ROHDE&SCHWARZ
Measuring Instruments
and Systems Division

Operating Manual

RADIOCOMMUNICATION SERVICE MONITOR CMS 52

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Supplement
to Operating Manual
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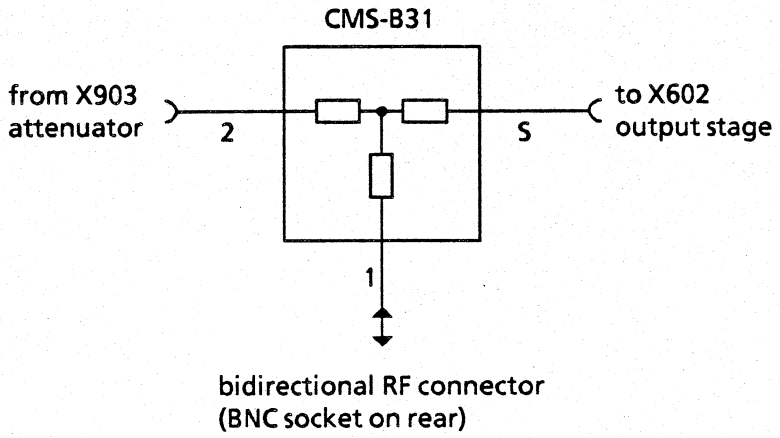
Option CMS-B31

Bidirectional RF connector for additional measuring instruments, e.g. signal generator (for two-signal measurements) or spectrum analyzer. The attenuation between the RF IN/OUT connector and the additional bidirectional RF connector amounts to 32 dB at 50-Ω termination of the bidirectional RF connector.



If the option CMS-B31 is fitted, the following data apply for the CMS Service Monitor differing from the specifications in the Data Sheet:

- RF counter:
  Input level range ..... 20 mW to 50 W
- Frequency deviation meter:
  Input level range ..... 20 mW to 50 W
- Phase deviation meter:
  Input level range ..... 20 mW to 50 W
- AM meter:
  Input sensitivity ..... 20 mW to 50 W
- Max. output level BNC socket on rear ..... 2.5 µW with 1 mW at RF IN/OUT
- Max. input level BNC socket on rear ..... 20 mW

Supplements B to C
to Operating Manual
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CMS 52

from Firmwareversion V1.80

Section 2.9 (CONFIG Menu)

Modifications:

The positions of some softkey functions have been changed in order to gain additional space for display of options; but take for granted that the functions of the softkeys have remained the same.

Additional Functions:

Display Illumination

Display illumination can be switched on and off using softkey 3 (ILLUM). The settings 5 min and 1 h mean that illumination is automatically switched off after the selected time has elapsed.

Note: **Depending on the kind of display and illumination "Switch off illumination" can also mean "half brightness".**

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.

600-Ohm AF-Transformers

With the CMS-B39 option (AF Transformers) installed, 600-Ω transformers can be connected into the AF-voltmeter input (AF/SCOPE) and modulation generator output (MOD GEN) respectively using softkey 10 (AF-TRANSF) (with setting "600 Ω" selected). The level indications of the AF voltmeter and modulation generator are corrected appropriately in this operating mode.

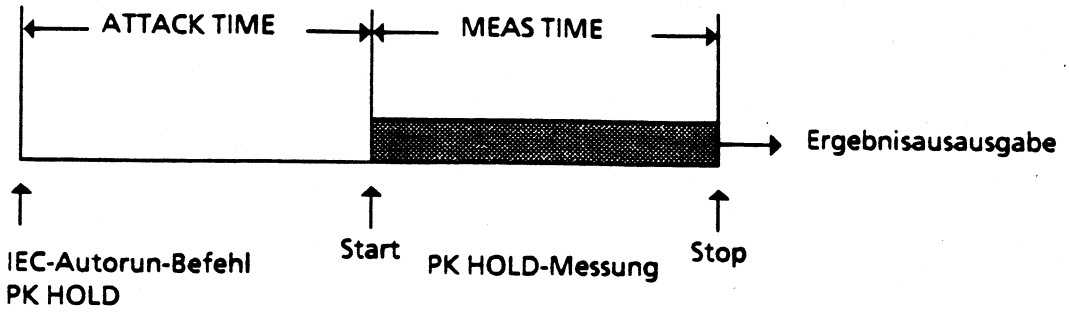
This function is also provided without the CMS-B39 option and may therefore be used for the CMS-Z39 option too.

In addition this option offers the possibility of setting/resetting the 4 lower relays and operating the 8 lower TTL/IN-/OUT lines via the CTRL submenu. (Operation is dealt with in Section 2.9.3 of the Operating Manual).

ATTACK TIME/MEAS TIME

Diese neu hinzugekommenen Funktionen des SEARCH-Untermenüs werden mit Softkey 6 bzw. 7 aktiviert. Im IEC-Bus- bzw. Autorun-Betrieb ist die PK-Hold-Messung ein einmaliger, zeitlich begrenzter Vorgang.

Die MEAS TIME ist die Zeit, in der der Spitzenwertmesser alle ankommenden Spannungsspitzen auswertet. Die ATTACK TIME ist die Zeit, um die die Auswertung nach Befehlsdurchführung verzögert wird.



Kap.2.5.4 Code/Count

Softkey 6: ACK TEST (Quittungstest)
Zusätzliche Funktion : + RF OFF
Durch Betätigen von Softkey 6 wird die automatische Sequenz "Quittungsruftest" eingeschaltet, durch Betätigen von Softkey 4 CODE im Hauptmenü RX-Test wird sie dann gestartet.
Die Sequenz besteht aus folgenden Schritten:

1. Abschicken der zuvor gewählten Tonfolge.

2. Nach dem letzten Ton der Tonfolge wechselt der CMS in den Sendertest mit all den zum Sendertest gehörenden Einstellungen. Dabei ist besonders darauf zu achten, daß die Sendertestarbeitsfrequenz noch im Sendertest auf die Frequenz einzustellen ist, auf der die Quittung des Funkgerätes zu erwarten ist. In der Stellung + RF OFF wird nach dem letzten Ton der Tonfolge zusätzlich der HF-Träger des CMS abgeschaltet, da einige Funkgeräte nur ohne Eingangssignal antworten.

3. Das Ergebnis des Quittungstests ist die decodierte Tonfolge und die Modulation.

Supplements A to B
to Operating Manual
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CMS 52
from Firmware Version V1.83

Addition to Section 2.4.2 Power Measurement

Extension of RF 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 operating mode BEAT 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. 125 µV to 50 V (-65 dBm to 47 dBm)
RF IN 2 : approx. 22 µV to 4 mV (-80 dBm to -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.

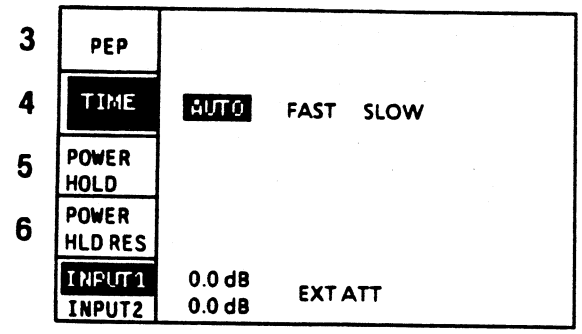
In contrast to the broadband RF power measurement, the selective RF power measurement also includes the peak value of the RF envelope (= PEP/Peak Envelope Power). In the case of AM, measurement results that are up to 6 dB higher (100%) are therefore obtained.
Calibration of the selective RF power measurement 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

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

The POWER submenu can be addressed in AUTOTEST and IEC bus mode using the menu number 1,4.



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
In the case of broadband RF power measurement a lowpass filter in the measurement path is switched on (SLOW) or off (FAST) using this function. With the setting AUTO the lowpass is switched on, if AM modulation is selected at the CMS; otherwise the lowpass is off. The cutoff frequency of the lowpass is about 4 Hz.
With AM modulated signals the setting SLOW is to be selected even in the case of selective RF power measurement.

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.

Applications of the
RADIOCOMMUNICATION SERVICE MONITOR CMS 52

Measurements on SSB transceivers

Note:

For SSB measurements, it is best to use option CMS-B1 (OCXO reference oscillator) to obtain a better frequency stability.

Transmitter test

- The CMS applies the modulation signal for the SSB transceiver to the MOD GEN connector.

  For intermodulation measurements a dual tone at any frequencies and amplitudes required can be selected.

- Apply RF output signal from the SSB transceiver to the RF IN/OUT connector of the CMS.

- If provided, select the CW mode on the SSB transceiver and measure the RF frequency and RF power with the CMS. The frequency offset can be shown directly by entering the nominal frequency using the REF function.

- Call the spectrum analyzer menu and enter the actual frequency measured at the SSB transceiver as the center frequency.

  Select a frequency span of 20 kHz and the 150-Hz resolution filter. Set a suitable RF attenuation (RF ATT) and reference level (REF LEV).

- Set SSB transceiver to modulation and apply a single or dual tone to the microphone input.

- The display of the CMS shows distortion or intermodulation products as well as carrier suppression and VSB suppression.

Receiver test

- Supply an RF signal to the SSB transceiver. The AF frequency is equal to the frequency offset from the nominal receive frequency. Enter the center frequency into the CMS and increase the frequency for USB transceivers and lower it for LSB transceivers.

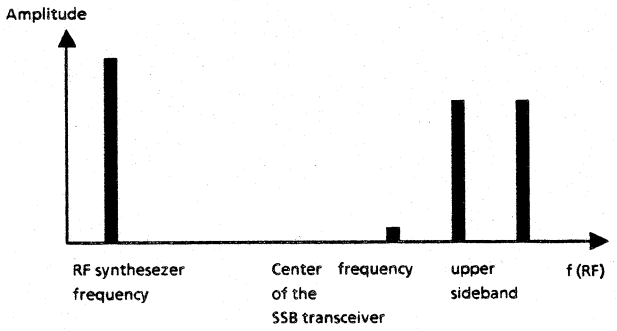
- Audio signal from transceiver to the AF/SCOPE connector of CMS.

- Interpret the signal using the AF voltmeter, oscilloscope, AF counter and distortion meter. The audio signal can be spectrally analyzed by selective measurement using the programmable resonance filter (center frequency 100 Hz to 5 kHz).

- Supply an RF signal consisting of two spectral lines to the SSB transceiver. Set the CMS to dual tone AM modulation. The test signal for the SSB transceiver is one modulation sideband. The carrier and the other sideband are - with sufficient frequency spacing - outside the receiver bandwidth.

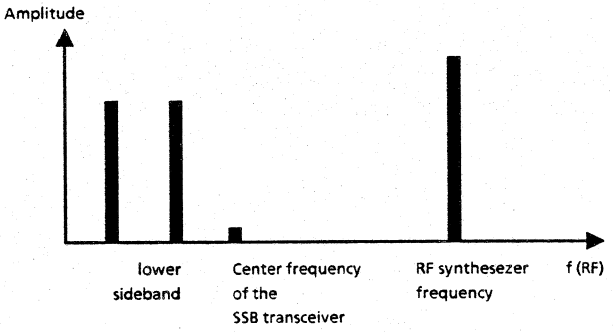
Make the following settings for transceivers using the USB:

- Set the frequency of the amplitude modulated RF synthesizer 10 kHz below the center frequency of the SSB transceiver.
- Increase the frequency of both AF generators by 10 kHz respectively.



Make the following settings for transceivers using the LSB:

- Set the frequency of the amplitude modulated RF synthesizer 10 kHz above the center frequency of the SSB transceiver.
- Increase the frequency of both AF generators by 10 kHz respectively.



- Feed the dual tone AF signal, applied to the transceiver loudspeaker, to the AF voltmeter.
- Select the programmable resonance filter (center frequency 100 Hz to 5 kHz) for frequency selective measurement and measure all relevant spectral lines.

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.

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.
- ESwitching-on the level which was switched off by OFF.

11

CLEAR
OFF

- Abortion of commenced input strings.
- Switching-off of levels with a relative quasi-dimension (e.g.: 0 dBm is a finite value, therefore switch off using OFF).
- Switching-off of functions such as REF, RANGE, VAR, TOL.
- Deletion of a deletable message in the 2nd status line.

12

VAR

Every setting 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 defined status.

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 screen contrast.

22

VOLUME

Adjustment of loudspeaker volume.

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.

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

⚠ 50 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: T10.0D/250 V DIN 41571

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.

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

PRINTER PARALLEL INTERFACE

Printer output (Centronics) (option CMS-B5).

47

Alternatively, depending on whether option CMS-B5 or CMS-B20 is fitted:

CONTROL (with fitted option CMS-B5)

Multifunction input/output with relay connections, TTL inputs / outputs and further functions (Option CMS-B5).

DC MEASUREMENT (with fitted option CMS-B20):
Connector for voltage and current measurements.

48

IEC 625
IEC/IEEE bus connection

49

AC supply voltage selector and fuse holder
100/120 V: DIN 41571 - T 1.6 D/250 V
220/240 V: DIN 41662 - T 800/250 V

50

AC power connection

47 to 420 Hz

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

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:

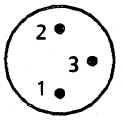
- Unscrew fuse holder ***49*** by $^1/_2$ rotation to the left and remove.
- Remove fuse from fuse holder.
- Set desired voltage (arrow). For this purpose, insert voltage selector switch and rotate.
- Insert fuse with required rating (fuses included in accessories).
  A fuse T 1.6 D is required for 100/120 V,
  a fuse T800 for 220/240 V.
- Insert fuse holder and lock by $^1/_2$ rotation to the right.

Once the AC cable has been inserted into the connector ***50***, 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). 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 free

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 independent of the battery voltage.

2.3 Operation

All 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.

The instrument is equipped with back-up batteries 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 low 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 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 is applicable; the other function can be selected using the SHIFT key ***13***.

Softkey 0 and sometimes softkey 8 allow for direct branching to other menu components. The destination is output on the display directly next to the 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 in the range between 20 Hz and 50 Hz are stored only if the function AF COUPL (submenu DIST/SINAD, DIST) is off.

  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	Imple-mentation in an autorun control program	Stroe RF setting in memory 3	Imple-mentation of storage pro-cedure in the autorun con-trol 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 display indicates all 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 all types of 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.

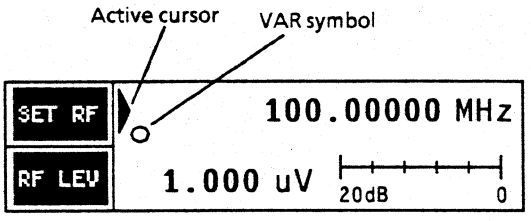


Fig. 2.3-1 Active cursor and VAR symbol

2.3.3 Menu Structure

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

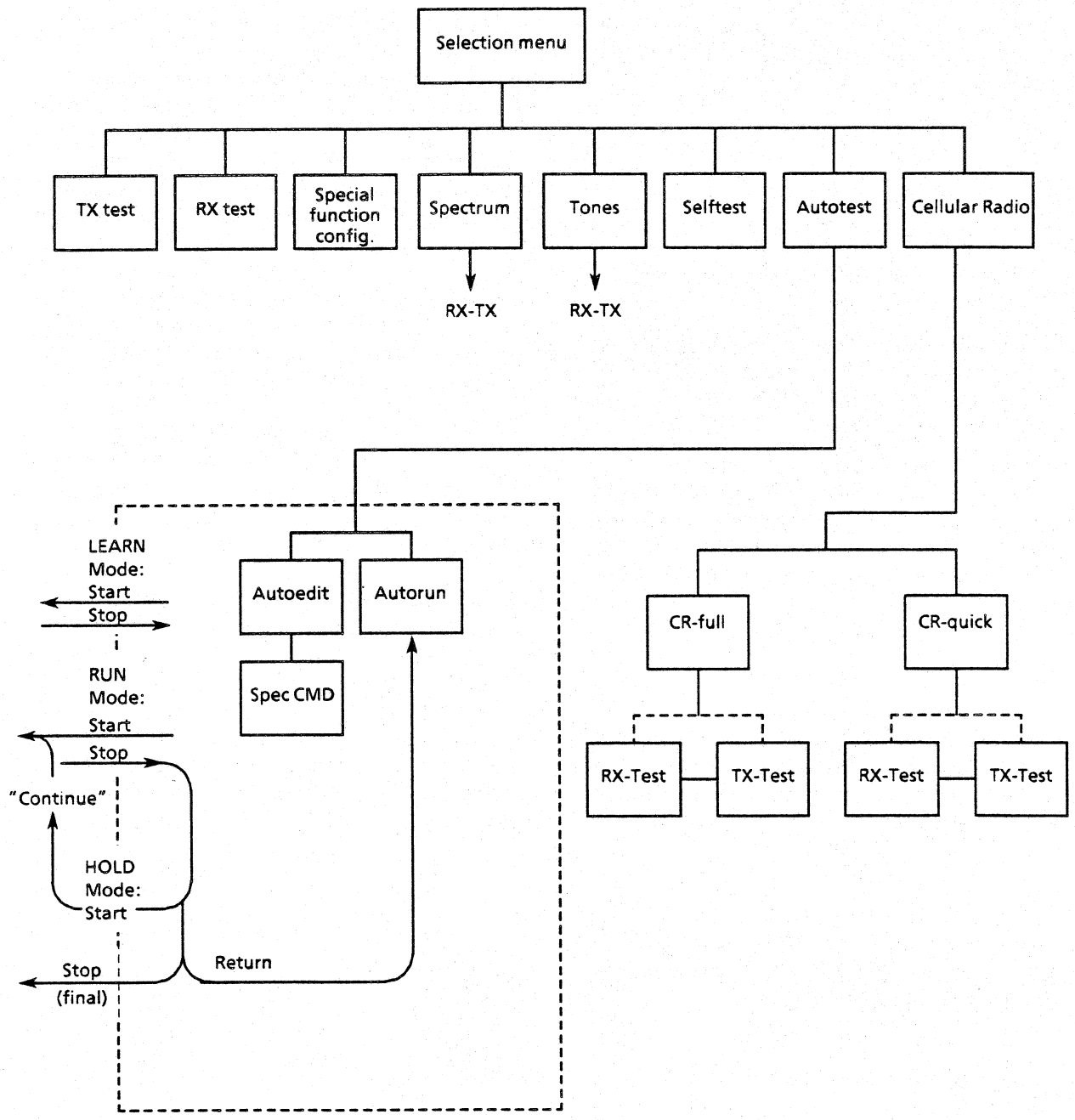


Fig. 2.3-2 Menu structure

2.3.4 Error Reaction

Erroneous operation of the instrument is nearly impossible. If this occurs, however, 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)

