) do not affect the comparison. Other control characters are interpreted as blanks.

Pressing SEND & WAIT together with STORE saves the text in the TX: line. When the autorun control processes the SEND & WAIT command the received text is output via the serial interface. Then the program waits until a string with the required terminator is received. If there is no character received within RX TIMEOUT, the autorun control continues processing the next program point. If softkey 13 RX DISABLE is active, the stored text is output without waiting for a reception.

2.13.2 Interface Configuration

Starting with the main menu SERIAL the main menu SER CFG is entered by pressing the softkey SER CFG (= SERIAL CONFIGURATION).

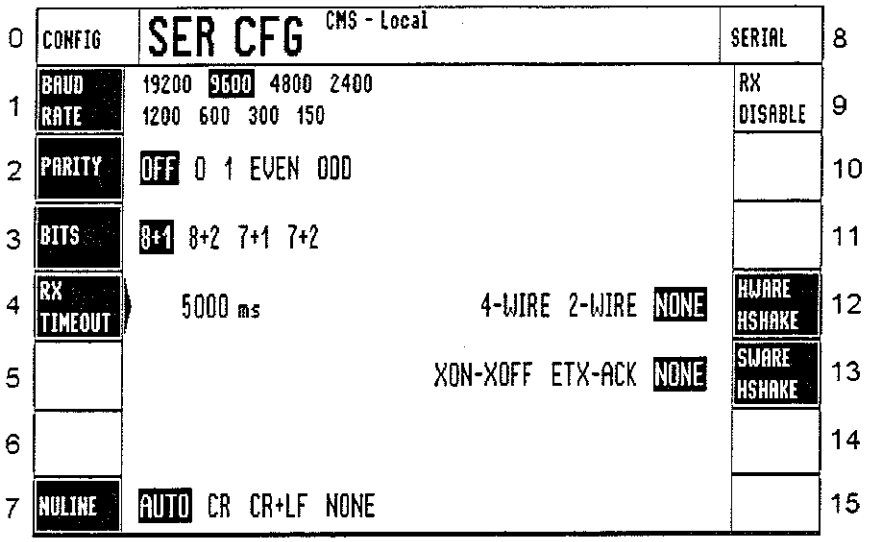


Fig. 2.13-2 Main menu SER CFG

Softkey 1: BAUD RATE (Determination of data transmission rate)

Softkey 1 BAUD RATE (toggle function) is used for determining the data transmission rate. The unit is bit/sec.

Softkey 2: PARITY

Softkey 2 PARITY (toggle function) indicates whether a parity bit is inserted and the kind of parity bit.

OFF	No parity bit is transmitted or received.
0	The parity bit is always replaced by zero.
1	The parity bit is always replaced by one.
EVEN	The parity bit is set such that the sum of data bits and parity bit is always zero.
ODD	The parity bit is set such that the sum of data bits and parity bit is always one.

Softkey 3: BITS (Determining the data format)

Softkey 3 BITS (toggle function) is used for determining the format of data transmission.

7 + 1	7 data bits and one stop bit. An additional parity bit is required for this operating mode.
7 + 2	7 data bits and two stop bits.
8 + 1	8 data bits and one stop bit.
8 + 2	8 data bits and two stop bits. This operating mode does not allow a parity bit to be inserted.

Illegal combinations are rejected by the CMS.

Softkey 4: RX TIMEOUT (Maximum waiting period for terminator)

After the "SEND & WAIT" command (softkey 11 of SERIAL menu) the CMS waits for a terminator (cf. softkey 7 NULINE) in case of AUTORUN or IEC REMOTE control.

The maximum waiting period between the reception of the last character and abortion of the reception function can be set using RX TIMEOUT.

This timeout has no effect on manual operation.

Softkey 7: NULINE (Selection of terminators applied)

This function is used for selecting the terminators (identifying the end of a string) used for data transmission. All terminators received are displayed by CR.

AUTO The CMS accepts the ASCII codes CR (= 0DH/13D), LF (= 0AH/10D) and FF (= 0CH/12D) as end of string with reception in AUTO mode.The terminators CR AND LF are transmitted.

NONE If this position is selected, no terminator is waited for. In case of automatic mode the reception function is disabled by TIMEOUT. Strings are transmitted without terminator.

CR If the CR position is selected, the terminator CR is waited for with reception. The terminator CR is added with transmission.

CR + LF With this position selected, a CR and a subsequent LF terminator are waited for with reception. CR and LF are transmitted.

Softkey 9: RX DISABLE (Disabling reception)

This softkey disables the RS232 receiver of the CMS. When this function is activated, the text in the RX: line is deleted (see softkey 13 (RX DISABLE) of SERIAL menu).

Softkeys 12, 13: HWARE HSHAKE / SWARE HSHAKE (Defining the handshake)

These softkeys determine the kind of handshake.

If HWARE HSHAKE (= hardware handshake) is selected, the additional wiring of the respective lines between receiver and transmitter must be provided.

Activating the SWARE HSHAKE function causes a software handshake requiring only the data lines and the ground connection.

Refer to Section 3 for further information.

Software Handshake

ETX/ACK This software handshake uses the ASCII codes ETX (03 hex) and ACK (06 hex). At the beginning of transmission the receiver sends an ACK code thus indicating that it is ready for accepting data. The transmitter thereupon sends a data block terminated by an ETX code. After processing this block the receiver again transmits ACK thus signalling to the transmitter that the next data block can be sent. The block size must not exceed the buffer capacity. The CMS needs a block size which is smaller than 30 bytes.

XON/XOFF This software handshake uses the ASCII codes XON (11 hex) and XOFF (13 hex). When the receiver is ready for accepting data it transmits an XON, e.g. when the receiver buffer was emptied. As soon as this buffer contains more than 46 characters, the receiver sends an XOFF to inform the transmitter not to send any more data until receiving an XON again. After transmitting the XOFF code the receiver buffer still provides a storage capacity of 4 bytes until valid data are overwritten.

Hardware Handshake

In contrast to the data lines a positive level (+ 9 V) on the handshake lines is interpreted as ON state, a negative level (-9 V) as OFF state.

4-WIRE This handshake is performed via 4 control lines according to the CCITT standard for V24 interfaces. This handshake is particularly suited for communication with a modem or another data communication equipment (DCE).

CONTROL connector	**CCITT circuit number**	**Function**
RTS (24)	105	If this output is in the ON state, the transmitter is ready for sending data. As soon as the CMS does not provide any more data for transmission, this line changes to the OFF state.
CTS (8)	106	When this input is in the ON state, the device connected is ready for receiving data. If this line is in the OFF state, the CMS does not send any data until the input changes to OFF.
DSR (25)	107	This input informs the CMS that a DCE is connected and ready for communication. When this line is in the OFF state, the CMS cannot transmit or receive any data.
DTR (41)	108/2	This output is always in the ON state with 4-wire handshake mode. The CMS is thus indicating that it is ready for transmitting or receiving data.

2-WIRE This handshake is performed via 2 control lines. It is used for communcication between two equivalent instruments (e.g. CMS and CMS).

CONTROL connector	**Function**
RTS (24)	The data flow is controlled by the receiver of the interface via this output. If RTS is set to ON, the CMS is ready for receiving data. As soon as the receiver buffer is full, the line changes to OFF. When the buffer provides storage capacity for further data again, the line changes to the ON state again.
CTS (8)	When this input is in the ON state it indicates to the CMS that it is ready for receiving data. If this line is OFF, the CMS does not send any data until the input has changed to ON again.

Programming example:

```
10 REM RS232-Test (TEST.BAS):
20 REM ======================
30 REM
40 IEC DCL
50 IEC TIME 10000
60 IEC TERM 10
70 REM
80 IEC OUT 24,"DISPLAY:MENU 21"
90 IEC OUT 24,"SERIAL:SEND? 'THIS IS A TEST'"
100 IEC IN 24,A$
110 PRINT A$
```

This program addresses a CMS with the IEC-bus address 24. The SERIAL menu is selected by *DISPLAY: MENU 21*. The text *'THIS IS A TEST'* is output via the serial interface by *SERIAL:SEND?*. Program line *100 IEC IN 24, A$* reads in the answer string received via the interface. Data are received in the meantime between calling the SEND function and the reception of a terminator. If the terminator is missing, reception is disabled when the timeout after the last character received has passed. The received string is output to a printer by means of line *110 PRINT A$*.