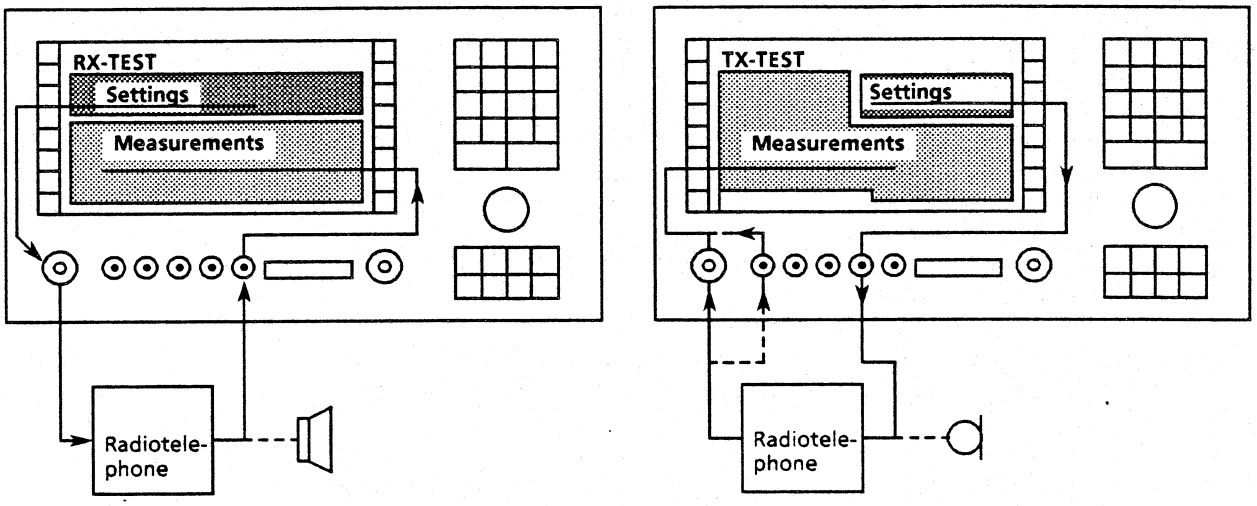


Fig. 2.3-3 Connection of the device under test

2.3.6 Selection Menu

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

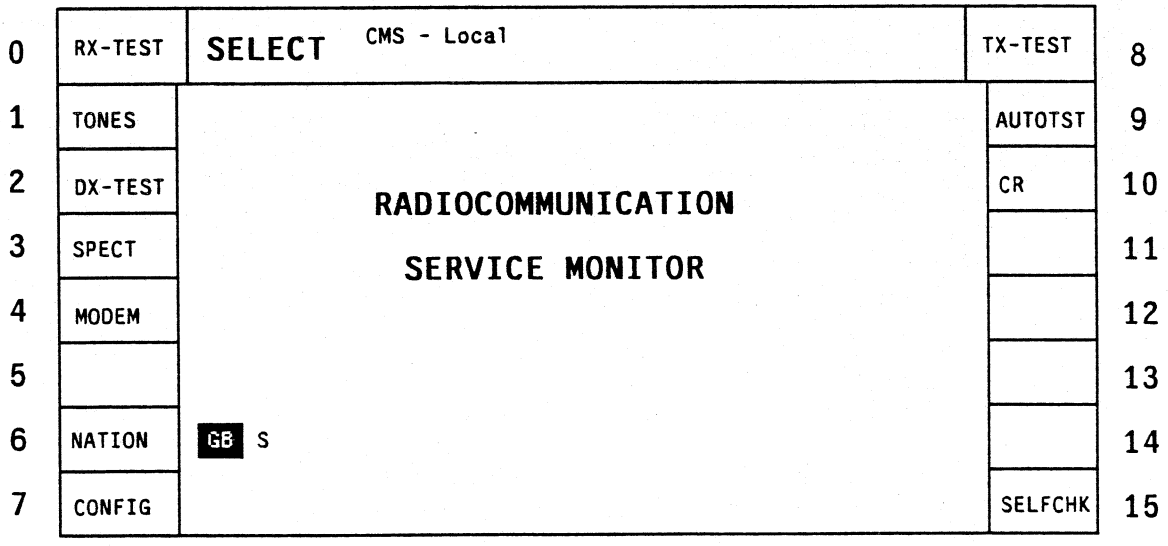


Fig. 2.3-4 Selection menu

2.4 Transmitter Test (TX-Test)

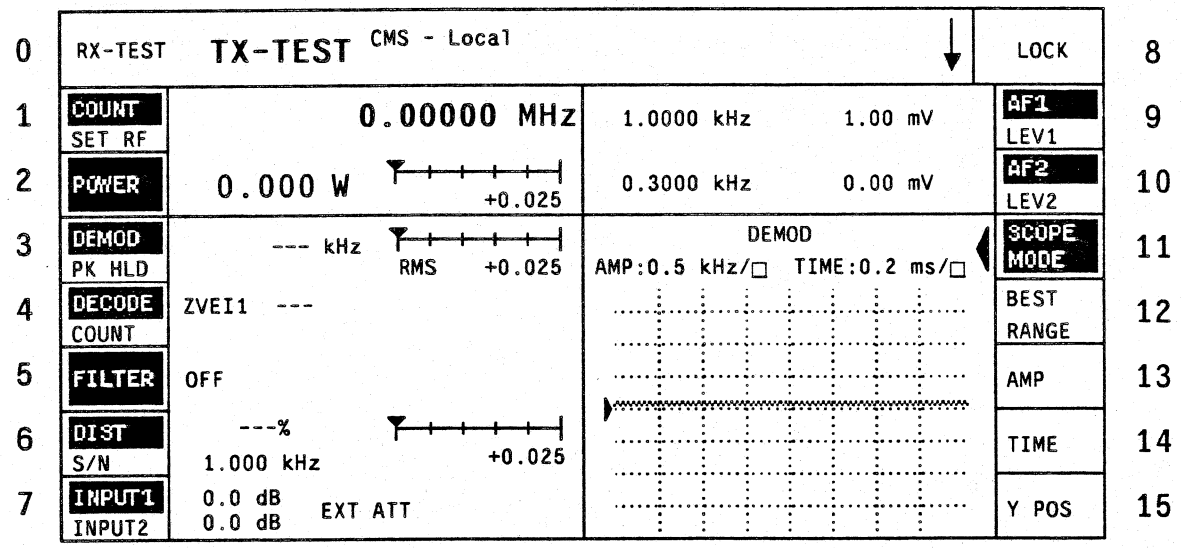


Fig. 2.4-1 Main menu TX-TEST

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 seldom 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 (remote measurement) 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. If not, it can be activated by entering SHIFT/softkey COUNT.

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

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.

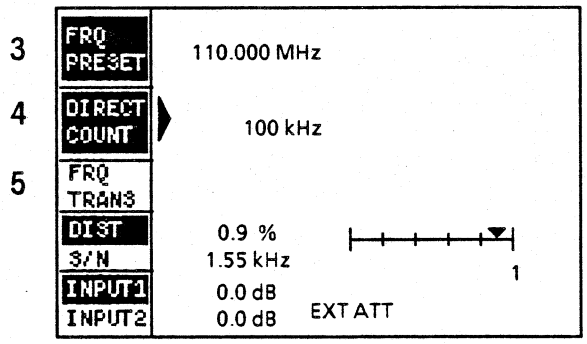


Fig. 2.4-2 COUNT submenu

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.

3	FRQ TRANS		
4	DUPLEX SPACE	+0.00000 MHz	
5	REF-CHANNEL	+120.00000 MHz	0
6	CH-SPACE	+25.00 kHz	
7	CH-NUMBER		

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 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, 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 RF power measurement can only be performed at the RF IN/OUT socket with the dimension W or dBm; tolerance markers can be set on the analog bars for both dimensions.

A logarithmic relative display based on a reference value can be selected.

Autorange or range hold can be selected on the analog display for the full-scale value.

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.

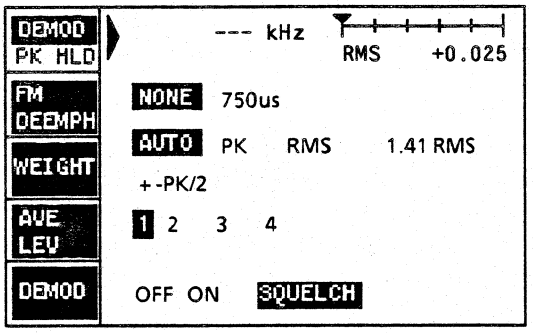


Fig. 2.4-4 DEMOD submenu

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.

1.41 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 LEV (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.

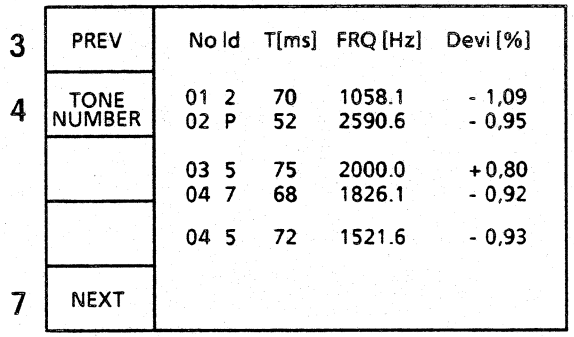


Fig. 2.4-5 DECODE submenu 1

This submenu reads out the contents of the decoded telegram in more detail. Each decoded telegram tone is identified by a sequential number.

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.

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)

This softkey is activated only if option CMS-B15 is fitted.

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.

DECODE Function: Submenu 2

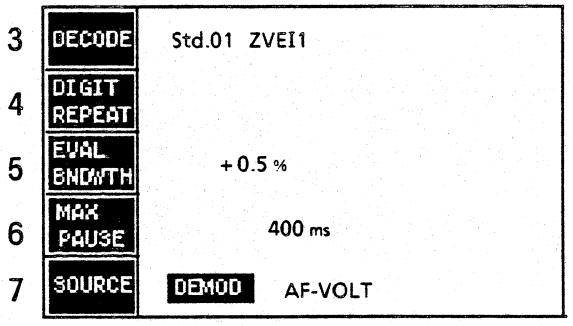


Fig. 2.4-6 DECODE submenu 2

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.

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

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.

Section 2.8 contains more detailed information and applications on the decoding 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`.
- 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.

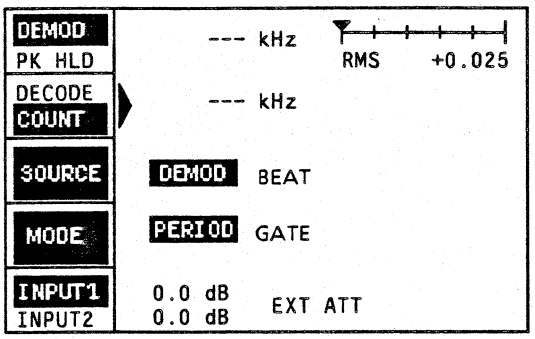


Fig. 2.4-7 COUNT submenu

Softkey 5: SOURCE (Signal source)

Softkey 5 can be used to switch between the signal sources DEMOD (demodulated signal) and BEAT (beat signal).

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.

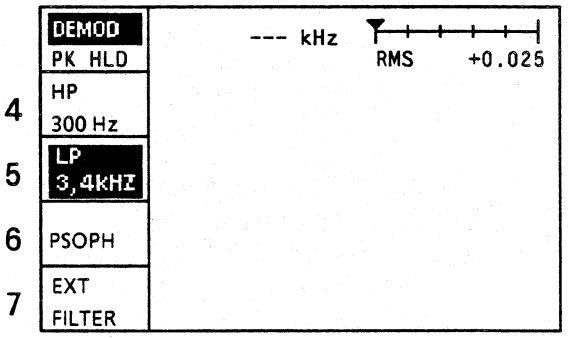


Fig. 2.4-8 FILTER submenu 1

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, option CMS-B5 or CMS-B20)

Switching the psophometric filter on and off. The psophometric filter is a CCITT filter or a C-message filter.

Softkey 7: EXT FILTER (external filter option CMS-B5)

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.

FILTER Function: Submenu 2

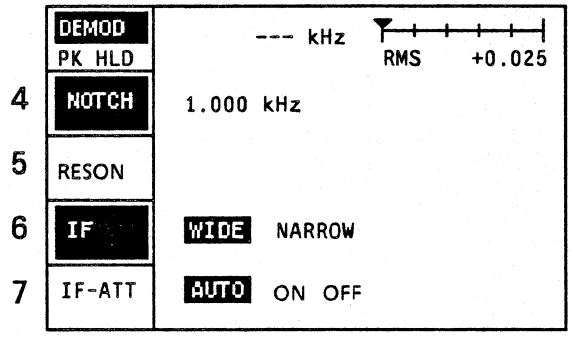


Fig. 2.4-9 FILTER submenu 2

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`.

The number corresponds to a frequency between 100 Hz and 4 kHz. 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 number corresponds to a frequency between 100 Hz and 4 kHz. 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.

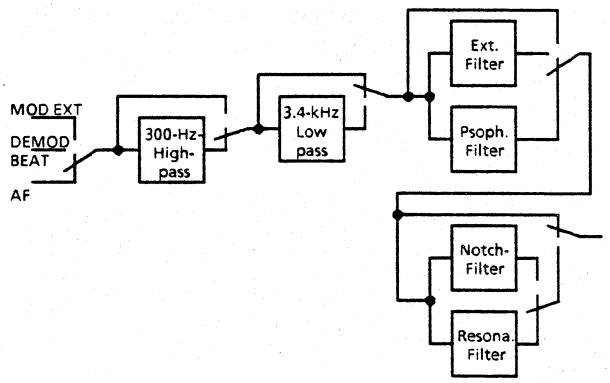


Fig. 2.4-10 Signal paths

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`. It corresponds to the number (with dimension) which can vary between 100 Hz and 4 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.

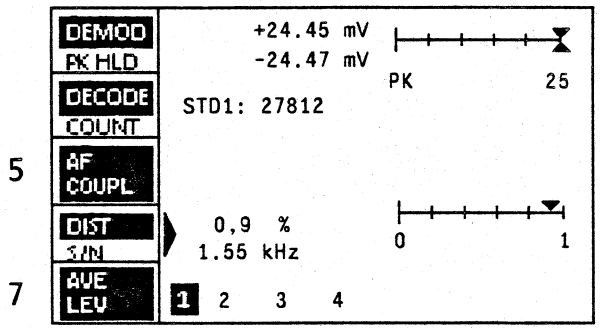


Fig. 2.4-11 DIST submenu

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 LEV (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.

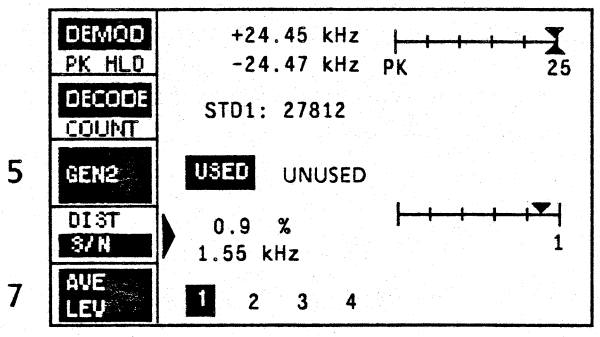


Fig. 2.4-12 S/N submenu

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 LEV (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 (approx. 2 Ω), 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 overloaded 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 sope 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.

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 without specifically assigning the VAR function to the AMP function.

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

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

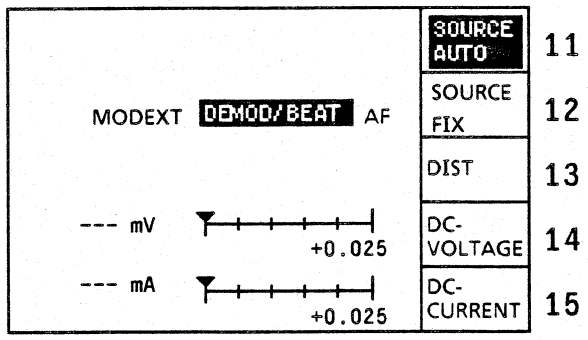


Fig. 2.4-13 SCOPE MODE submenu

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.

Softkey 13: DIST

When this softkey is activated, the signal path SOURCE DIST shown in Fig. 2.4-14 will be applied to the sope.

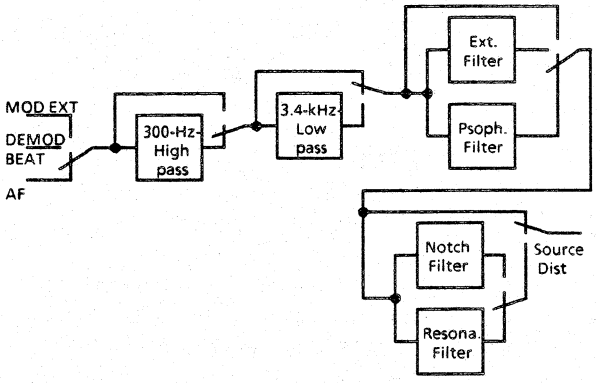


Fig. 2.4-14 Signal paths

Softkey 14: DC-VOLTAGE (Option CMS-B20)

The DC voltage measurement is initiated by pressing softkey 14. The voltage between the V_{DC} connectors on the rear panel is displayed in digital as well as analog form. The measurement is stopped by pressing the CLEAR key or again the softkey 14.

Softkey 15: DC-CURRENT (Option CMS-B20)

The DC current measurement is initiated by presing softkey 15. The current is determined using a shunt of 50-mΩ between the I_{DC} connectors on the rear panel and displayed in digital as well as analog form.
The measurement is stopped by pressing the CLEAR key or again the softkey 15.

Note:

DC-voltage and DC-current measurements are both possible simultaneously.

2.5 Receiver Test (RX-Test)

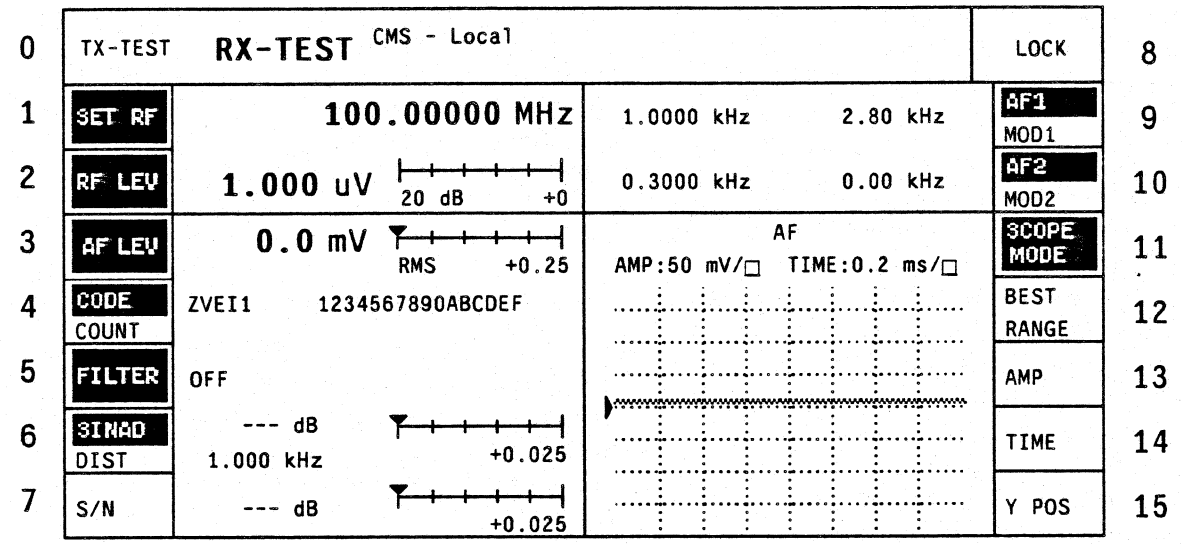


Fig. 2.5-1 Main menu RX-Test

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.

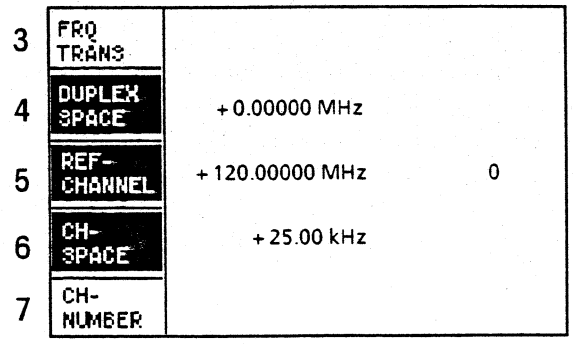


Fig. 2.5-2 SET RF submenu

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.

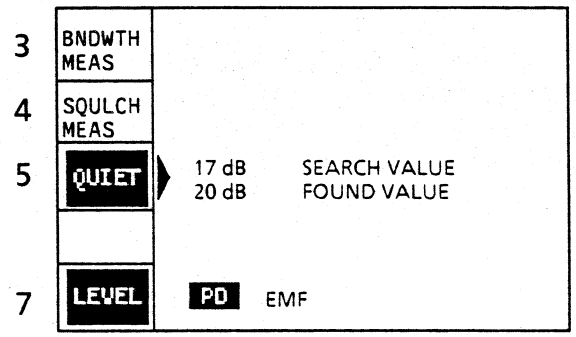


Fig. 2.5-3 RF LEV submenu

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: SQULCH 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`.

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.

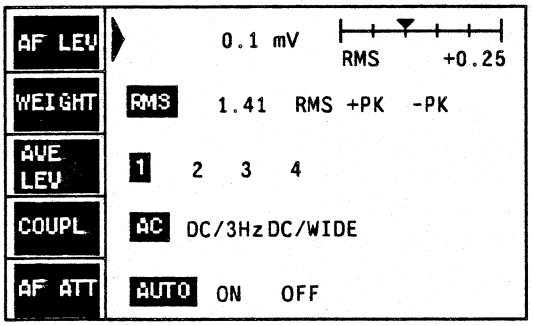


Fig. 2.5-4 AF LEV submenu

Softkey 4: WEIGHT

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

RMS: Real RMS weighting

1.41 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 LEV (averaging factor)

Softkey 5 can be used to select an averaging factor for RMS and 1.41 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:
CODE (Code outputs)
COUNT (AF frequency counting)

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

CODE 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.

Code Function: Submenu 1

The CODE 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 code 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).

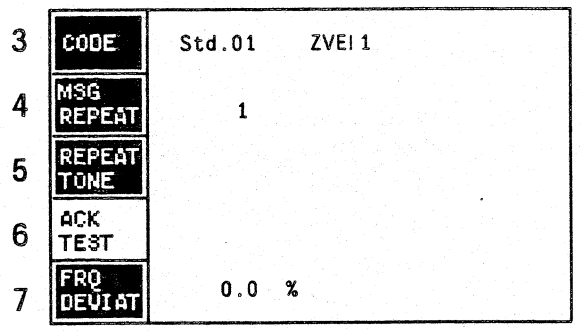


Fig. 2.5-5 CODE submenu 1

Softkey 3: CODE (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.

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. 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.
3. The result of the acknowledgement test is the decoded tone sequence and the modulation.

Softkey 7: FRQ DEVIA (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 %.

CODE Function: Submenu 2

3	NO SPC LENGTH	1 70 ms
4	OTHER LENGTH	70 ms
5	DIGIT PAUSE	0 ms
6	MSG PAUSE	200 ms
7	RESET STD	

Fig. 2.5-6 CODE submenu 2

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

Softkey 3: NO SPC

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.

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.

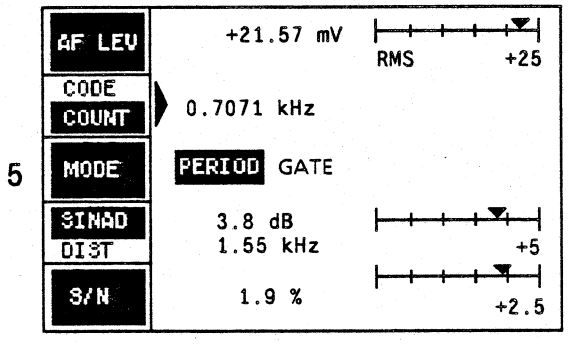


Fig. 2.5-7 COUNT submenu

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.

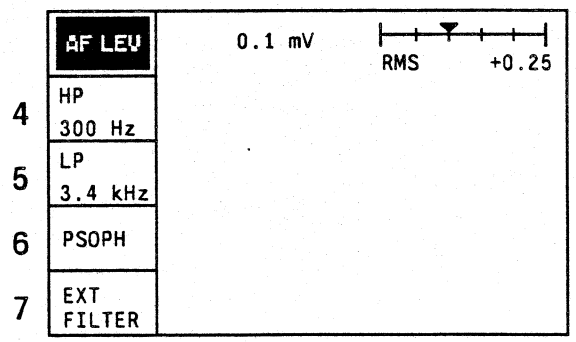


Fig. 2.5-8 FILTER submenu 1

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

Switching the 300-Hz highpass filter on and off.

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

Switching the 3.4-kHz lowpass filter on and off.

Softkey 6: PSOPH (psophometric filter option CMS-B5 or CMS-B20)

Switching the psophometric filter on and off. The psophometric filter is a CCITT filter or a C-message filter.

Softkey 7: EXT FILTER (external filter, CMS-B5)

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

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

FILTER Function: Submenu 2

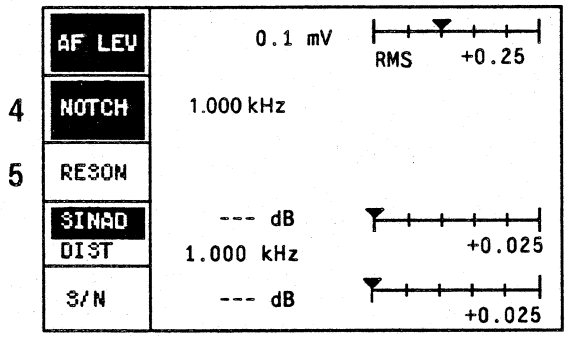


Fig. 2.5-9 FILTER submenu 2

Softkey 4: NOTCH (notch filter)

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

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

The number corresponds to a frequency between 100 Hz and 4 kHz. 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 and off using `softkey 5/ON` and `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 number corresponds to a frequency between 100 Hz and 4 kHz. The actually set frequency is displayed as with the notch filter.die tatsächlich eingestellte Frequenz angezeigt.

Filter combinations

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 can be combined independently to 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.

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 corresponds to the number (with dimension) which can range between100 Hz and 4 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.

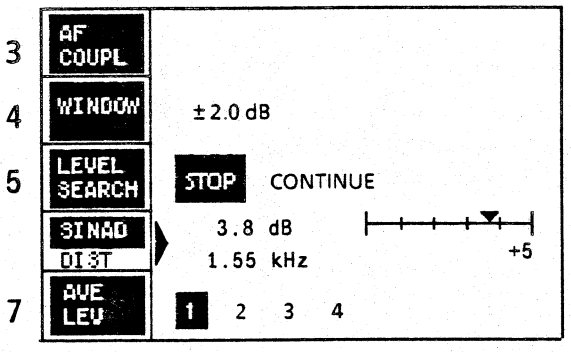


Fig. 2.5-10 SINAD/DIST submenu

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 LEV (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.

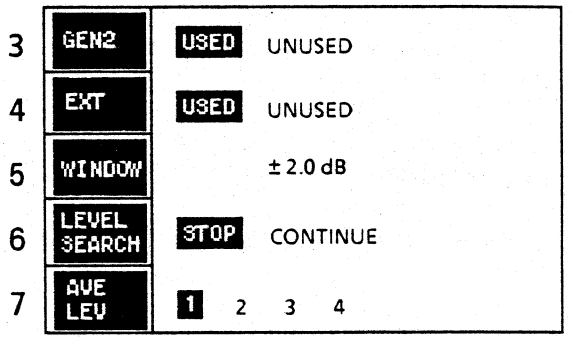


Fig. 2.5-11 S/N submenu

Softkey 3: GEN2 (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 LEV (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.

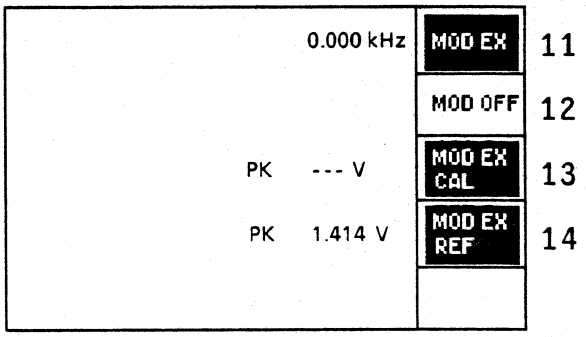


Fig. 2.5-12 MOD1/MOD2 submenu

Softkey 11: MOD EX (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 EX 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 EX 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.

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 Duplex Test (DX-Test)

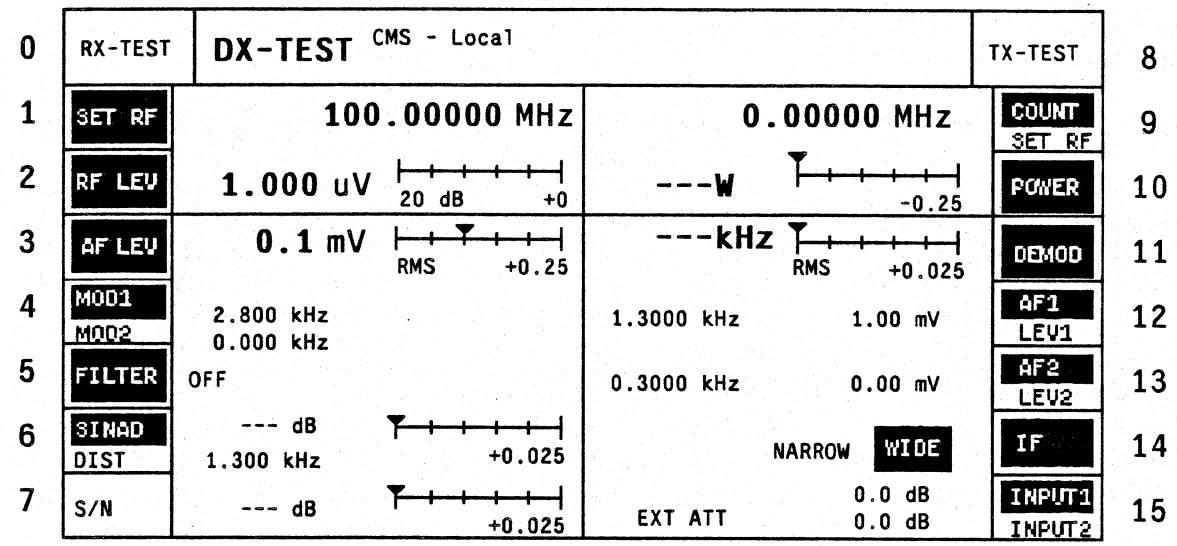


Fig. 2.6-1 Main menu DX-Test

Starting with the main menus of the selection menu, the main menu DX-TEST (duplex test) is accessed by actuating softkey DX-TEST.

It contains all controls required to perform a standard duplex test. Submenus are provided for almost any function. Also, these submenus contain controls to be used for less often required duplex test functions.

Softkey 0 is available to directly branch to the main menu for the receiver test (RX-TEST), softkey 8 can be used to directly reach the main menu for the transmitter test (TX-TEST).

The duplex test is a combination of the most important transmitter test and receiver test functions. Mutual dependences, e.g. influence of the transmitter power on the receiver sensitivity can thus be immediately detected.

2.6.1 RF Setting

SET RF Function

The SET RF function is used for setting the signal generator frequency of the instrument. The function is entered by key sequence `softkey` SET `RF/number/dimension` or `ENTER`.

For variation of the signal generator frequency setting, the function VAR and the VAR spinwheel are provided. The signal generator frequency can also be set in relative mode.

The reference frequency is entered either via key sequence `softkey` SET `RF/REF/ENTER`, if the current frequency is to be defined as reference frequency, or key sequence `softkey` SET `RF/REF/number/dimension` or `ENTER`, if another frequency value is to be entered as 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.

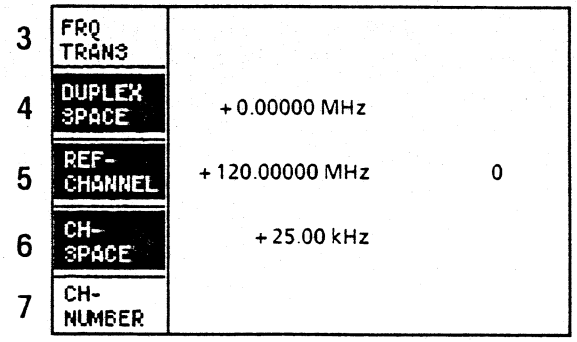


Fig. 2.6-2 SET RF submenu

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 space 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.

2.6.2 RF Level Setting

RF LEV Function

The RF LEV function sets the signal generator level. The entry is made by key sequence `softkey 2/number/dimension` or `ENTER`. If no number is entered, this sequence can be used to convert the dimension of the set level (µV ↔ dBm ↔ dBµV).

The RF level can be temporarily switched off by `softkey 2/OFF`. To reactivate the previously valid level, the key sequence `softkey 2/ON` is used.

Whereas directly entering parameters or varying parameters using the VAR spinwheel are simply different methods of operation that 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 as much as possible for variation of the level to smaller values by means of the VAR spinwheel. The level can be reduced interrupt-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 specified 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 via the digital keypad mainly uses the mechanical attenuators (audible switching).

The interrupt-free electronic level fine variation is used to search for the squelch point and the squelch hysteresis of the radio receiver. However, 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 by means of key sequence `softkey RF LEV/VAR/number/dimension or ENTER`.

The signal generator level can also be set on the instrument in relative mode. The reference level is entered either via key sequence `softkey RF LEV/REF/ENTER`, if the current level is to be defined as reference level, or key sequence `softkey RF LEV/REF/number/dimension` or `ENTER`, if another level value is to be entered as reference level.

RF LEV Function: Submenu

The RF LEV function branches in a very important submenu that 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 make sure that the radiotelephone is completely connected to the CMS. The connectors RF IN/OUT and AF/SCOPE are used for this purpose.

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

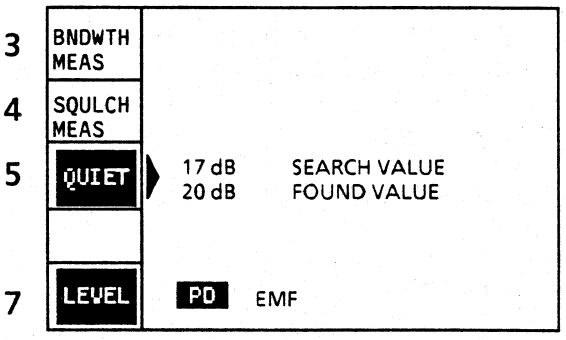


Fig. 2.6-3 RF LEV submenu

Softkey 3: BNDWTH MEAS (Bandwidth measurement)

Softkey 3 starts the bandwidth measurement.

The measurement is run as follows:

1. Basic 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: SQULCH 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 through on the radiophone. This is the squelch switch-off point.
3. The RF level is decreased until the AF level on the radiophone 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 key sequence `softkey 5/number/dimension dB or ENTER` initiates the quieting measurement. The number entered 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.

2.6.3 AF Level Measurement

AF LEV Function

The AF level measurement is selected on actuation of softkey 3. The dimension can be selected by subsequently pressing a dimension key. The dimensions mV, W, dBuV and dBm are available. Measurements in W and dBm are normally based on a load resistance of 600 Ω.

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

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

The currently measured value is defined as the reference value using key sequence `softkey 3/REF/dimension or ENTER`, which means that all 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`.

AF LEV Function: Submenu

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

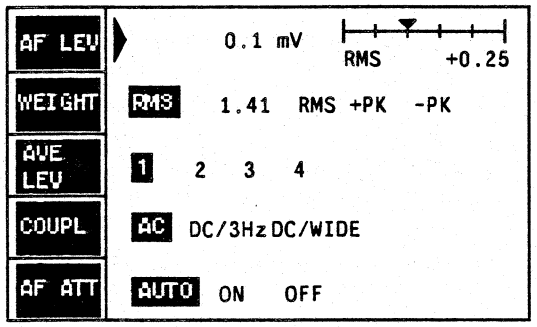


Fig. 2.6-4 AF LEV submenu

Softkey 4: WEIGHT
(Weighting)

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

RMS: Real RMS weighting

1.41RMS: 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 at the same time the integrating effect of the RMS detector is to be used (e.g. with noisy signals).

+PK: Positive peak weighting

- PK: Negative peak weighting

Softkey 5: AVE LEV
(Averaging factor)

Softkey 5 is used to select an averaging factor for RMS and 1.41 RMS weighting. Four avaraging 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.

In IEC bus operation, the individual measurements are repeated if high changes in signal level occurred following a delay.

Application:

Compared with a single measurement, a higher averaging factor gives more reproducible results in particular in the case of noisy signals. However, a highly averaged measurement takes longer. Often, the AF voltmeter is 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.

No averaging is carried out with peak weighting.

Softkey 6: COUPL
(AC/DC coupling)

Softkey 6 can be used to have the detectors coupled to the signal source in three different ways:

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

DC/3Hz: Pure DC measurement. AC components of more than 3 Hz are suppressed.

DC/WIDE: Both AC and DC components are considered for RMS or peak weighting.

Softkey 7: AF ATT
(Input divider)

In view of expanding the dynamic range of the measurement points at higher values, the CMS is fitted with a selectable input voltage divider. In general, this divider is automatically switched on or off depending on the measured value.

In case the automatic feature should not meet all requirements, it can also be switched off (e.g. to save time).

Three states are available for selection via softkey 7:

AUTO: Automatic adaptation to measured value.

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

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

2.6.4 Modulation

Softkey 4 selects the modulation generators. The modulation generator currently activated is indicated by inverse display. Using the SHIFT key, modulation generator 1 and 2 can be selected.

MOD1/MOD2 Function

The modulation is entered using the sequence `softkey 4/number/dimension` or `ENTER`. The modulation mode 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.

The modulation mode of the 2nd modulation generator follows that of the 1st (dual-tone modulation). Modulation 2 is therefore terminated only by ENTER.

The modulation is switched off by means of `softkey 4/OFF`, `softkey 4/ON` switches the previously valid modulation back on again.

Variation function (MOD1 only)

The increment for data variation via the VAR spinwheel is entered using the sequence `softkey 4/VAR/number/dimension` or `ENTER`.

Reference function (MOD1 only)

The sequence `softkey 4/REF/number/dimension` or `ENTER` is used to define the selected modulation as reference.

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.
The filters are switched on as in the RX test.

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.

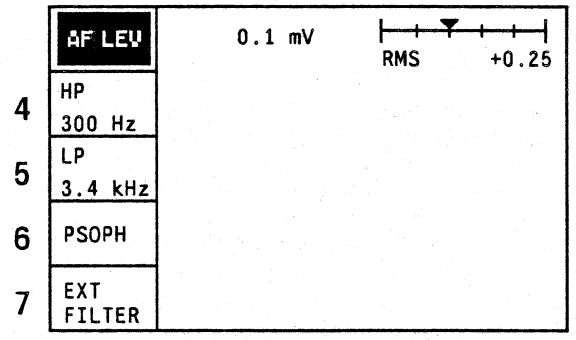


Fig. 2.6-5 FILTER submenu 1

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

Switching the 300-Hz highpass filter on and off.

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

Switching the 3.4-kHz lowpass filter on and off.

Softkey 6: PSOPH (psophometric filter option CMS-B5 or CMS-B20)

Switching the psophometric filter on and off. The psophometric filter is a CCITT filter or a C-message filter.

Softkey 7: EXT FILTER (external filter, CMS-B5)

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

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

FILTER Function: Submenu 2

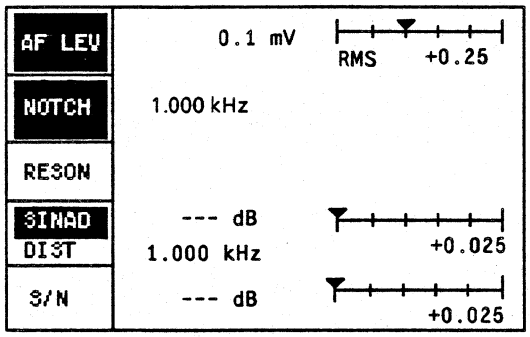


Fig. 2.6-6 FILTER submenu 2

Softkey 4: NOTCH (notch filter)

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

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

The number corresponds to a frequency between 100 Hz and 4 kHz. Since the resolution of the set frequencies cannot always be set as finely as required, the actually set frequency is output in the display.

Softkey 5: RESON (resonance filter)

The resonance filter is switched on and off using `softkey 5/ON` and `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 number corresponds to a frequency between 100 Hz and 4 kHz. The actually set frequency is displayed as with the notch filter.

Filter combinations

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 can be combined independently to 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.

2.6.6 SINAD and Distortion Measurements

Softkey 6 is assigned two functions:

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

The SHIFT key permits switching between the two functions.

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 corresponds to the number (with dimension) which can range between100 Hz and 4 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 by 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.

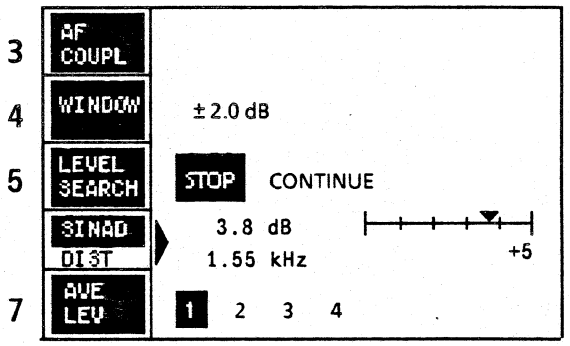


Fig. 2.6-7 SINAD/DIST submenu

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 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 LEV (Averaging factors)

Four averaging factors are available for selection with 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.

2.6.7 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/N measurement.

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 fields next to softkeys 3 to 7.

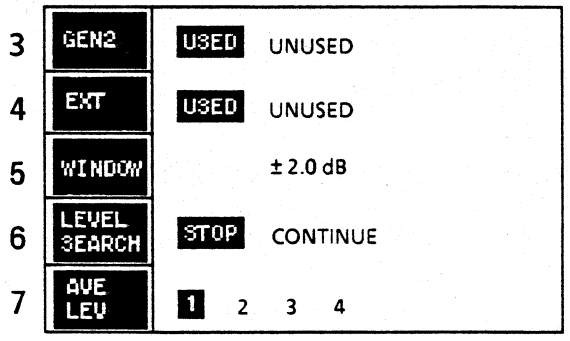


Fig. 2.6-8 S/N submenu

Softkey 3: GEN2 (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 LEV (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 in case of large changes in signal level. (Different S/N ratios (measurement times) may result.)

2.6.8 RF Frequency Measurement

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

COUNT Function

The count function is continuously activated if the COUNT field is shown in inverse display. The function can be activated by entering `SHIFT/ Softkey COUNT`.

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

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 counter resolution.

It is possible to have the sensitivity of the RF counter enhanced in particular with frequencies < 1 MHz by switching the IF filter on.

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 /terminating key or ENTER defines the entered frequency as 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.

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

SET RF Function: Submenu

This submenu is identical to the submenu assigned to softkey 1 and already described in Section 2.6.1.

2.6.9 Power Measurement

POWER Function

The RF power measurement can only be performed at connector RF IN/OUT with the dimension W or dBm. It is possible to set tolerance markers for both dimensions on the analog bars.

A logarithmic relative display based on a reference value can be selected with RF power measurements.

Autorange or range hold can be selected on the analog display for the full-scale value.

2.6.10 Demodulation

DEMOD Function

The instrument is capable of demodulating the transmitter signal according to AM, FM or ϕM. Input of softkey DEMOD/dimension selects one of the three demodulation modes. FM demodulation is then effected with the dimensions Hz and kHz, AM demodulation with % and ϕM demodulation with rad.

The associated submenu allows selection of different weighting modes. If peak weighting is selected, the positive and negative peaks are simultaneously displayed. However, tolerance markers and decision criteria such as for instance branching in the autorun control program are always referred to the positive peak value. The RMS weighting generates one measured value only.

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 pre-defined modulation depth, frequency deviation or phase deviation are attained as transmitter modulation.

The entry is made via:

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 indicated in the display is to be retained, ENTER can be input instead of the dimension.