2.14 Self-Test

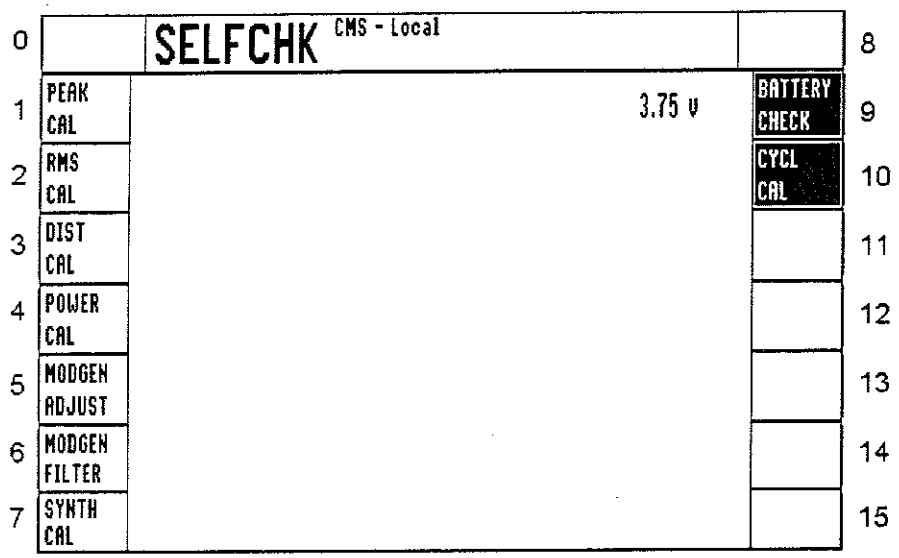


Fig. 2.14-1 Main menu SELFCHK (Self-test)

Starting with the main menus of the selection menu, the main menu SELF CHK (self-test) is reached by pressing the softkey SELFCHK. Several internal measuring facilities are checked and evaluated.

2.14.1 Calibration of PEAK Meter

PEAK CAL Function

The PEAK meter in the CMS is adjusted by pressing the softkey PEAK CAL.

2.14.2 Calibration of RMS Meter

RMS CAL Function

No signal must be applied to the instrument during this test. The RMS meter in the CMS is adjusted by pressing th softkey RMS CAL.

2.14.3 Calibration of Distortion Meter

DIST CAL Function

The RMS meter of the distortion meter / SINAD meter is adjusted by pressing the softkey DIST CAL.

2.14.4 Power Calibration

POWER CAL Function

This test can be carried out only if the RF IN/OUT socket ***29*** is empty.

The POWER CAL softkey is pressed for once adjusting the offset for power measurement at the respective measuring facilities.

2.14.5 Calibration of Modulation Generator

MODGEN ADJUST Function

An offset adjustment of the modulation generator output voltage is carried out by pressing the softkey MODGEN ADJUST.
The following text
"MOD GEN adjust completed? <ENTER>"
is read out in the status line.
A hardware offset adjustment (see CMS Service Manual) can then be internally performed in the instrument.
When the ENTER key is pressed, the measurement of the respective calibration data is carried out.

2.14.6 Adjustment of the Modulation Generator Filter

MODGEN FILTER Function

The frequency response caused by the ouput filters of the modulation generator is adjusted using the softkey MODGEN FILTER.

2.14.7 Synthesizer Calibration

SYNTH CAL Function

The deviation of the signal generator in the CMS is adjusted by pressing the softkey SYNTH CAL. This procedure takes some soconds and is output in the status line when completed.

2.14.8 Battery Check

BATT CHECK Function

The softkey BATT CHECK is pressed for once measuring the battery of the RAM with backup. The result is displayed next to the softkey, the evaluation is read out in the status line.

2.14.9 Cyclic Calibration

CYCL CAL Function

The following measuring facilities or generator functions are calibrated cyclically by pressing the softkey CYCL CAL: modulation generator offset, RMS meter, peak-value meter and A/D converter.