The analog display can be assiged a full-scale value depending on the measured value or a fixed full-scale value. 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. In the event of two measured values it is again the positive peak value that is used for the tolerance weighting.

2.6.11 Modulation Generators

Softkeys 12 and 13 are assigned the frequency of the respective modulation generator as first function and the level of the respective modulation generator as second function. The SHIFT key permits switching between the two functions.

AF 1/AF 2 Function

The frequency is entered using the key sequence softkey 12 or 13/number/dimension or ENTER. The sequence softkey 12 or 13/OFF switches the modulation generator off, softkey 12 or 13/ON switches it back on again.

Variation function

The increment for data variation via the VAR spinwheel is entered using the sequence softkey 12 or 13/VAR/number/dimension or ENTER.In contrast to the usual operation, actuation of VAR/0/ ENTER does not set the minimum increment but leads to variation with the fixed frequency series (300 Hz, 600 Hz to 10 kHz).

Reference function

The instantaneous frequency is defined as the reference by entering REF/number/dimension or ENTER. The set frequencies must then be understood as difference from the reference frequency.

LEV1/LEV2 Function

As the source impedance of the modulation generator is very low (about 2 Ω), the set level is to be understood as the EMF.

The modulation generator level is entered using softkey 12 or 13/number/dimension or ENTER. The power is referred to 600 Ω when the dimension dBm is selected. Softkey 12 or 13/OFF switches off the level, Softkey 12 or 13/ON switches the previously valid level back on again.

Variation function

The increment for data variation via the VAR spinwheel is entered using softkey 12 or 13/VAR/ number/dimension or ENTER.

Reference function

The increment for level variation via the VAR spinwheel is entered using softkey 12 or 13/REF/ number/dimension or ENTER.

2.6.12 IF Filter

The IF filter can be switched on and off via softkey 14. The IF bandwidth is limited to approx. 25 kHz by the NARROW filter, which improves the S/N ratio especially when receiving small RF levels, but also results in a distortion at higher deviations and/or modulation frequencies.

2.6.13 Input Switchover

INPUT 1/INPUT 2 Function

The selected RF input (RF IN/OUT or RF IN2) is shown in inverted form. The other input can be selected by entry SHIFT/softkey 15. It is possible to inform the CMS of the attenuation value connected prior to the associated input. By entry softkey 15/number/dB or ENTER, the CMS takes into account the entered attenuation for the level with RF measurement and setting.

2.7 Spectrum Analyzer

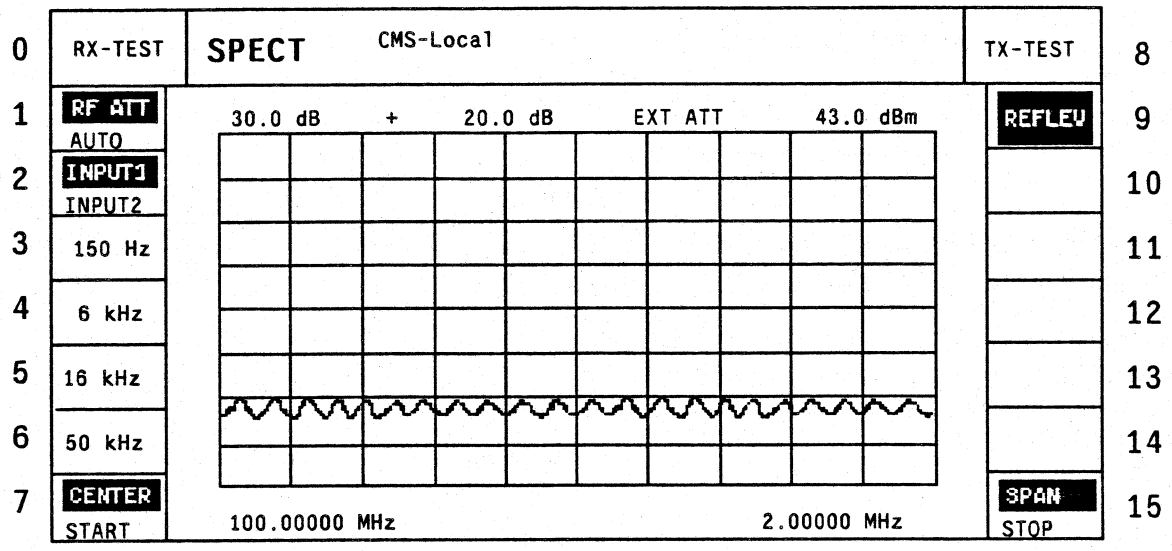


Fig. 2.7-1 Main menu SPECTRUM

Starting from the main menu display in the selection menu, the main menu SPECTRUM (spectrum analyzer operation) can be entered by pressing the SPECT softkey.

In this CMS operating mode, all the RF functions of the instrument are used even if the duplex synthesizer is fitted. Thus no duplex operation is possible.

Softkey 0 can be used to directly branch to the main menu for the receiver test (RX-Test). Actuation of softkey 8 directly gives access to the main menu for the transmitter test (TX-Test).

2.7.1 RF Attenuation

RF ATT/AUTO Function

For measurements via connector RF IN/OUT, the spectrum analyzer input disposes of switchable attenuator pads in the range from 0 to 60 dB. This input attenuation can be manually selected, or it is automatically set by the instrument depending on the power measured by the power meter.

Switchover from automatic attenuation to manual attenuation and vice versa is performed by entering `SHIFT / softkey 1`.

No RF level adaption is possible for measuring smaller voltages via the sensitive input connector RF IN2. The functions RF ATT or AUTO are irrelevant in this case.

Manual attenuation setting:

The RF attenuation is manually defined by entering `softkey 1/ number /dB or ENTER`. If high input levels are applied, an attenuation below 20 dB cannot be selected. Also, with incoming power the 20-dB attenuator is immediately activated.

Automatic attenuation setting:

The power measurement, on the basis of which the attenuation is set, is performed before each new test run. For security reasons, a 20-dB attenuation is always switched on even with small test voltages.

2.7.2 Input Selection

INPUT1/INPUT2 Function

Entering SHIFT/Softkey 2 switches over from the test input RF IN/OUT to test input RF IN2 (or vice versa).

The CMS can be informed which attenuation value is set before the respective input. When softkey 2/ number /dB or ENTER are entered, the CMS considers the entered attenuation with RF level measurements separately for both RF inputs. The entered external attenuation for the respective input is displayed next to the display for the RF attenuation setting.

2.7.3 Measurement Filter

150 Hz/6 kHz/16 kHz/50 kHz Function

Softkeys 3, 4, 5 and 6 can be used to select four filter bandwidths. This selection, however, is dependent on the current frequency spans (softkeys 7, 15):

Filter bandwidth 150 Hz is suitable for frequency spans up to 30 kHz

Filter bandwidth 6 kHz is suitable for frequency spans up to 1.2 MHz

Filter bandwidth 16 kHz is suitable for frequency spans up to 3.2 MHz

Filter bandwidth 50 kHz is suitable for frequency spans up to 10 MHz

For selecting a smaller filter bandwidth, first the frequency span must be suitably reduced. Vice versa, if a larger frequency span is selected the filter bandwidth is automatically switched over if required.

Applications:

Filter bandwidth

150 Hz: Modulation spectra within one or few channels.

6 kHz: For channel assignment observation of 10-kHz and 12.5-kHz channel steps.

16 kHz: For channel assignment observation of 20-kHz and 25-kHz channel steps.

50 kHz: For large frequency spans.

2.7.4 Frequency Axis

CENTER/START Function
SPAN/STOP

Settings on the frequency axis are performed by softkeys 7 and 15, which are interdependent softkeys.The frequency axis can be divided up either via the functions CENTER and SPAN or START and STOP. Entering SHIFT/Softkey 7 or SHIFT/Softkey 15 switches over between the two features. One keystroke is sufficient for switchover. The setting parameters are entered with softkey 7 or 15/ number / dimension or ENTER. Under certain conditions, these settings can influence the filter selection (cf. Section 2.7.3).

2.7.5 Level Reference Line

REF LEV Function

The reference level is entered using softkey 9/ number / dimension or ENTER. It is automatically defined such that it corresponds to the upper edge of the screen. Also the RF attenuator pads or the attenuator pads switched before the test inputs RF IN/OUT or RF IN2 are taken into consideration.

2.8 Definition Menu for Tones

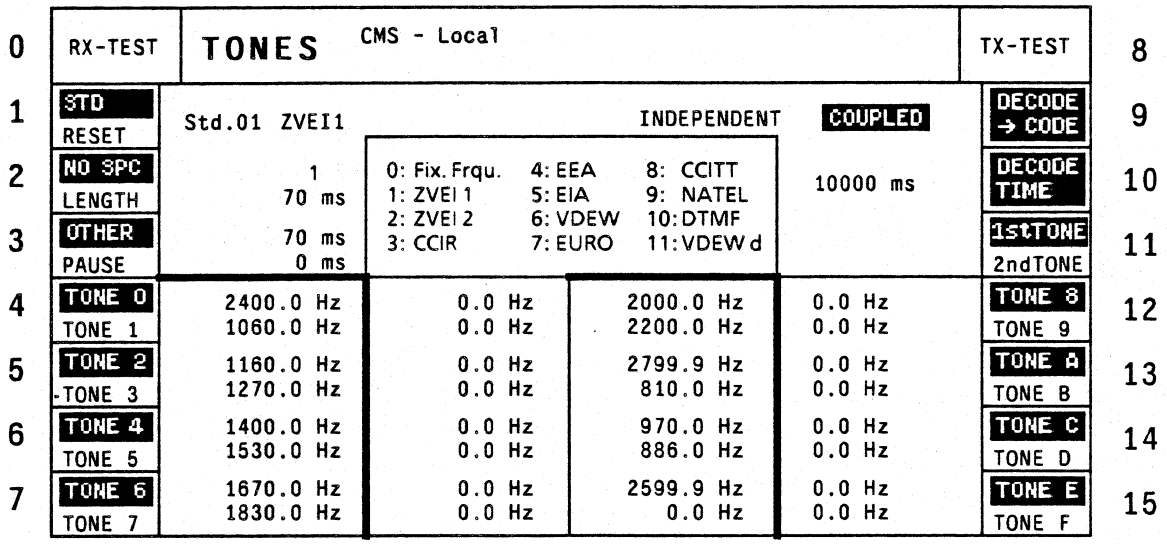


Fig. 2-8-1 Main menu TONES

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.

2.8.1 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

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) can not be selected in this menu, but only from the CODE submenu 1 or DECODE submenu 2.

2.8.2 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 SPC

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.

2.8.3 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.

2.8.4 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.

2.8.5 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.

2.8.6 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.

2.9 Definition Menu for Special Functions

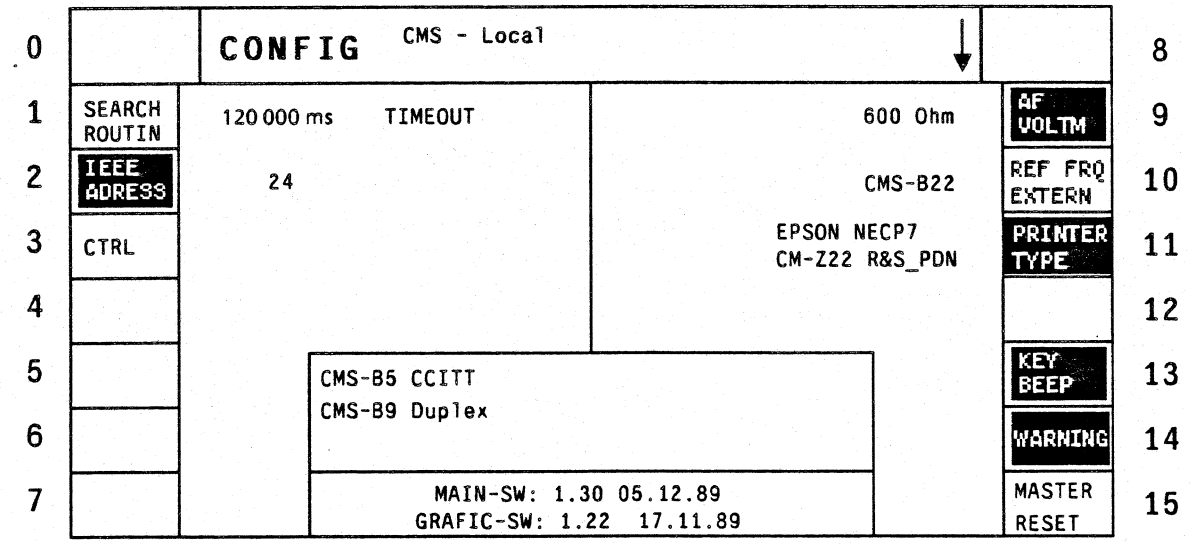


Fig. 2.9-1 Main menu CONFIG (special functions)

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.

2.9.1 Search Routines

SEARCH ROUTIN Function

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

SEARCH ROUTIN Function: Submenu

A submenu is available for the SEARCH ROUTIN function, which is output in the display fields next to the softkeys 2 to 5.

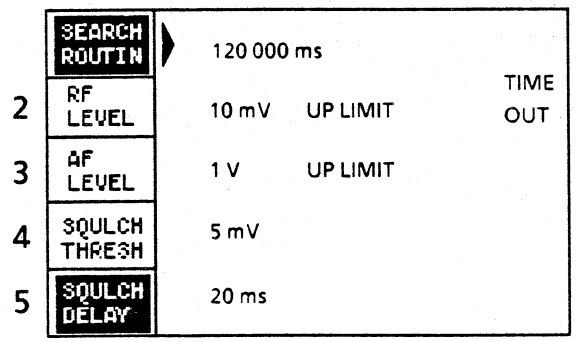


Fig. 2.9-2 SEARCH ROUTIN submenu

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: SQULCH THRESH

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

Softkey 5: SQULCH DELAY

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

2.9.2 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 2/ number/ ENTER`.

2.9.3 Relay and 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.

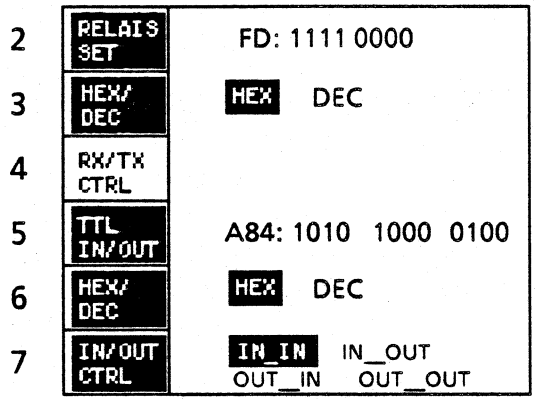


Fig. 2.9-3 CTRL submenu

Softkey 2: RELAIS SET

All relays can be set and reset individually or jointly. The two less significant hexadecimal positions determine which relay is influenced.

1. Setting all relays: range of values between 0 and 255 (0 and FF Hex)

   All relays are set irrespective of the previous setting in accordance with the binary number.

   e.g. setting all relays:

previous setting:	55 Hex	→	0101 0101 B
entered value:	0 0F Hex	→	0000 1111 B
new setting:	5F Hex	→	0000 1111 B

   relays are set

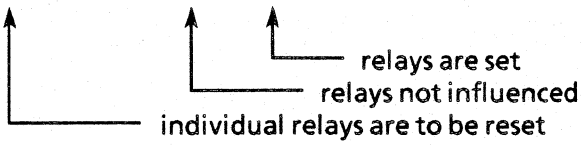
   all relays are to be set

2. Setting individual relays: range of values between 0 and 255 + 256 (100 and 1FF Hex)

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

   e.g.: setting all less significant relays, leaving the more significant relays unaffected.

   previous setting: 55 Hex → 0101 0101 B
   entered value: 1 0F Hex → 0000 1111 B
   new setting: 5F Hex → 0101 1111 B

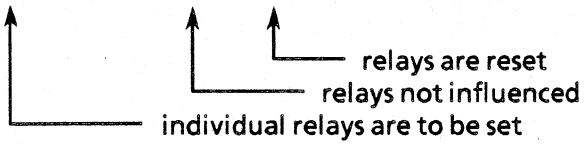


3. Resetting individual releys: range of values between 0 and 255 + 512 (200 and 2FF Hex)

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

   e. g.: resetting all less significant relays, leaving the more significant relays unaffected.

   previous setting: 55 Hex → 0101 0101 B
   entered value: 2 0F Hex → 0000 1111 B
   new setting: 5F Hex → 0101 0000 B



Softkey 3: HEX / DEC

Softkey 3 can be used to select whether the relay position is to be entered in decimal or hexadecimal form.

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.

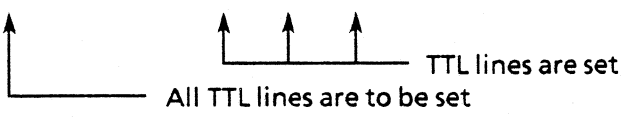
Example f or TTL IN/OUT (IN/OUT CTRL = OUT_OUT)

1. Setting all TTL lines: range of values between 0 and 255 (0 and FF 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 → 0101 0000 1111 B

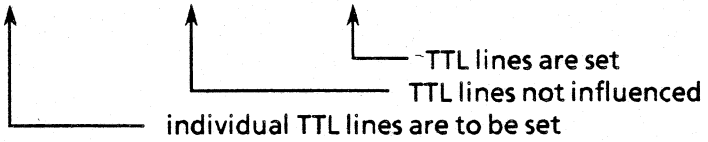


2. Setting individual TTL lines: range of values between 0 and 255 + 256 (100 and 1FF Hex)

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

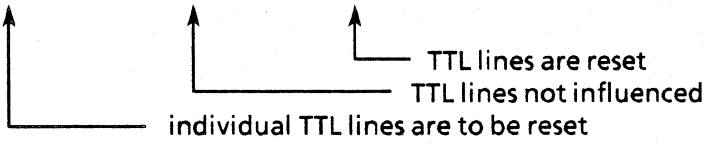


3. Resetting individual TTL lines: range of values between 0 and 255 + 512 (200 and 2FF Hex)

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.

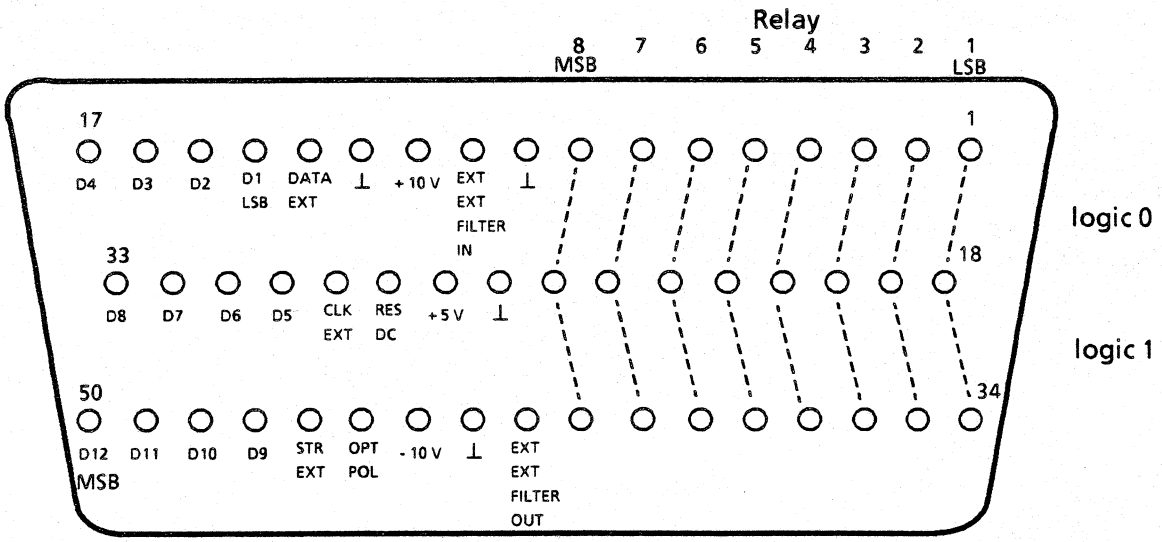


Fig. 2.9-4 Pin assignment of connector CONTROL

2.9.4 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.

2.9.5 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.

2.9.6 Selection of Printer

PRINTER TYPE Function

Various printer types may be selected on actuation of softkey 11 (toggle function).

2.9.7 Acoustic Acknowledgement

KEY BEEP Function

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

2.9.8 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.

2.9.9 Master Reset

MASTER RESET Function

The instrument is set to the factory setting using the softkey MASTER RESET

2.10 Remote Control

The instrument is fitted with an IEC bus interface as standard. The 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.

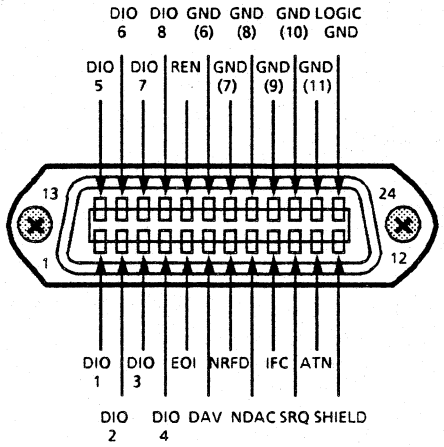


Fig. 2.10-1 Pin assignment of socket ***48***

The bus connection socket ***48*** 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 2.10-1 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

2.10.1 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.

2.10.2 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 disabled.

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 state 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.

2.10.3 Interface Messages

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

2.10.3.1 Universal 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 2.10-2 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 variable "status".

2.10.3.2 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").

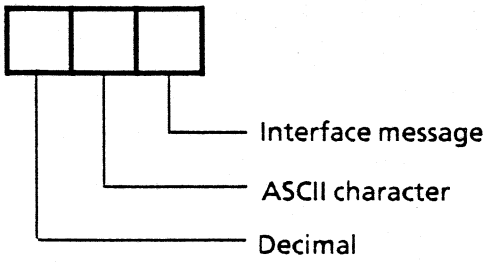
Table 2.10-3 Addressed commands

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 2.10-4 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:



2.10.4 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 2.10-5 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

2.10.4.1 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: *FREQUENCY:RF:TXTEST?*

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:RF:TXTEST 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

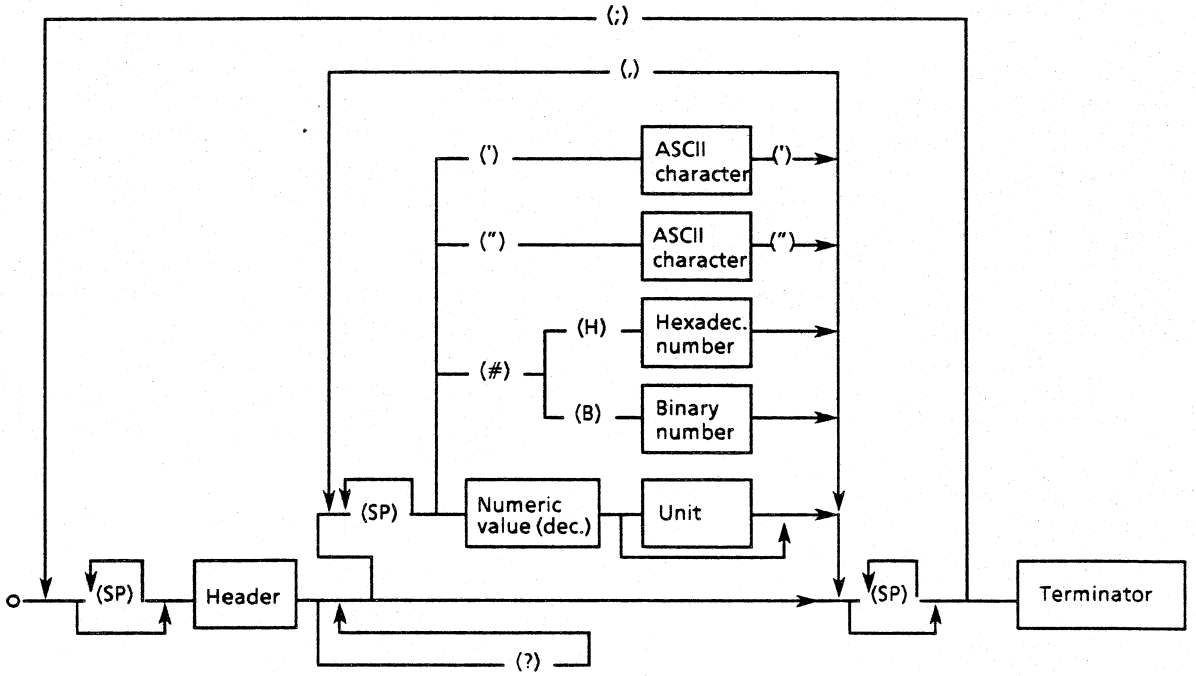
Binary number
e.g. #b101011, #B11001

String entries:

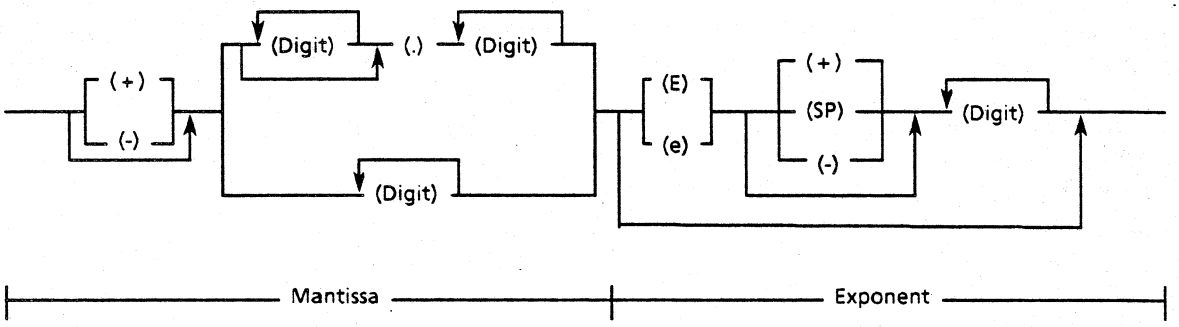
The following notations are permissible for string entries:

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. 2.10-2 Syntax diagram of a command line

2.10.4.2 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 2.10.5), 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 2.10-8, 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.

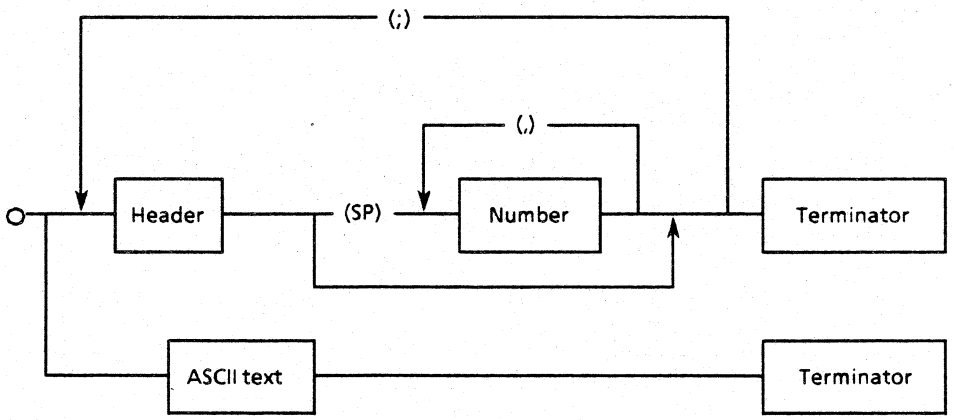
The syntax of the messages sent by the CMS is shown in Fig. 2.10-3. The syntax is similar to that for commands received by the CMS.

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

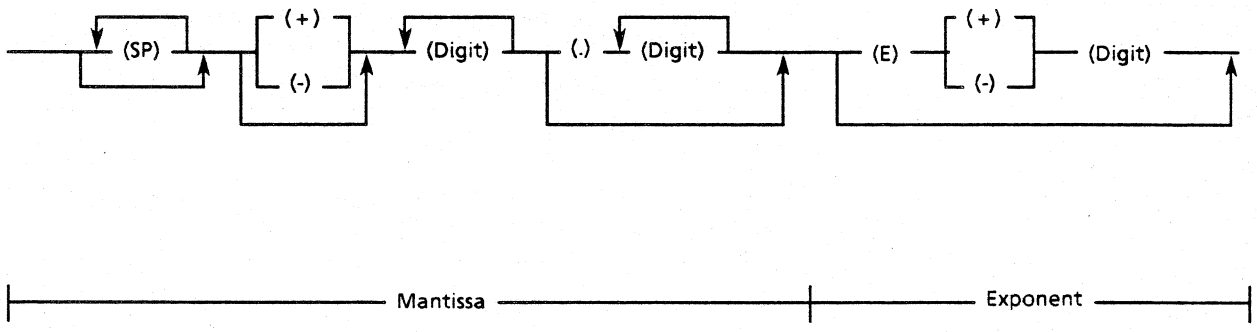
The transmission of "header and numbers" makes it possible that the messages sent by the CMS can again be returned to the CMS in the same form, without any amendments as setting commands. Thus a setting made on the keyboard can be read, stored in the controller and repeated later via the IEC bus.

- 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. 2.10-3. The exact form of the numbers of each message is described in Tables 2.10-7 and 2.10-8.
- Messages sent by the CMS do not contain units. In the case of physical variables, the numbers are referred to the basic unit specified in Table 2.10-8.

Output message line



Number



SP: Space (ASCII code 32 decimal)
ASCII text: Reply to command *IDN? (see Table 2.10-7)

Fig. 2.10-3 Syntax diagram of messages sent by the CMS

2.10.4.3 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 2.10-6 Device-independent commands (common commands) received by the CMS

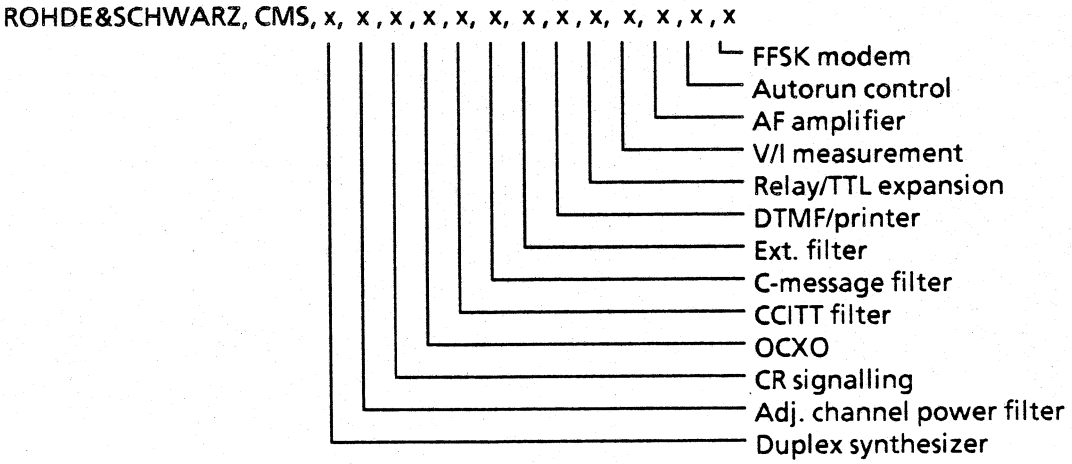
Command	Number, range	Meaning
*RST	---	**Reset** Acts on the instrument setting like the RESET key. This command does not change the status of the IEC-bus interface, the set IEC-bus address, the mask register of the Service Request function and the output buffer. A current Service Request is only reset 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 2.10.7).
*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 2.10.5).
*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 2.10.5).
*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 2.10.5).

Command	Number, range	Meaning
*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 2.10.5).
*WAI	---	**Wait To Continue** Only process the subsequent commands when all previous commands have been completely executed (see Section 2.10.7).

Table 2.10-7 Device-independent commands sent by the CMS

Command	Output message Data value		Meaning
	No. of digits	Range	
*IDN?	23	alphanume-ric	**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 2.10-6
*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 2.10.7).
*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.

Command	Output message Data value		Meaning
	No. of digits	Range	
*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 2.10.5)
*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 (alpha-numeric)	**Option Identification Query** The following text is sent via IEC bus in response to the OPT? command (see table below)



x = 1: option fitted
x = 0: option not fitted

2.10.4.4 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 2.10-8 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 2.10-8 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 2.10-8 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 2.10-8. 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 2.10-8 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**
0	Selection menu	0	no submenu
1	TX-Test menu	1	TX-RX-SET
2	RX-Test menu	3	TX-RF-COUNT
3	Duplex-Test	6	TX-DEMOD
4	TONES menu	7	TX-AF-COUNT
5	TONES AF1/AF2	8	TX-DECODE 1
6	SPECTRUM menu	9	TX-DECODE 2
7	CONFIG menu	10	TX-FILTER 1
13	SELFCHECK menu	11	TX-FILTER 2
14	CR-SEL menu	12	TX-DISTOR
15	CR main menu	13	TX-S/N
16	Modem menu	15	TX-RX-CONT SCOPE
		17	RX-RF-LEVEL
		18	RX-AF-LEVEL
		19	RX-AF-COUNT
		20	RX-CODE 1
		21	RX-CODE 2
		22	RX-FILTER 1
		23	RX-FILTER 2
		24	RX-SINAD
		25	RX-S/N
		26	RX-MOD 1
		28	CONFIG search routine
		30	CONFIG Control

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	number	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	number	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	
DEMODULATION	number	PCT MHZ KHZ HZ RAD	Selection of demodulation type
DEMODULATION:TOLERANCE:UPPER	number ON OFF	PCTMHZ KHZ HZ RAD	DEMOD measurement and search routine
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	number	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	

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 MS US**	Tolerable pause
DECODE:**SO**URCE	**D**EMOD **A**FVOLT	---	Selection of source
CODE	---	---	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	---	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 MS US**	Length of extra tone
CODE:**O**THER:**L**ENGTH	number	**S MS US**	Duration of other tones
CODE:**D**IGITPAUSE	number	**S MS US**	Time elapsing between the tones
CODE:**MSGP**AUSE	number	**S MS US**	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	**MHZ KHZ HZ**	Notch filter in TX-Test
FILTER:**T**XTEST:**R**ESONANCE	number **ON OF**F	**MHZ KHZ HZ**	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

Command	Data	Units	Function
MODULATION:OFF	---	---	
DC:VOLTAGE	number	MV V	DC voltage measurement
DC:VOLTAGE:REFERENCE	number ON OFF	MV V DB	
DC:VOLTAGE:RANGE	number ON OFF	MV V DB	
DC:VOLTAGE:TOLERANCE:UPPER	number ON OFF	MV V DB	
DC:VOLTAGE:TOLERANCE:LOWER	number ON OFF	MV V DB	
DC:CURRENT	number	MA A	DC current measurement
DC:CURRENT:REFERENCE	number ON OFF	MA A DB	
DC:CURRENT:RANGE	number ON OFF	MA A DB	
DC:CURRENT:TOLERANCE:UPPER	number ON OFF	MA A DB	
DC:CURRENT:TOLERANCE:LOWER	number ON OFF	MA A DB	

IEC-bus-command for the SCOPE mode

Command	Data	Units	Function
SCOPE:CONTINUE	---	---	Activation of the scope
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 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:**R**_REFERENCE	number	**O**HM	Reference resistance of AF voltmeter
CONFIGURATION:**K**EYBEEP	**ON OF**F	---	Acoustic key acknowledgement
CONFIGURATION:**W**ARNING	**ON OF**F	---	Warning in case of erroneous operation
CONFIGURATION:**CL**OCK:**E**XTERNAL	**ON OF**F	---	Switching to ext. reference
CONFIGURATION:**PR**INTER:**T**YPE	**N**ECP6,7 **E**PSON **P**DN **C**M-Z22	---	Printer type
CONFIGURATION:**RO**UTINE:**L**IMIT:**TI**MEOUT	number	**S MS US**	Timeout value for search routines
CONFIGURATION:**RO**UTINE:**L**IMIT:**D**ELAY	number	**S MS US**	Wait time for slowing down the test cycle with squelch measurement
CONFIGURATION:**RO**UTINE:**L**IMIT:**TH**RESHOLD	number	**MV UV W DBUV DBM**	AF level (measurement): threshold value for squelch on/off
CONFIGURATION:**RO**UTINE:**L**IMIT:**AF** LEVEL	number	**MV UV W DBUV DBM**	Upper AF level limit for search routines
CONFIGURATION:**RO**UTINE:**L**IMIT:**RF** LEVEL	number	**MV UV W DBUV DBM**	Upper RF level limit for search routines
CONFIGURATION:**RO**UTINE:**L**IMIT:**M**EASURE	number	**S MS US**	Measuring time
CONFIGURATION:**RO**UTINE:**L**IMIT:**A**TTACKTIME	number	**S MS US**	Wait time until meas. start
CONFIGURATION:**CO**NTROL:**T**TL **CON**FIGURATION:**CO**NTROL:**T**TL:**V**ARIATION	number number	--- ---	Input and/or output of the TTL interfaces
CONFIGURATION:**CO**NTROL:**T**TL:**RE**LAYS **CON**FIGURATION:**CO**NTROL:**T**TL:**RE**LAYS :**V**ARIATION	number number	--- ---	Programming of the relays
CONFIGURATION:**CO**NTROL:**I**NOUT	**IN_I**N **IN_O**UT **OUT_I**N **OUT_O**UT	---	Programming of the TTL interface
CONFIGURATION:**CO**NTROL:**RX** TX	**ON OF**F	---	Setting most significant relays via RX - TX switchover
LANGUAGE	**E**NGLISH **SW**EDISH	---	Language switchover

IEC-bus commands for the SPECTRUM operation

Command	Data	Units	Function
SPECTRUM:ATTENUATION	number	DB	RF input attenuation
SPECTRUM:REFERENCE:LEVEL	number	MV UV W DBM DBUV	Reference level
:VARIATION	number ON OFF	MV UV W DBM DBUV	
SPECTRUM:STOP	number	MHZ KHZ HZ	Stop frequency
SPECTRUM:SPAN	number	MHZ KHZ HZ	Frequency span
SPECTRUM:START	number	MHZ KHZ HZ	Start frequency
SPECTRUM:CENTER	number	MHZ KHZ HZ	Center frequency
SPECTRUM:FILTER	SEL_150 HZ SEL_6 KHZ SEL_16 KHZ SEL_50 KHZ	---	Resolution filter
SPECTRUM:AUTO ATTENUATION	---	---	Automatic RF input attenuation

IEC-bus commands for the self-test

Command	Data	Units	Function
SERVICE:BATTERY	ON OFF		Battery voltage measurement
CALIBRATION:POWER	---	---	Calibration of power meter
CALIBRATION:PEAK	---	---	Calibration of peak meter
CALIBRATION:CYCLIC	ON OFF	---	Cyclic calibration
CALIBRATION:DISTORTION	---	---	Distortion calibration
CALIBRATION:DETECTOR:RMS	---	---	Calibration of RMS detector
CALIBRATION:MODULATION:FILTER	---	---	Calibration of AF synthesizer filters
CALIBRATION:MODULATION:GENERATOR	---	---	Calibration of offset and amplitude of the AF synthesizers
CALIBRATION:SYNTHESIZER	---	---	Calibration of synthesizer deviation
SERVICE:BATTERY	---	---	Battery voltage

2.10.5 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).

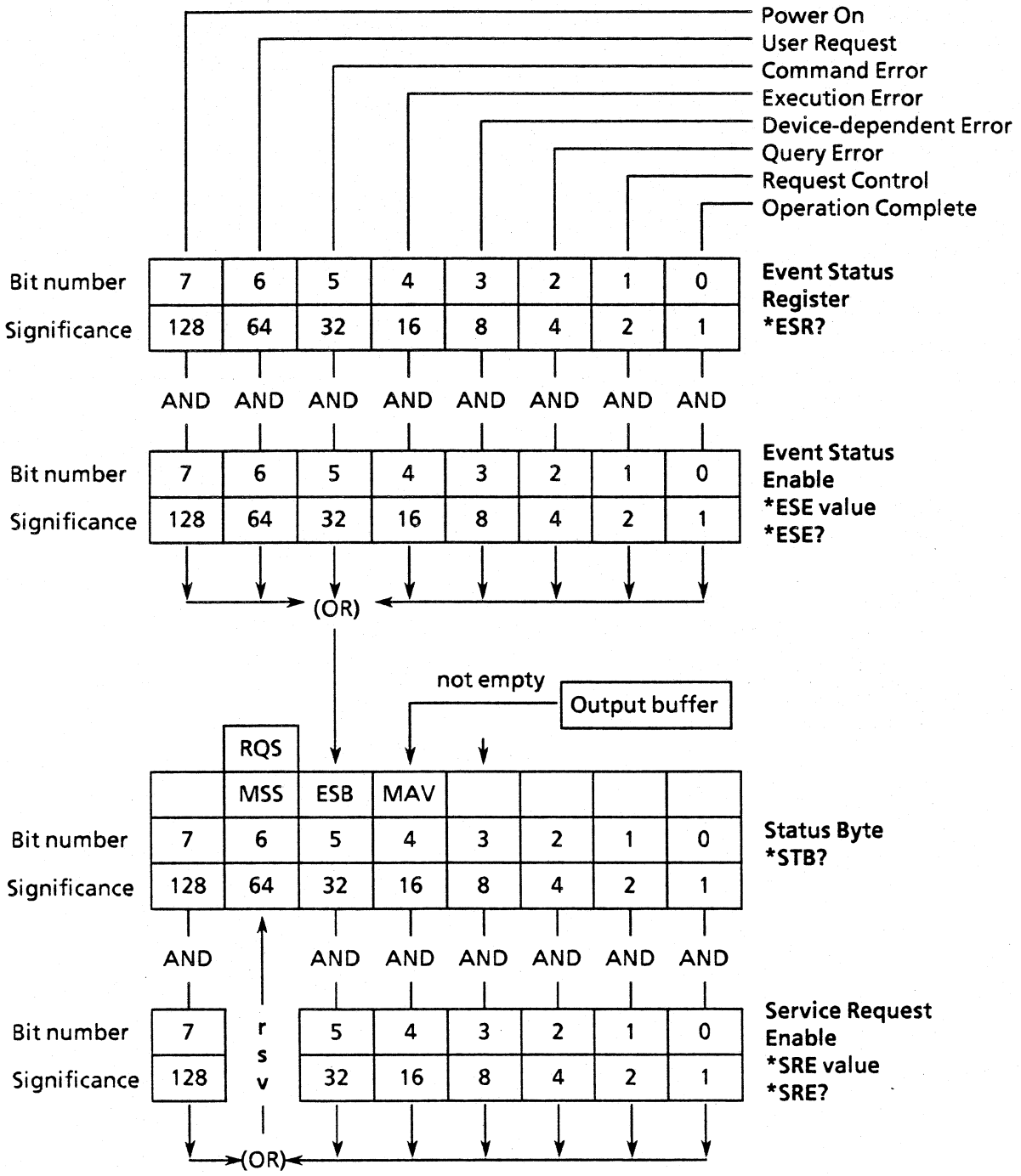


Fig. 2.10-4 Status registers

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 2.10-9 are used in the status byte (STB):

Table 2-10-9 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 2.10-10 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 2.10-11), and the combinations thereof.