If measuring sequences are required at a defined point in time (especially in automatic operation), this function should better be switched off in order to prevent that asynchronous calibration measurements interfere with the time scale.

2.14.10 Limits of Calibration Values

Calibration	Calibration value	Min.	Max.	Unit
PEAK CAL	Output Offset	- 20	+ 20	mV
	Gain	0.9	1.1	./.
	Input Offset			
	(Path AF AC)	- 30	+ 30	mV
	(Path Demod)	- 30	+ 30	mV
	(Path Dist)	- 30	+ 30	mV
	(Path Psoph)	- 30	+ 30	mV
	(Path Hp)	- 30	+ 30	mV
	(Path Lp Demod)	- 30	+ 30	mV
	(Path Lp AF AC)	- 30	+ 30	mV
RMS CAL	Output Offset	- 20	+ 20	mV
	Gain	0.9	1.1	./.
	Input Offset			
	(Path AF AC)	- 50	+ 50	mV
	(Path Demod)	- 50	+ 50	mV
	(Path Dist)	- 50	+ 50	mV
	(Path Psoph)	- 50	+ 50	mV
	(Path Hp)	- 50	+ 50	mV
	(Path Lp Demod)	- 50	+ 50	mV
	(Path Lp Af AC)	- 50	+ 50	mV
DIST CAL	Offset	- 40	+ 40	mV
	Gain	0.9	1.1	./.
POWER CAL	Offset	- 20	+ 20	mV
MODGEN ADJUST	Offset	- 270	+ 270	mV
	Amplitude	125	1550	mV
MODGEN FILTER	min/max Filter Correction Value at internal Modulation (GEN)	4152	7118	./.
	for f > 20 kHz		14236	./.
	min/max Filter Correction Value at MODGEN Output	4152	7118	./.
	for f > 20 kHz		14236	./.
SYNTH CAL	min/max Deviation Correction Value at Oscillator 1	5	254	./.
	min/max Deviation Correction Value at Oscillator 2	5	254	./.
BATT CHECK	Voltage	3.0	5.0	V

2.14.11 Error Messages

Battery Check

- error 1 : Voltage error - falling below
- error 2 : Voltage error - exceeding
- error : General error

ADC Calibration

- error 1 : Offset error
- error 2 : Gain error
- error 3 : Offset error of DC amplifier
- error : General error

Peak Detector Calibration

- error 1 : Offset error
- error 2 : Gain error
- error 3 : Offset error in AF AC path
- error 4 : Offset error in Demod path
- error 5 : Offset error in Dist. path
- error 6 : Offset error in CCITT path
- error 7 : Offset error in Hp Pfad
- error 8 : Offset error in Lp Demod path
- error 9 : Offset error in Lp AF AC path
- error : General error

Modgen Filter Calibration

- error 1 : Freq. response error Modgen 1 - falling below
- error 2 : Freq. response error Modgen 1 - exceeding
- error 3 : Freq. response error Modgen 2 - falling below
- error 4 : Freq. response error Modgen 2 - exceeding
- error : General error

Modgen Generator Calibration

- error 1 : Offset error
- error 2 : Amplitude error
- error : General error

RMS Detector Calibration

- error 1 : Offset error
- error 2 : Gain error
- error 3 : Offset error in AF AC path
- error 4 : Offset error in Demod path
- error 5 : Offset error in Dist path
- error 6 : Offset error in CCITT path
- error 7 : Offset error in Hp path
- error 8 : Offset error in Lp Demod path
- error 9 : Offset error in Lp AF AC path
- error : General error

Distortion Detector Calibration

- error 1 : Offset error
- error 2 : Gain error
- error : General error

Power Meter Calibration

- error 1 : Offset error - exceeding
- error 2 : Offset error - falling below
- error : General error

RF-Synthesizer Deviation Calibration

- error 1 : Deviation corr. value Osc. 1 - falling below
- error 2 : Deviation corr. value Osc. 1 - exceeding
- error 3 : Deviation corr. value Osc. 2 - falling below
- error 4 : Deviation corr. value Osc. 2 - exceeding
- error : General error