Table 2.10-11 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.

2.10.6 Resetting of Device Functions

The following table lists the various commands and events which cause individual device functions to be reset.

Table 2.10-12 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.

2.10.7 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
```

2.10.8 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 2.10-10). 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.

2.11 Self-Test

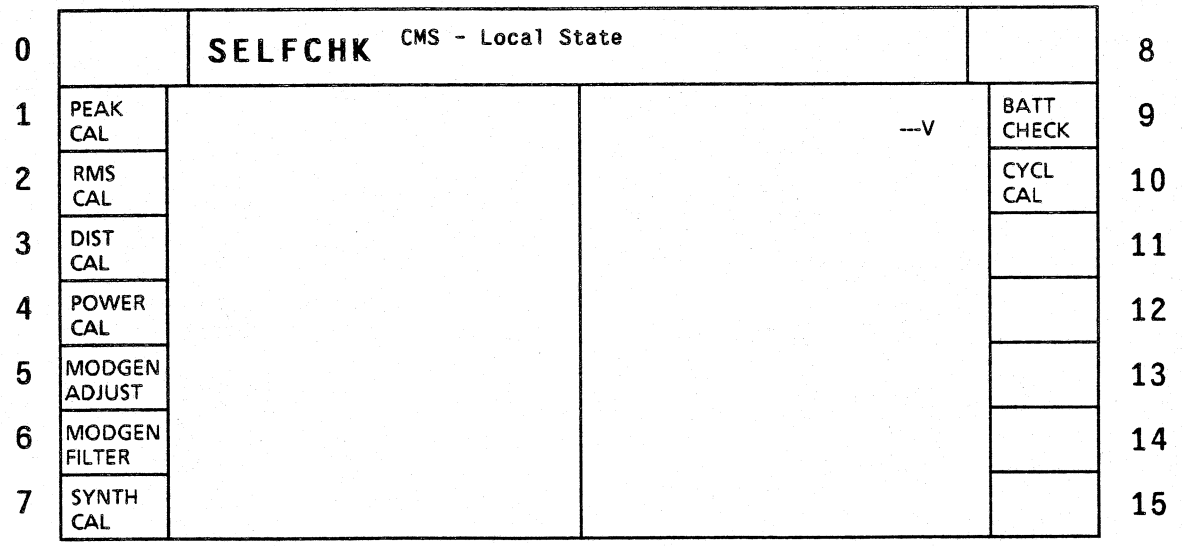


Fig. 2.11-1 Main menu SELFCHK (Self-test)

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.

2.11.1 Calibration of PEAK Meter

PEAK CAL Function

The PEAK meter in the CMS is adjusted by pressing the softkey PEAK CAL.

2.11.2 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.

2.11.3 Calibration of Distortion Meter

DIST CAL Function

The RMS meter of the distortion meter / SINAD meter is adjusted by pressing the softkey DIST CAL.

2.11.4 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.

2.11.5 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.

2.11.6 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.

2.11.7 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.

2.11.8 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.

2.11.9 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.

2.12 Fitting the Options

Remove the top and bottom covers of the cabinet for fitting the options and replacing the EPROMs. For this purpose, first the rear panel feet screws have to be undone and the feet withdrawn.

2.12.1 Fitting Option Duplex Modulation Meter CMS-B9

- Insert the Duplex Modulation Meter PC board in the slot with the yellow-grey guide rails (marked A4 on the motherboard).
- Connect X401 of new board A4 with X603 of Output Stage PC board A6 by means of the supplied solid-jacket cable.

2.12.2 Fitting Option Signaling Unit CMS-B13

- Insert the Signaling Unit PC board in the slot with the grey-grey guide rails (marked A3 on the motherboard).
- Remove the three jumpers X20, X21 and X22 on the bottom side of the motherboard. (When removing the option again, the jumpers must be reinserted as they are required for the CMS functions demodulation and modulation AM and FM.)
- Replace the EPROMs on the Digital Section board (cf. Section 2.12.6).

2.12.3 Fitting Option OCXO Reference Oscillator CMS-B1

- Withdraw the RF Synthesizer PC board (red-grey guide rails, marked A5 on the motherboard) and remove the top cover.
- Replace TCXO by OCXO (to be plugged in).
- Following installation of the board and the required warm-up time for the OCXO, the reference frequency can be set using R321 (accessible from above right side).

  For this purpose, connect a calibrated frequency counter to X501 and adjust reference frequency to 10 MHz ± 5Hz.

2.12.4 Fitting Option Control Interface CMS-B5

If Option CMS-B5 is fitted, Option CMS-B20 cannot be installed at the same time!

- Unscrew the blower board on the rear panel of the instrument.
- Remove both cutouts.
- Install the Control connector (bottom) and the Centronics connector (top) and screw on tightly.
- Lead the ribbon cables in the instrument upward before fixing the blower board.
- Insert Control Interface PC board (black-grey guide rails, marked A7 on the motherboard).
- Connect ribbon cables W20 and W21.

2.12.5 Fitting Option V/I-DC Measurement Unit CMS-B20

If Option CMS-B20 is fitted, Option CMS-B5 cannot be installed at the same time!

Installation of this option is more demanding than with any of the other options. Please contact your nearest R&S service representation for help if required.

- Unscrew the blower board on the rear panel of the instrument.
- Screw in the V/I sockets.
- Stick on the labeling foil.
- Lead the ribbon cables in the instrument upward before fixing the blower board.
- Insert the V/I-DC Measurement Unit PC board (black-grey guide rails, marked A7 on the motherboard).
- Connect ribbon cables W20 and W21.
- Diasssemble front panel:
- Remove the three spinwheels VAR, VOLUME and CONTRAST.
- Loosen the nine Phillips screws (4 large screws in the corners and 5 small screws).
- Remove the dummy panel for inserting the memory card.
- Disconnect the two ribbon cables after releasing the strain relief.
- Tilt front panel forwards.

- Replace MOD GEN connector with cable by the supplied connector with cable.
- Remount the front panel.
- Plug in cable W13 to X701 of new board A7.
- Connect X703 of new board A7 with the now free connector X203 by cable W11.

2.12.6 Replacing the EPROMs

- Disconnect the two ribbon cables of the Digital Section PC board after releasing the strain relief.
- Withdraw the Digital Section PC board (black-black guide rails, marked A1 on the motherboard) and remove the top cover.
- Replace the EPROMs (please return the disassembled EPROMs to R&S).
- Insert the PC board and plug in the ribbon cables.

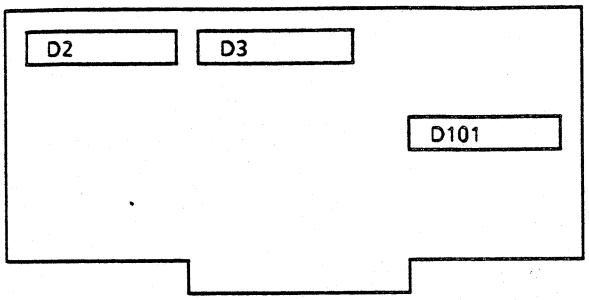


Fig. 2.12-1 Positions of EPROMs on the Digital Section PC board

2.12.7 Fitting Option Autorun Control/ Printer Control CMS-B15

- Disconnect the two ribbon cables of the Digital Section PC board after releasing the strain relief.
- Withdraw the Digital Section PC board (black-black guide rails, marked A1 on the motherboard) and remove the top cover.
- Remove threaded hook above D2, if available.
- Unsolder X5A, X5B, if available.
- Unsolder X8, if available.
- Move R12 from component side to solder side, if not already performed.
- Remove elements D2 and D3 and insert module in their place.
- Connect the three cables to the Digital Section PC board as outlined in the plan supplied with the option.
- Replace D101 by the supplied EPROM (please return the disassembled EPROMs to R&S).
- If no EPROMs are contained on the module, D2 and D3 are taken from the Digital Section board for the module (D2 remains on the left, D3 on the right plug-in locations).
- Insert PC board and plug in ribbon cables.

3 Performance Test

3.1 Required Measuring Instruments and Accessories

Item No.	o Instrument type, required specifications • Recommended R&S instrument	Type	Order No.	Application Section
1	o Frequency Counter up to 1000 MHz Error ≤ $1 \cdot 10^{-9}$ Resolution 1 Hz or 0.1 Hz			3.2.2 3.2.10
2	o Power Meter 1 to 1000 MHz Z = 50 Ω 1 to 1000 mW Error < 0.1 dB • Power Meter	 NAP	 392.4017.02	3.2.5 3.2.6
3	o Precision attenuation set 0 to 1000 MHz • Precision attenuation set	 RSP	 831.3515.02	3.2.7
4	o RF analyzer 1 to 1000 MHz Dynamic range > 80 dB • Spectrum analyzer	 FSA	 804.8010.52	3.2.3 3.2.7
5	o Modulation analyzer 1 to 1000 MHz AM, FM, φM Bandwidths: CCITT, 3 kHz, 20 kHz, 200 kHz Peak / RMS weighting Level meter and distortion meter for the demodulated signal and external AF AF counter • Modulation analyzer	 FAM	 334.2015.54	3.2.4 3.2.8 3.2.9 3.2.10 3.2.20 3.2.22
6	o AF generator 10 Hz to 1 MHz ($1 \cdot 10^{-5}$) 1 mV to 10 V (± 1 %) • AF generator	 SPN	 336.3019.02	3.2.8.2 3.2.9.2 3.2.11 to 3.2.16 3.2.23
7	o RF generator 1 MHz to 1 GHz 5 µV to 1 V AM and FM modulation • RF generator	 SMG SMPC	 801.0001.52 300.1000.55	3.2.17 3.2.19 to 3.2.22 3.2.25

Item No.	o Instrument type, required specifications • Recommended R&S instrument	Type	Order No.	Application Section
8	o RF power amplifier 1 to 1000 MHz up to 50 W Z = 50 Ω			3.2.18
9	o Selective-call encoder • Selective-call encoder	 SCUD	 393.7110.02	3.2.25
10	o IEC-bus controller IEC 625 standard • IEC-bus controller	 PUC or PCA5	 344.8900.14 375.2010.02	

3.2 Testing the Rated Specifications

3.2.1 General

A self-test checking the significant instrument functions is carried out when the instrument is switched on.

The self-check menu provides the following calibration routines:

- Measurement of the battery voltage
- Calibration of the power meter
- Calibration of the RF synthesizer deviation
- Calibration of amplitude and offset of the modulation generator
- Calibration of the modulation generator filter
- Calibration of RMS meter
- Calibration of distortion meter
- Calibration of peak value meter

Befor testing the rated specifications all calibrations should better be carried out after the warm-up period.

All keys with acoustic acknowledgement, the variation spinwheel and the display illumination can also be checked.

3.2.2 Reference Frequency

- Connect calibrated RF counter to the RF IN/OUT connector
- Receiver test:
  -3 dBm, 1000 MHz, unmodulated

Instrument without CMS-B1 Option:

- Frequency accuracy: 1×10^{-6}

Instrument with CMS-B1 Option:

- The warm-up time for the CMS should be at least 15 minutes (crystal oscillator, OCXO)
- Frequency accuracy: 1×10^{-7}

3.2.3 Frequency Setting and Harmonics and Non-harmonics Ratio

- Connect the spectrum analyzer to the RF IN/OUT connector
- Receiver test: -3 dBm, unmodulated
- Set the following frequencies:
  1000 MHz, 700 MHz, 500 MHz, 240 MHz, 220 MHz, 200 MHz, 100 MHz, 50 MHz, 10 MHz, 2 MHz and 0,4 MHz
- Check the frequency accuracy
- Check the harmonic ratio (> 25 dBc)
- Check the non-harmonic ratio especially in the 200 to 250 MHz range (> 50 dBc)
- Check the non-harmonic ratio near the carrier (1 kHz) with odd frequencies (e.g 500.001 MHz)

3.2.4 Spurious FM and AM

- Connect the modulation meter to the RF IN/OUT connector
- Receiver test: -3 dBm, unmodulated
- Measure the spurious FM or AM by switching on the CCITT filter or the bandwidth filter 30 Hz to 20 kHz and RMS weighting on the modulation meter.

Carrier frequency	Spurious AM CCITT	Spurious AM 30 Hz to 20 kHz
1000 MHz	<10 Hz	<40 Hz
751 MHz	<10 Hz	<40 Hz
749 MHz	<10 Hz	<40 Hz
501 MHz	<10 Hz	<40 Hz
490 MHz	<5 Hz	<20 Hz
260 MHz	<5 Hz	<20 Hz
100 MHz	<10 Hz	<40 Hz
5 MHz	<10 Hz	<40 Hz

Carrier frequency	Spurious AM CCITT	Spurious AM 30 Hz to 20 kHz
1000 MHz	<0.03 %	<0.3 %
30 MHz	<0,03 %	<0,3 %
0.4 MHz	<0.03 %	<0.3 %

3.2.5 RF Frequency Response of the Output Level

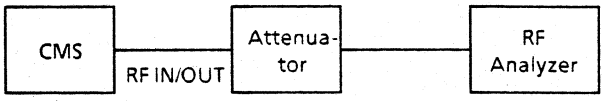
- Connect the power meter to the RF IN/OUT connector
- Receiver test -3dBm, unmodulated
- Set carrier frequencies between 0.4 and 1000 MHz
- The deviation from the rated value must not exceed 1 dB

3.2.6 Fine Level Setting

- Connect the power meter to the RF IN/OUT connector
- Receiver test: -3 dBm, 30 MHz, unmodulated
- Reduce the RF level by 10 dB and by 10.9 dB using the VAR spinwheel (fine level setting)
- The deviation from the rated value must not exceed 1 dB.

3.2.7 RF Attenuator

Test setup:



- Receiver test: 30 MHz, unmodulated
- Set the RF analyzer to the 10-µV range (1 dB/div) 30 MHz center with 15 kHz bandwidth.

CMS level	Attenuation of attenuator	permissible deviation
-3 dBm	94.5 dB	Bezug
-10.5 dBm	87 dB	<1 dB
-18 dBm	79.5 dB	<1 dB
-23 dBm	74.5 dB	<1 dB
-25.5 dBm	72 dB	<1 dB
-33 dBm	64.5 dB	<1 dB
-43 dBm	54.5 dB	<1 dB
-53 dBm	44.5 dB	<1 dB
-63 dBm	34.5 dB	<1 dB
-73 dBm	24.5 dB	<1 dB
-80.5 dBm	17 dB	<1 dB
-87.5 dBm	10 dB	<1 dB

3.2.8 FM Modulation

3.2.8.1 Internal FM Modulation

Notes:

The internal ϕM modulation is calculated from the FM mdoulation and must not be individually checked.

Multitone modulations with FM, ϕM and AM must not be checked individually, since they are digitally added in the computer.

- Connect the modulation analyzer to the RF IN/OUT connector
  (broadband, peak weighting)

RF frequency response:

- Receiver test: -3 dBm, 25 kHz deviation at 1 kHz AF frequency
- Measure the FM deviation with the following RF frequencies;
  500, 540 to 740, 760, 800 to 960 and 1000 MHz
- The deviation from the rated value must not exceed 2%.

AF frequency response:

- Receiver test: -3 dBm, 600 MHz, 25 kHz FM deviation
- Measure the FM deviation with the following AF frequencies:
  20 Hz, 100 Hz, 300 Hz, 1 kHz, 3 kHz, 5 kHz, 10 kHz, 15 kHz, 20 kHz
- A deviation of 2% referred to the value at 1 kHz is permissible

FM deviation divider

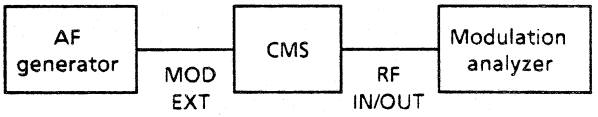
- Receiver test: -3 dBm, 600 MHz, frequency modulation with an AF frequency of 1 kHz
- Set the following modulation deviations:
  50 kHz, 25 kHz, 10 kHz, 5 kHz, 2 kHz, 1 kHz, 500 Hz, 200 Hz, 100 Hz, 50 Hz and 20 Hz
- The set modulation deviations must not vary more than 5% from the rated value. The deviation may exceed 5% for modulation deviations below 200 Hz due to the spurious FM.

FM distortion factor:

- Receiver test: -3 dBm, 600 MHz, frequency modulation with an AF frequency of 1 kHz
- The modulation distortion is below 1% with deviations below 10 kHz.

3.2.8.2 External FM Modulation

Test setup:



- Receiver test: -3 dBm, 600 MHz, external FM modulation with 1.41 V_s with 25 kHz deviation
- Apply $1V_{rms}$ with the following frequencies: 20 Hz, 300 Hz, 1 kHz, 3 kHz, 10 kHz and 20 kHz
- The deviation from the rated value must not exceed 5%

- Receiver test: -3 dBm, 600 MHz, external FM modulation with EXT CAL and 25 kHz deviation
- Set the NF generator to 1 kHz and the levels 50 mV and $1V_{rms}$, then calibrate using softkey MOD EXT CAL.
- In addition to the deviation from the rated value a calibration error may occur (< 5%). The guaranteed data sheet values with respect to the modulation do not include the external modulation with calibration. The correct calibration function with external AM modulation is also guaranteed with this check.

3.2.9 AM Modulation

3.2.9.1 Internal AM Modulation

- Connect the modulation analyzer to the RF IN/OUT connector
  (broadband, peak weighting)

RF frequency response:

- Receiver test: -15 dBm, 80 % AM modulation with 1 kHz AF frequency
- Measure the modulation depth with the following frequencies:
  0.4 MHz, 1 MHz, 5 MHz, 30 MHz, 100 MHz, 200 MHz, 400 MHz, 600 MHz, 800 MHz, 1000 MHz
- The deviation from the rated value must not exceed 2%.

AM error:

- Receiver test: -15 dBm, 30 MHz

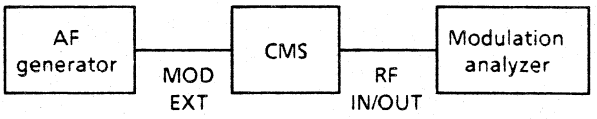
Modulation depth	AF frequency	max.deviation from rated value
1 %	1 kHz	100 %
5 %	1 kHz	50 %
10 %	1 kHz	10 %
30 %	300 Hz	3 %
30 %	1 kHz	3 %
30 %	3 kHz	3 %
80 %	300 Hz	3 %
80 %	1 kHz	3 %
80 %	3 kHz	3 %

AM distortion:

- Receiver test: -15 dBm, 80 % modulation depth with 1 kHz AF frequency
- The modulation distortion is to be measured with the following RF frequencies:
  0.4 MHz, 1 MHz, 5 MHz, 30 MHz, 100 MHz, 200 MHz, 400 MHz, 600 MHz, 800 MHz, 1000 MHz
- The distortion must be below 2%.

3.2.9.2 External AM Modulation

Test setup:



- Receiver test: -9 dBm, 30 MHz , external AM modulation with 1.41 V_p and 80 % AM
- Feed 1 V_{rms} with the following AF frequencies:
  300 Hz, 1 kHz, 3 kHz
- The deviation from the rated value must not exceed 5%.

3.2.10 Modulation Generator

Notes:

The generation of selective-call sequences is also checked with this test.

The two-tone modulation must not be checked individually, since it is digitally generated in the controller.

Frequency setting and accuracy:

- Connect AF counter to the MOD GEN connector
- Transmitter test: AF level 1000 mV
- Set the following AF frequencies:
  20 Hz, 999.9 Hz, 1 kHz, 1.0001 kHz, 19.9999 kHz, 20 kHz
- Maximum deviation with 0.1 Hz resolution:
  ± 1 digit

Distortion factor of the modulation generator:

- Connect a distortion meter to the MOD GEN output

AF frequency	AF level	Load resistance
20 Hz	70 mV	100 kΩ
20 Hz	70 mV	50 Ω
20 Hz	5 V	100 kΩ
20 Hz	5 V	350 Ω
1 kHz	70 mV	100 kΩ
1 kHz	70 mV	50 Ω
1 kHz	5 V	100 kΩ
1 kHz	5 V	350 Ω
20 kHz	70 mV	100 kΩ
20 kHz	70 mV	50 Ω
20 kHz	5 V	100 kΩ
20 kHz	5 V	350 Ω

- The distortion must be below 0.5%.

AF frequency response:

- Connect an AF voltmeter to the MOD GEN output
- Transmitter test: AF level 1000 mV
- Measure the AF level with the following frequencies:
  20 Hz, 100 Hz, 300 Hz, 1 kHz, 3 kHz, 5 kHz, 10 kHz, 15 kHz, 20 kHz
- The deviation from the rated value must not exceed 3%

Output voltage of the modulation generator:

- Connect an AF voltmeter to the MOD GEN output
- Transmitter test: AF frequency 1 kHz
- Set the following AF levels:
  1 mV, 10 mV, 50 mV, 100 mV, 200 mV, 500 mV, 1 V, 2 V, 3 V, 4 V, 5 V
- The deviation from the rated value should not exceed 2.5%.

3.2.11 AF Voltmeter

Note:

Only the RMS rectifier is checked with AF voltmeter test, whereas the demodulator test only includes a check of the peak rectifier.

- Connect an AF generator to the AF/SCOPE input

AF frequency response:

- Receiver test: Start AF voltmeter test (rms weighting)
- Apply signals with a 1 V amplitude and the following frequencies to the AF/SOPE input:
  50 Hz, 100 Hz, 300 Hz, 1 kHz, 3 kHz, 5 kHz, 10 kHz, 15 kHz, 20 kHz
- The max. deviation may be 2.5%.

Measuring accuracy with reference to the input level:

- Receiver test: Start AF voltmeter measurement (rms weighting)
- Apply signals with 1 kHz frequency and the following amplitudes to the AF/SCOPE input:
  1 mV, 5 mV, 10 mV, 50 mV, 100 mV, 500 mV, 1 V, 5 V, 10 V, 30 V
- The max. deviation may be 3.5%.

3.2.12 Lowpass and Highpass Filter

- Connect an AF generator to the AF/SCOPE input
- Receiver test: start AF voltmeter test (rms weighting)
- Apply a signal with a $1V_{rms}$ amplitude to AF/SCOPE
- Switch on 3.4 kHz lowpass filter

Frequency	Attenuation
300 Hz	<1 dB
1 kHz	<1 dB
2 kHz	<1 dB
3.4 kHz	<1 dB
10 kHz	>37 dB
13.6 kHz	>40 dB

- Switch off lowpass filter and switch on 300 Hz highpass filter

Frequency	Attenuation
20 kHz	<1 dB
10 kHz	<1 dB
5 kHz	<1 dB
1 kHz	<1 dB
300 Hz	<1 dB
200 Hz	>37 dB
150 Hz	>40 dB

3.2.13 Resonance Filter

- Connect an AF generator to the AF/SCOPE input
- Receiver test: start AF voltmeter test (rms weighting)
- Apply a signal with a 1 V_{rms} amplitude to the AF/SCOPE input
- Switch on the narrowband bandpass filter (resonance filter)

Center frequency of the resonance filter	Signal frequency	Attenuation
100 Hz	80 Hz	>40 dB
100 Hz	100 Hz	<1 dB
100 Hz	120 Hz	>40 dB
1 kHz	800 Hz	>40 dB
1 kHz	1 kHz	<1 dB
1 kHz	1.2 kHz	>40 dB
4 kHz	3.2 kHz	>40 dB
4 kHz	4 kHz	<1 dB
4 kHz	4.8 kHz	>40 dB

3.2.14 Psophometric Filter

- Connect an AF generator to the AF/SOPE input
- Receiver test: Start AF voltmeter test (rms weighting)
- Apply a signal with an 1 V_{rms} amplitude to this input
- Switch on the CCITT filter or C-message filter

CCITT filter:

Frequency	Rated attenuation	Tolerance
50 Hz	-63 dB	2 dB
150 Hz	-29 dB	2 dB
300 Hz	-10,6 dB	1 dB
600 Hz	-2 dB	1 dB
800 Hz	0 dB	0.1 dB (reference)
1 kHz	+ 1 dB	1 dB
2 kHz	-3 dB	1 dB
3 kHz	-5,6 dB	1 dB
4 kHz	-15 dB	3 dB
5 kHz	-36 dB	3 dB

C-message filter:

Frequency	Rated attenuation	Tolerance
60 Hz	-55.7 dB	2 dB
100 Hz	-42.5 dB	2 dB
200 Hz	-25 dB	2 dB
300 Hz	-16.5 dB	1 dB
500 Hz	-7.5 dB	1 dB
800 Hz	-1.5 dB	1 dB
1 kHz	0 dB	0.1 dB (reference)
2 kHz	-1.3 dB	1 dB
3 kHz	-2.5 dB	2 dB
4 kHz	-14.5 dB	3 dB
5 kHz	-28.5 dB	3 dB

3.2.15 Distortion Meter

Note:

This test includes a check of the SINAD meter.

Inherent distortion:

- Apply a distortion-free AF signal to the AF/SCOPE input
- Receiver test: call distortion measurement (DIST)
- Select the following signal and test frequencies:
  100 Hz, 400 Hz, 600 Hz, 1 kHz, 2 kHz, 4 kHz
- The distortion factor displayed must not exceed 0.5%

Display accuracy of the distortion meter:

- Connect two AF generators to the AF/SCOPE input via two decoupling resistors
- Receiver test: call distortion measurement (DIST)
- Select a center frequency of 1 kHz
- Set the first AF generator to 1 kHz (1 V_{rms} amplitude)
- Set second AF generator to 3 kHz

Amplitude of 2nd AF generator	Permissible measured value
100 mV	9 to 11 %
30 mV	2.35 to 3.65 %
10 mV	0.45 to 1.55 %

3.2.16 AF Counter

- Connect an AF generator to the AF/SCOPE input
- Receiver test: call AF counting by pressing the COUNT softkey, resolution 0.1 Hz
- Set an amplitude of 1 V_{rms} on the AF generator
- Apply the following frequencies:
  20 Hz, 100 Hz, 1 kHz, 10 kHz, 20 kHz, 100 kHz, 500 kHz
- The max. error should be 1 digit
- Select a resolution of 1 Hz
- Select the following generator settings for a functional check:

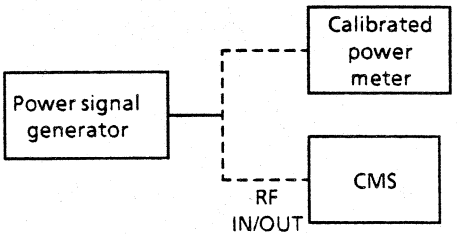
Frequency	Amplitude
20 Hz	10 mV
20 Hz	1 V
1 kHz	10 mV
1 kHz	1 V
3 kHz	10 mV
3 kHz	1 V
20 kHz	10 mV
20 kHz	1 V
100 kHz	50 mV
100 kHz	1 V
500 kHz	100 mV
500 kHz	1 V

3.2.17 RF Counter

- Connect an RF synthesizer to the RF IN/OUT connector
- Transmitter test: call RF counter by actuating the COUNT softkey
- Apply the following unmodulated signals with a 7dBm level:
  0.5 MHz, 1 MHz, 10 MHz, 100 MHz, 150 MHz, 300 MHz, 500 MHz, 800 MHz, 1000 MHz
- Inaccuracies of the reference frequency must be taken into consideration.

3.2.18 Power Meter

Test setup:



- Transmitter test: call power measurement by pressing the POWER softkey
- Alternately connect an unmodulated power signal generator to a calibrated power meter and to the CMS (RF IN/OUT connector)
- Measure with the following levels and frequencies set:
  13 dBm, 20 dBm, 47 dBm
  1.5 MHz, 20 MHz, 500 MHz, 1000 MHz
- Compare the two measured values. The deviation must not exceed 0.4 dB.

3.2.19 Automatic Switchover with Incoming Power

- Receiver test: 0 dBm
- Connect an RF synthesizer to the RF IN/OUT connector
- Slowly increase the level of the RF synthesizer from 0 dBm to 20 dBm
- The instrument switches over to transmitter test. The attenuator switches audibly.
- A low RF level is output when the RF synthesizer is removed.

3.2.20 Frequency Deviation Meter

Note:

The deviation meter test checks the peak rectifier. The rms rectifier was checked with AF voltmeter test.

Inherent residual FM of the deviation meter:

- Connect an RF synthesizer to the RF IN/OUT input (unmodulated, 13 dBm RF level)
- Transmitter test: call RF counter and frequency deviation meter
- Connect an AF voltmeter (rms weighting with CCITT filter) to the DEMOD output
- Apply the following RF frequencies:
  1000 MHz, 875 MHz, 751 MHz, 749 MHz, 625 MHz, 501 MHz
- The measured voltage must be below 0.35 mV_{rms}

Check of the mixing oscillator:

- Connect an RF synthesizer with an RF level of 13 dBm and an FM deviation of 10 kHz at 800 Hz AF frequency to the RF IN/OUT connector
- Transmitter test: call RF counter by pressing the COUNT softkey. Call the frequency deviation meter.
- Apply the following RF frequencies and check the correct function (using deviation reading, scope, loudspeaker):
  500 MHz, 251 MHz, 250 MHz, 126 MHz, 125 MHz, 63.5 MHz, 62.5 MHz, 32.5 MHz, 31.5 MHz, 30 MHz, 1.5 MHz

AF frequency response of the frequency deviation meter:

- Connect an RF synthesizer to the RF IN/OUT connector
  (50 MHz, 13 dBm, 10 kHz FM deviation)
- Transmitter test: call the frequency deviation meter (peak weighting)
- Set the following modulation frequencies on the RF synthesizer:
  20 Hz, 100 Hz, 300 Hz, 1 kHz, 3 kHz, 10 kHz, 15 kHz, 20 kHz
- The deviation reading should not exceed 2.5%

Deviation meter accuracy:

- Connect an RF synthesizer to the RF IN/OUT connector
  (50 MHz, 13 dBm, frequency modulation with 800 Hz AF frequency)
- Transmitter test: call the frequency deviation meter (peak weighting)
- Set the following FM deviations on the RF synthesizer:
  100 kHz, 50 kHz, 20 kHz, 10 kHz, 5 kHz, 1 kHz
- The deviation from the rated value should not exceed 3.5% (with 1 kHz deviation the 3.5% may be exceeded due to the residual FM)

3.2.21 Phase Deviation Meter

- Connect an RF synthesizer to the RF IN/OUT connector
  (50 MHz, 13 dBm, ϕM modulation with 2.5 rad)
- Transmitter test: call the phase deviation meter (peak weighting)
- Set the following modulation frequencies on the synthesizer:
  300 Hz, 600 Hz, 1kHz, 2 kHz, 4 kHz, 6 kHz
- The deviation reading must not exceed 4.5% from the rated value.

3.2.22 AM Meter

Inherent residual AM:

- Connect an RF synthesizer to the RF IN2 connector (unmodulated, 5 mV RF level)
- Transmitter test: call modulation depth meter, preset the respective RF frequency using the softkey SET RF
- Connect an AF voltmeter to the DEMOD output (rms weighting with CCITT filter)
- Set the following RF frequencies on the RF synthesizer and on the CMS:
  1.5 MHz, 100 MHz, 500 MHz, 1000 MHz
- The measured voltage must be below 1 mV_{rms}

AF frequency response of the modulation depth meter:

- Connect RF synthesizer to the RF IN 2 connector (5 mV, 30 MHz, 80 % AM modulation)
- Transmitter test: call modulation depth meter (peak weighting), set RF frequency to 30 MHz (SET RF)
- Set the following modulation frequencies on the RF synthesizer:
  50 Hz, 300 Hz, 1 kHz, 3 kHz, 10 kHz, 15 kHz, 20 kHz
- The deviation reading must not exceed 3.5%.

Accuracy of the modulation depth meter:

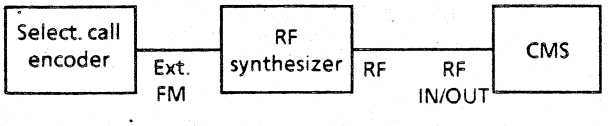
- Connect the RF synthesizer to the RF IN 2 connector (5 mV, 30 MHz, modulation frequency 800 Hz)
- Transmitter test: call modulation depth meter (peak weighting), set RF frequency to 30 MHz (SET RF)
- Set the following modulation depths on the RF synthesizer:
  80%, 50%, 30%, 20%, 10%, 5%
- The modulation depth should not vary more than 5% from the rated value.

3.2.23 Oscilloscope and Loudspeaker

- Connect an AF generator to the AF/SCOPE input
- Receiver test: AF signal to scope
- Apply a 1-kHz signal and check all amplitude scales (2 mV/div to 10 V/div) by varying the input level
- Apply an AF signal of 1 V_{rms} and check all time base settings (50 ms/div to 0.05 ms/div) by varying the input frequency
- Set the scope scale such that the loudspeaker can easily be checked with various frequencies and positions of the VOLUME control.

3.2.24 DTMF Decoder

Test setup:



- Transmitter test: Decode
- Functional check: Press the DECODE key, send the selective-call sequence. It is then output on the CMS display after the sequence has been decoded.

3.2.25 DC Voltage and Current Measurements

- Apply the following voltages to the connectors V_{DC} :

  + 20 V
  - 20 V
  + 2 V
  - 2 V
  + 200 mV
  - 200 mV

- The voltage value read out in the display must not deviate by more than 1%.
- Impress the following currents (connectors I_{DC}):

  + 10 A
  - 10 A
  + 1 A
  - 1 A
  + 100 mA
  - 100 mA

- The current value read out in the display must not deviate by more than 4%.

3.2.26 RF Spectrum Monitor

Functional test:

- Connect unmodulated RF synthesizer to the RF IN/OUT connector (100 MHz, -10 dBm)
- Select the SPECT menu
- RF ATT 0 dB, REF LEV -7 dBm, CENTER 100 MHz
- Test the functioning at the following frequency spans and filter bandwidths:

Filter bandwidth	Span
50 kHz	6 MHz
16 kHz	3 MHz
6 kHz	1 MHz
150 Hz	20 kHz

Testing the dynamic range of the display:

- Apply no signal
- Setting as follows:

  INPUT 1

  RF ATT 0 dB

  REF LEV -7 dBm

  Frequency span 20 kHz

  Filter bandwidth 150 Hz

  Center frequency 1000 MHz
- Dynamic range of display must exceed 60 dB
- Same setting as above, but

  INPUT 2

  and REF LEV -27 dBm
- Dynamic range of display must exceed 60 dB

Testing the RF frequency response:

- Connect unmodulated RF synthesizer to connector RF IN/OUT (-10 dBm)
- RF ATT 0 dB, REF LEV -7 dBm, filter bandwidth 6 kHz
- Test the RF level display at the following frequencies (modify RF synthesizer and center frequency for this purpose):

  1 MHz, 10 MHz, 50 MHz, 100 MHz, 300 MHz, 500 MHz, 700 MHz, 900 MHz, 1000 MHz
- The level error must be below 3 dB.

3.3 Performance Test Report

Rohde & Schwarz
RADIOCOMMUNICATION SERVICE MONITOR CMS
Id. No. 840.0009.52
Serial No.. .....

Date .....
Name .....

Item No.	Characteristic	Measure-ment to section	Min.	Actual value	Max.	Unit
1	Self check, calibration, keyboard, VAR spin-wheel, backlighting, acoustic acknowledge-ment	3.2.1	-	.....	-	-
2	Reference frequency without CMS-B1 option with CMS-B1 option	3.2.2	 -1000 -100		 + 1000 + 100	 Hz Hz
3	Frequency setting	3.2.3	For deviation of the reference frequency refer to item No. 2		For deviation of the reference frequency refer to item No. 2	
	1000 MHz		.....	.....	.....	MHz
	700 MHz		.....	.....	.....	MHz
	500 MHz		.....	.....	.....	MHz
	240 MHz		.....	.....	.....	MHz
	220 MHz		.....	.....	.....	MHz
	200 MHz		.....	.....	.....	MHz
	100 MHz		.....	.....	.....	MHz
	50 MHz		.....	.....	.....	MHz
	10 MHz		.....	.....	.....	MHz
	2 MHz		.....	.....	.....	MHz
	0.4 MHz		.....	.....	.....	MHz
	Harmonic rejection					
	1000 MHz		-	.....	<25	dBc
	700 MHz		-	.....	<25	dBc
	500 MHz		-	.....	<25	dBc
	240 MHz		-	.....	<25	dBc
	220 MHz		-	.....	<25	dBc
	200 MHz		-	.....	<25	dBc
	100 MHz		-	.....	<25	dBc
	50 MHz		-	.....	<25	dBc
	10 MHz		-	.....	<25	dBc
	2 MHz		-	.....	<25	dBc
	0.4 MHz		-	.....	<25	dBc

Item No.	Characteristic	Measure-ment to section	Min.	Actual value	Max.	Unit
3	Non-harmonic rejection	3.2.3				
	1000 MHz		-	.....	<50	dBc
	700 MHz		-	.....	<50	dBc
	500 MHz		-	.....	<50	dBc
	240 MHz		-	.....	<50	dBc
	220 MHz		-	.....	<50	dBc
	200 MHz		-	.....	<50	dBc
	100 MHz		-	.....	<50	dBc
	50 MHz		-	.....	<50	dBc
	10 MHz		-	.....	<50	dBc
	2 MHz		-	.....	<50	dBc
	0.4 MHz		-	.....	<50	dBc
	500.001 MHz		-	.....	<50	dBc
4	Spurious FM (CCITT)	3.2.4				
	1000 MHz		-	.....	10	Hz
	751 MHz		-	.....	10	Hz
	749 MHz		-	.....	10	Hz
	501 MHz		-	.....	10	Hz
	490 MHz		-	.....	5	Hz
	260 MHz		-	.....	5	Hz
	100 MHz		-	.....	10	Hz
	5 MHz		-	.....	10	Hz
	Spurious FM (30 Hz to 20 kHz)					
	1000 MHz		-	.....	40	Hz
	751 MHz		-	.....	40	Hz
	749 MHz		-	.....	40	Hz
	501 MHz		-	.....	40	Hz
	490 MHz		-	.....	20	Hz
	260 MHz		-	.....	20	Hz
	100 MHz		-	.....	40	Hz
	5 MHz		-	.....	40	Hz
	Spurious AM (CCITT)					
	1000 MHz		-	.....	0.03	%
	30 MHz		-	.....	0.03	%
	0.4 MHz		-	.....	0.03	%
	Spurious AM (30 Hz to 20 kHz)					
	1000 MHz		-	.....	0.3	%
	30 MHz		-	.....	0.3	%
	0.4 MHz		-	.....	0.3	%

Item No.	Characteristic	Measure-ment to section	Min.	Actual value	Max.	Unit
5	Frequency response of the RF output level	3.2.5				
	1000 MHz		-4	.....	-2	dBm
	800 MHz		-4	.....	-2	dBm
	600 MHz		-4	.....	-2	dBm
	400 MHz		-4	.....	-2	dBm
	200 MHz		-4	.....	-2	dBm
	100 MHz		-4	.....	-2	dBm
	50 MHz		-4	.....	-2	dBm
	10 MHz		-4	.....	-2	dBm
	1 MHz		-4	.....	-2	dBm
	0.4 MHz		-4	.....	-2	dBm
6	Fine level setting	3.2.6				
	0 dB			Reference		
	-10 dB		-9	.....	-11	dB
	-19.9 dB		-19	.....	-21	dB
7	RF attenuator CMS level	3.2.7				
	-3 dBm			Reference		
	-10.5 dBm		-1	.....	+1	dB
	-18 dBm		-1	.....	+1	dB
	-23 dBm		-1	.....	+1	dB
	-25.5 dBm		-1	.....	+1	dB
	-33 dBm		-1	.....	+1	dB
	-43 dBm		-1	.....	+1	dB
	-53 dBm		-1	.....	+1	dB
	-63 dBm		-1	.....	+1	dB
	-73 dBm		-1	.....	+1	dB
	-80.5 dBm		-1	.....	+1	dB
	-87.5 dBm		-1	.....	+1	dB
8	FM modulation RF frequency response	3.2.8.1				
	500 MHz		49	.....	51	kHz
	540 MHz		49	.....	51	kHz
	580 MHz		49	.....	51	kHz
	620 MHz		49	.....	51	kHz
	660 MHz		49	.....	51	kHz
	700 MHz		49	.....	51	kHz
	740 MHz		49	.....	51	kHz
	760 MHz		49	.....	51	kHz
	800 MHz		49	.....	51	kHz
	840 MHz		49	.....	51	kHz
	880 MHz		49	.....	51	kHz
	920 MHz		49	.....	51	kHz
	960 MHz		49	.....	51	kHz
	1000 MHz		49	.....	51	kHz

Item No.	Characteristic	Measure-ment to section	Min.	Actual value	Max.	Unit
8	AF frequency response	3.2.8.1				
	20 Hz		-2	.....	+2	%
	100 Hz		-2	.....	+2	%
	300 Hz		-2	.....	+2	%
	1 kHz			Reference		
	3 kHz		-2	.....	+2	%
	5 kHz		-2	.....	+2	%
	10 kHz		-2	.....	+2	%
	15 kHz		-2	.....	+2	%
	20 kHz		-2	.....	+2	%
	FM deviation divider					
	50 kHz		47.5	.....	52.5	kHz
	25 kHz		23.75	.....	26.25	kHz
	10 kHz		9.5	.....	10.5	kHz
	5 kHz		4.75	.....	5.25	kHz
	2 kHz		1.9	.....	2.1	kHz
	1 kHz		0.95	.....	1.05	kHz
	500 Hz		475	.....	524	Hz
	200 Hz		200	.....	230	Hz
	100 Hz		100	.....	130	Hz
	50 Hz		50	.....	80	Hz
	20 Hz		20	.....	50	Hz
	FM distortion					
	deviation 10 kHz		-	.....	<1	%
	deviation 1 kHz		-	.....	<1	%
9	External FM modulation AF frequency	3.2.8.2				
	20 Hz		47.5	.....	52.5	kHz
	300 Hz		47.5	.....	52.5	kHz
	1 kHz		47.5	.....	52.5	kHz
	3 kHz		47.5	.....	52.5	kHz
	10 kHz		47.5	.....	52.5	kHz
	20 kHz		47.5	.....	52.5	kHz
	Level					
	50 mV		40	.....	60	kHz
	200 mV		40	.....	60	kHz
	1 V		40	.....	60	kHz
10	AM modulation RF frequency response	3.2.9.1				
	0.4 MHz		78	.....	82	%
	1 MHz		78	.....	82	%
	5 MHz		78	.....	82	%
	30 MHz		78	.....	82	%
	100 MHz		78	.....	82	%
	200 MHz		78	.....	82	%
	400 MHz		78	.....	82	%
	600 MHz		78	.....	82	%
	800 MHz		78	.....	82	%
	1000 MHz		78	.....	82	%

Item No.	Characteristic	Measure-ment to section	Min.	Actual value	Max.	Unit
10	AM error	3.2.9.1				
	1 %, 1 kHz		1	.....	2	%
	5 %, 1 kHz		2.5	.....	7.5	%
	10 %, 1 kHz		9	.....	11	%
	30 %, 300 Hz		29.1	.....	30.9	%
	30 %, 1 kHz		29.1	.....	30.9	%
	30 %, 3 kHz		29.1	.....	30.9	%
	80 %, 300 Hz		77.5	.....	82.5	%
	80 %, 1 kHz		77.5	.....	82.5	%
	80 %, 3 kHz		77.5	.....	82.5	%
11	External AM modulation	3.2.9.2				
	300 Hz		76	.....	84	%
	1 kHz		76	.....	84	%
	3 kHz		76	.....	84	%
12	Modulation generator	3.2.10				
	Frequencies					
	20 Hz		19.9	.....	20.1	Hz
	999.9 Hz		999.8	.....	1000.0	Hz
	1 kHz		999.9	.....	1000.1	Hz
	1.0001 kHz		1.0000	.....	1.0002	kHz
	19.9999 kHz		19.9998	.....	20.0000	kHz
	20 kHz		19.9999	.....	20.0001	kHz
	Distortion					
	20 Hz Frequency					
	70 mV, 100 kΩ		-	.....	<0.5	%
	70 mV, 50 Ω		-	.....	<0.5	%
	5 V, 100 kΩ		-	.....	<0.5	%
	5 V, 350 Ω		-	.....	<0.5	%
	1 kHz frequency					
	70 mV, 100 kΩ		-	.....	<0.5	%
	70 mV, 50 Ω		-	.....	<0.5	%
	5 V, 100 kΩ		-	.....	<0.5	%
	5 V, 350 Ω		-	.....	<0.5	%
	20 kHz frequency					
	70 mV, 100 kΩ		-	.....	<0.5	%
	70 mV, 50 Ω		-	.....	<0.5	%
	5 V, 100 kΩ		-	.....	<0.5	%
	5 V, 350 Ω		-	.....	<0.5	%
	AF frequency response					
	20 Hz		970	.....	1030	mV
	100 Hz		970	.....	1030	mV
	300 Hz		970	.....	1030	mV
	1 kHz		970	.....	1030	mV
	3 kHz		970	.....	1030	mV
	5 kHz		970	.....	1030	mV
	10 kHz		970	.....	1030	mV
	15 kHz		970	.....	1030	mV
	20 kHz		970	.....	1030	mV

Item No.	Characteristic	Measure-ment to section	Min.	Actual value	Max.	Unit
12	Output voltage	3.2.10				
	1 mV		0.975	.....	1.025	mV
	10 mV		9.75	.....	10.25	mV
	50 mV		48.75	.....	51.25	mV
	100 mV		97.5	.....	102.5	mV
	200 mV		195	.....	205	mV
	500 mV		487.5	.....	512.5	mV
	1 V		0.975	.....	1.025	V
	2 V		1.95	.....	2.05	V
	3 V		2.925	.....	3.075	V
	4 V		3.9	.....	4.1	V
	5 V		4.875	.....	5.125	V
13	Frequency response of AF voltmeter	3.2.11	0.975	.....	1.025	V
	50 Hz		0.975	.....	1.025	V
	100 Hz		0.975	.....	1.025	V
	300 Hz		0.975	.....	1.025	V
	1 kHz		0.975	.....	1.025	V
	3 kHz		0.975	.....	1.025	V
	5 kHz		0.975	.....	1.025	V
	10 kHz		0.975	.....	1.025	V
	15 KHz		0.975	.....	1.025	V
	20 kHz		0.975	.....	1.025	V
	Input level					
	1 mV		0.965	.....	1.035	mV
	5 mV		4.825	.....	5.175	mV
	10 mV		9.65	.....	10.35	mV
	50 mV		48.25	.....	51.75	mV
	100 mV		96.5	.....	103.5	mV
	500 mV		482.5	.....	517.5	mV
	1 V		0.965	.....	1.035	V
	5 V		4.825	.....	5.175	V
	10 V		9.65	.....	10.35	V
	30 V		28.95	.....	31.05	V
14	Low pass filter	3.2.12				
	300 Hz		-	.....	<1	dB
	1 kHz		-	.....	<1	dB
	2 kHz		-	.....	<1	dB
	3,4 kHz		-	.....	<1	dB
	10 kHz		-	.....	>37	dB
	13.6 kHz		-	.....	>40	dB

Item No.	Characteristic	Measure-ment to section	Min.	Actual value	Max.	Unit
14	High pass filter	3.2.12				
	20 kHz		-	.....	<1	dB
	10 kHz		-	.....	<1	dB
	5 kHz		-	.....	<1	dB
	1 kHz		-	.....	<1	dB
	300 Hz		-	.....	<1	dB
	200 Hz		-	.....	>37	dB
	150 Hz		-	.....	>40	dB
15	Resonance filter	3.2.13				
	100 Hz, 80 Hz		-	.....	>40	dB
	100 Hz, 100 Hz		-	.....	<1	dB
	100 Hz, 120 Hz		-	.....	>40	dB
	1 kHz, 800 Hz		-	.....	>40	dB
	1 kHz, 1 kHz		-	.....	<1	dB
	1 kHz, 1.2 kHz		-	.....	>40	dB
	4 kHz, 3.2 kHz		-	.....	>40	dB
	4 kHz, 4 kHz		-	.....	<1	dB
	4 kHz, 4.8 kHz		-	.....	>40	dB
16	CCITT filter	3.2.14				
	50 Hz		-65	.....	-61	dB
	150 Hz		-31	.....	-27	dB
	300 Hz		-11.6	.....	-9.6	dB
	600 Hz		-3	.....	-1	dB
	800 Hz		Reference	.....	Reference	dB
	1 kHz		0	.....	2	dB
	2 kHz		-4	.....	-2	dB
	3 kHz		-6.6	.....	-4.6	dB
	4 kHz		-18	.....	-12	dB
	5 kHz		-39	.....	-33	dB
	C-message filter	3.2.14				
	60 Hz		-57.7	.....	-53.7	dB
	100 Hz		-44.5	.....	-40.5	dB
	200 Hz		-27	.....	-23	dB
	300 Hz		-17.5	.....	-15.5	dB
	500 Hz		-8.5	.....	-6.5	dB
	800 Hz		-2.5	.....	-0.5	dB
	1 kHz		Reference	.....	Reference	dB
	2 kHz		-2.3	.....	-0.3	dB
	3 kHz		-4.5	.....	-0.5	dB
	4 kHz		-17.5	.....	-11.5	dB
	5 kHz		-31.5	.....	-25.5	dB

Item No.	Characteristic	Measure-ment to section	Min.	Actual value	Max.	Unit
17	Distortion meter	3.2.15				
	Inherent distortion					
	100 Hz		-	.....	<0.5	%
	400 Hz		-	.....	<0.5	%
	600 Hz		-	.....	<0.5	%
	1 kHz		-	.....	<0.5	%
	2 kHz		-	.....	<0.5	%
	4 kHz		-	.....	<0.5	%
	Display accuracy					
	100 mV		9	.....	11	%
	30 mV		2.35	.....	3.65	%
	10 mV		0.45	.....	1.55	%
18	AF counter	3.2.16				
	20 Hz		19.9	.....	20.1	Hz
	100 Hz		99.9	.....	100.1	Hz
	1 kHz		999.9	.....	1000.1	Hz
	10 kHz		9.999	.....	10.001	kHz
	20 kHz		19.999	.....	20.001	kHz
	100 kHz		99.999	.....	100.001	kHz
	500 kHz		499.999	.....	500.001	kHz
	Functional test					
	20 Hz, 10 mV		-	.....	-	-
	20 Hz, 1 V		-	.....	-	-
	1 kHz, 10 mV		-	.....	-	-
	1 kHz, 1 V		-	.....	-	-
	3 kHz, 10 mV		-	.....	-	-
	3 kHz, 1 V		-	.....	-	-
	20 kHz, 10 mV		-	.....	-	-
	20 kHz, 1 V		-	.....	-	-
	100 kHz, 50 mV		-	.....	-	-
	100 kHz, 1 V		-	.....	-	-
	500 kHz, 100 mV		-	.....	-	-
	500 kHz, 1 V		-	.....	-	-
19	RF counter	3.2.17				
	0.5 MHz		-	.....	-	-
	1 MHz		-	.....	-	-
	10 MHz		-	.....	-	-
	100 MHz		-	.....	-	-
	150 MHz		-	.....	-	-
	300 MHz		-	.....	-	-
	500 MHz		-	.....	-	-
	800 MHz		-	.....	-	-
	1000 MHz		-	.....	-	-

Item No.	Characteristic	Measure-ment to section	Min.	Actual value	Max.	Unit
20	Power meter	3.2.18				
	Power stage 13 dBm					
	1.5 MHz		-	.....	<0.4	dB
	20 MHz		-	.....	<0.4	dB
	500 MHz		-	.....	<0.4	dB
	1000 MHz		-	.....	<0.4	dB
	Power stage 20 dBm					
	1.5 MHz		-	.....	<0.4	dB
	20 MHz		-	.....	<0.4	dB
	500 MHz		-	.....	<0.4	dB
	1000 MHz		-	.....	<0.4	dB
	Power stage 47 dBm					
	1.5 MHz		-	.....	<0.4	dB
	20 MHz		-	.....	<0.4	dB
	500 MHz		-	.....	<0.4	dB
	1000 MHz		-	.....	<0.4	dB
21	Switchover with in-coming power	3.2.19	-	.....	-	-
22	Frequency deviation meter	3.2.20				
	Residual FM		-	.....	<0.35	mV_{rms}
	1000 MHz		-	.....	<0.35	mV_{rms}
	875 MHz		-	.....	<0.35	mV_{rms}
	751 MHz		-	.....	<0.35	mV_{rms}
	749 MHz		-	.....	<0.35	mV_{rms}
	625 MHz		-	.....	<0.35	mV_{rms}
	501 MHz					
	Mixing oscillator		-	.....	-	-
	500 MHz		-	.....	-	-
	251 MHz		-	.....	-	-
	250 MHz		-	.....	-	-
	126 MHz		-	.....	-	-
	125 MHz		-	.....	-	-
	63.5 MHz		-	.....	-	-
	62.5 MHz		-	.....	-	-
	32.5 MHz		-	.....	-	-
	31.5 MHz		-	.....	-	-
	30 MHz		-	.....	-	-
	1.5 MHz					

Item No.	Characteristic	Measure-ment to section	Min.	Actual value	Max.	Unit
22	Frequency deviation meter	3.2.20				
	AF frequency response					
	20 Hz		9.75	.....	10.25	kHz
	100 Hz		9.75	.....	10.25	kHz
	300 Hz		9.75	.....	10.25	kHz
	1 kHz		9.75	.....	10.25	kHz
	3 kHz		9.75	.....	10.25	kHz
	10 kHz		9.75	.....	10.25	kHz
	15 kHz		9.75	.....	10.25	kHz
	20 kHz		9.75	.....	10.25	kHz
	Display accuracy					
	100 kHz		96.5	.....	103.5	kHz
	50 kHz		48.25	.....	51.75	kHz
	20 kHz		19.3	.....	20.7	kHz
	10 kHz		9.65	.....	10.35	kHz
	1 kHz		4.825	.....	5.175	kHz
			0.965	.....	1.035	kHz
23	Phase deviation meter	3.2.21				
	300 Hz		2.3875	.....	2.6125	rad
	600 Hz		2.3875	.....	2.6125	rad
	1 kHz		2.3875	.....	2.6125	rad
	2 kHz		2.3875	.....	2.6125	rad
	4 kHz		2.3875	.....	2.6125	rad
	6 kHz		2.3875	.....	2.6125	rad
24	AM meter	3.2.22				
	Residual AM					
	1.5 MHz		-	.....	<1	mV_{rms}
	100 MHz		-	.....	<1	mV_{rms}
	500 MHz		-	.....	<1	mV_{rms}
	1000 MHz		-	.....	<1	mV_{rms}
	AF frequency response					
	50 Hz		77.2	.....	82.5	%
	300 Hz		77.2	.....	82.5	%
	1 kHz		77.2	.....	82.5	%
	3 kHz		77.2	.....	82.5	%
	10 kHz		77.2	.....	82.5	%
	15 kHz		77.2	.....	82.5	%
	20 kHz		77.2	.....	82.5	%
	Display accuracy					
	80%		76	.....	84	%
	50%		47.5	.....	52.5	%
	30%		28.5	.....	31.5	%
	20%		19	.....	21	%
	10%		9.5	.....	10.5	%
	5%		4.75	.....	5.25	%

Item No.	Characteristic	Measure-ment to section	Min.	Actual value	Max.	Unit
25	Oscilloscope	3.2.23				
	Amplitude		-	.....	-	-
	Time base		-	.....	-	-
	Loudspeaker		-	.....	-	-
26	Two-tone decoder	3.2.24	-	.....	-	-
27	DC voltage measure-. ment	3.2.25	+ 19.8	.....	+ 20.2	V
			- 19.8	.....	- 20.2	V
			+ 1.98	.....	+ 2.02	V
			- 1.98	.....	- 2.02	V
			+ 198	.....	+ 202	mV
			- 198	.....	- 202	mV
28	DC current measurement	3.2.25	+ 9.96	.....	+ 10.4	A
			- 9.96	.....	- 10.4	A
			+ 0.996	.....	+ 1.04	A
			- 0.996	.....	- 1.04	A
			+ 99.6	.....	+ 104	mA
			- 99.6	.....	- 104	mA
29	RF spectrum monitor	3.2.26				
	Functional test					
	Filter bandwidth					
	50 kHz		-	.....	-	-
	16 kHz		-	.....	-	-
	6 kHz		-	.....	-	-
	150 Hz		-	.....	-	-
	Dynamic range of display					
	Input 1		-	.....	>60	dB
	Input 2		-	.....	>60	dB
	RF frequency response					
	1 MHz		- 7	.....	- 13	dBm
	10 MHz		- 7	.....	- 13	dBm
	50 MHz		- 7	.....	- 13	dBm
	100 MHz		- 7	.....	- 13	dBm
	300 MHz		- 7	.....	- 13	dBm
	500 MHz		- 7	.....	- 13	dBm
	700 MHz		- 7	.....	- 13	dBm
	900 MHz		- 7	.....	- 13	dBm
	1000 MHz		- 7	.....	- 13	dBm

3.4 Maintenance

3.4.1 Electrical Maintenance

The self-test initiated in the CMS each time it is switched on informs the user on the occurrence of any faults.

Various calibration routines can be started in the self-check menu. Calibration routines and self-tests which do not lead to an error message indicate that no errors are detected and the CMS functions properly.
The user may request readout of the battery voltage in the self-check menu to know exactly when the batteries need be replaced.

Readjustment of the reference frequency is recommended once a year (for adjustment see section 4 in the CMS Service Manual).

3.4.2 Mechanical Maintenance

No mechanical maintenance is required under normal operating conditions.

3.5. Storage

A storage temperature between - 40 and + 70 °C is allowed. It should be noted that storage at high temperatures reduces the service life of the batteries. Before starting operation of the instrument again the battery charge should be checked (self-check menu).

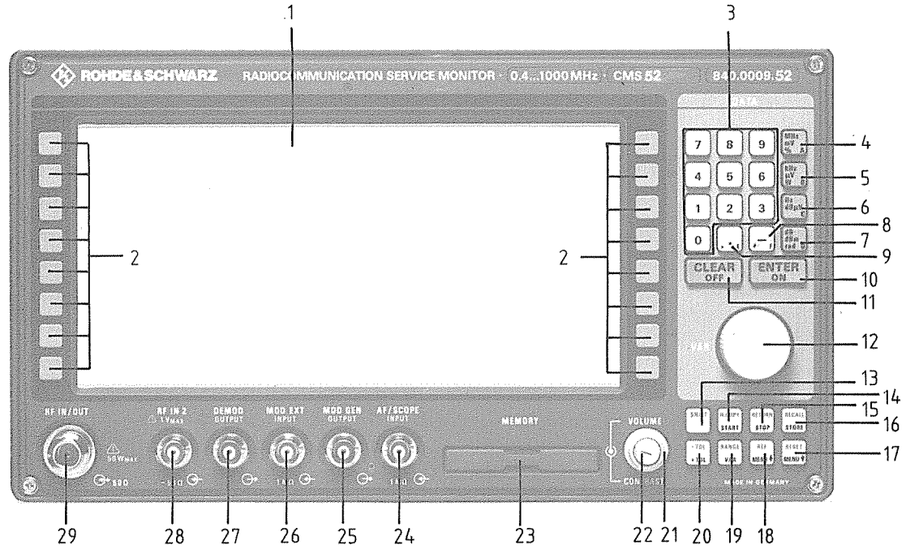


Bild 2-1 Frontansicht
Fig. 2-1 Front view

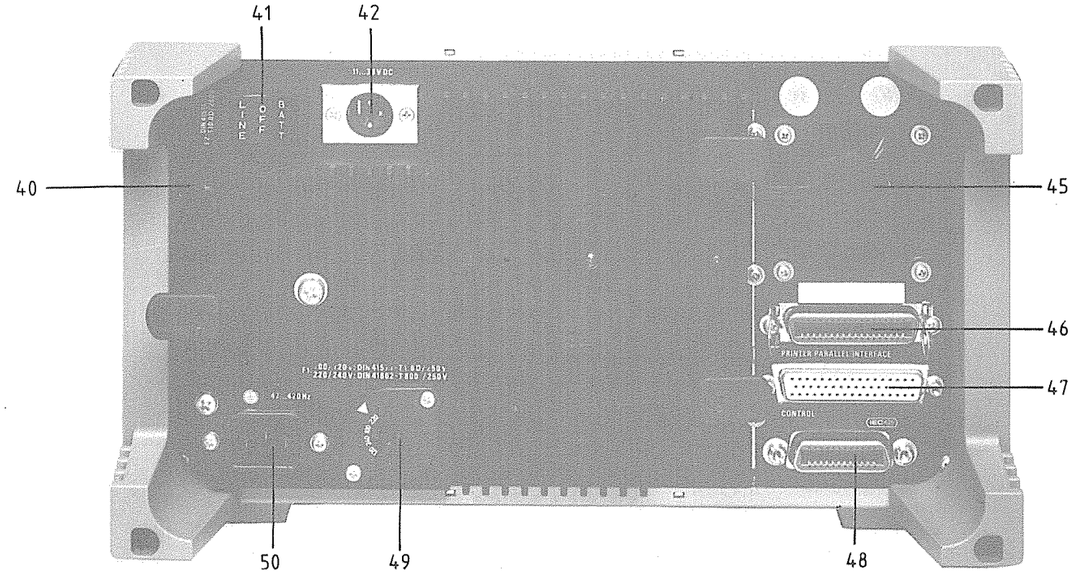


Bild 2-2 Rückansicht
Fig. 2-2 Rear view