Basic Instrument and Options

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1 RF Spectrum Analyzer

1.1 Spectrum Analyzer Main Menu
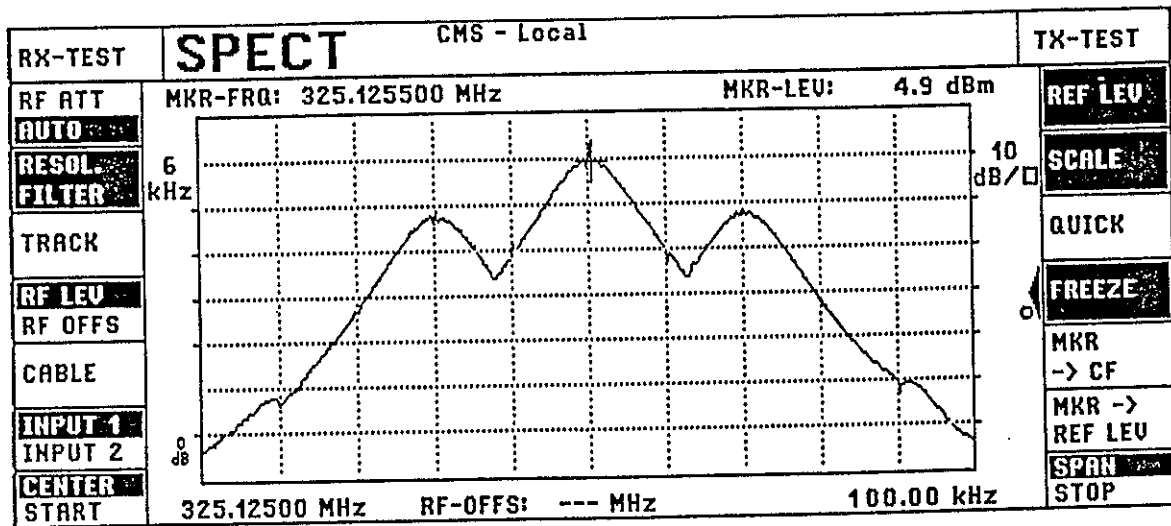
Fig. 1.1 Main menu of RF spectrum analyzer

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

In this menu, the CMS permits displaying modulation spectra within one or a few channels and observing the complete frequency spectrum in the range from 1 MHz to 1 GHz with a maximal span of 50 MHz.

The softkey 0 permits to branch directly into the main menu for the receiver test (RX-test), softkey 8 into the main menu for the transmitter test (TX-test).

In operating mode RF Spectrum analyzer, all RF functions of the instrument are made use of, even if the duplex synthesizer is installed. Thus no duplex operation is possible.

1.2 Functions of the Main Menu

1.2.1 Function RF Att/Auto

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

Changing from automatic setting to manual setting and vice versa is effected by pressing softkey 1. For measuring small voltages via the sensitive input connector RF IN 2, RF level matching is not possible. The functions RF ATT and AUTO are insignificant in this case.

Manual attenuation setting:

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

Automatic attenuation setting:

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

1.2.2 Function Resolution Filter

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

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

Span	Settable resolution filters				
2.4 kHz ... 30 kHz	150 Hz,	6 kHz,	16 kHz,	50 kHz	
30 kHz ... 1.2 MHz	6 kHz,	16 kHz,	50 kHz,	300 kHz,	1 MHz
1.2 MHz ... 3.2 MHz	16 kHz,	50 kHz,	300 kHz,	1 MHz,	3 MHz
3.2 MHz ... 10 MHz	50 kHz,	300 kHz,	1 MHz,	3 MHz,	
10 MHz ... 50 MHz	300 kHz,	1 MHz,	3 MHz,		

Table 1.1   Settable resolution filters depending on the frequency span set.

1.2.3 Function Tracking Mode (only if fitted with CMS-B9/-B59)

Softkey 3 permits to activate and deactivate the tracking mode (tracking generator). In this operating mode, an RF signal is output at the connector RF IN/OUT according to the span selected and the signal at the input connector RF IN 2 is displayed in the spectrum analyzer display. In this way, filter frequency responses can be recorded, for example.

Tracking mode is only possible if the CMS is provided with a duplex synthesizer. Besides, RF input 2 must be selected, because the test signal is generated at the connector RF IN/OUT.

The key RF LEV/RF OFFS is used in tracking mode. RF LEV indicates the level of the RF signal at the connector RF IN/OUT. The value corresponds to the setting of the RF transmitter level in the Rx or Dx test.

The function RF OFFS defines the frequency difference between the connector RF IN/OUT and the connector RF IN 2, e.g. for measurement on frequency-converting modules. The value may be positive or negative.

The settings for the RF level and the offset frequency are indicated in the upper display area as soon as the tracking key is active.
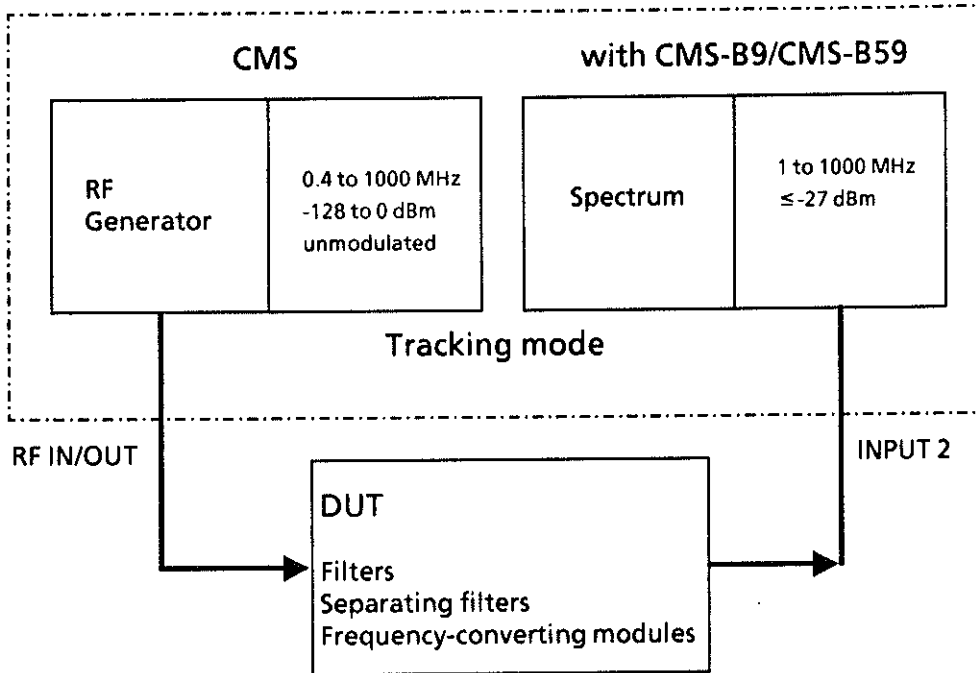
Fig. 1.2 Tracking mode

1.2.4   Function Cable (only if CMS-B9/B59 is fitted)

This function can be used to detect short circuits or open circuits in RF lines.

To carry out the measurement, connect the CMS as shown in Fig. 1.3.
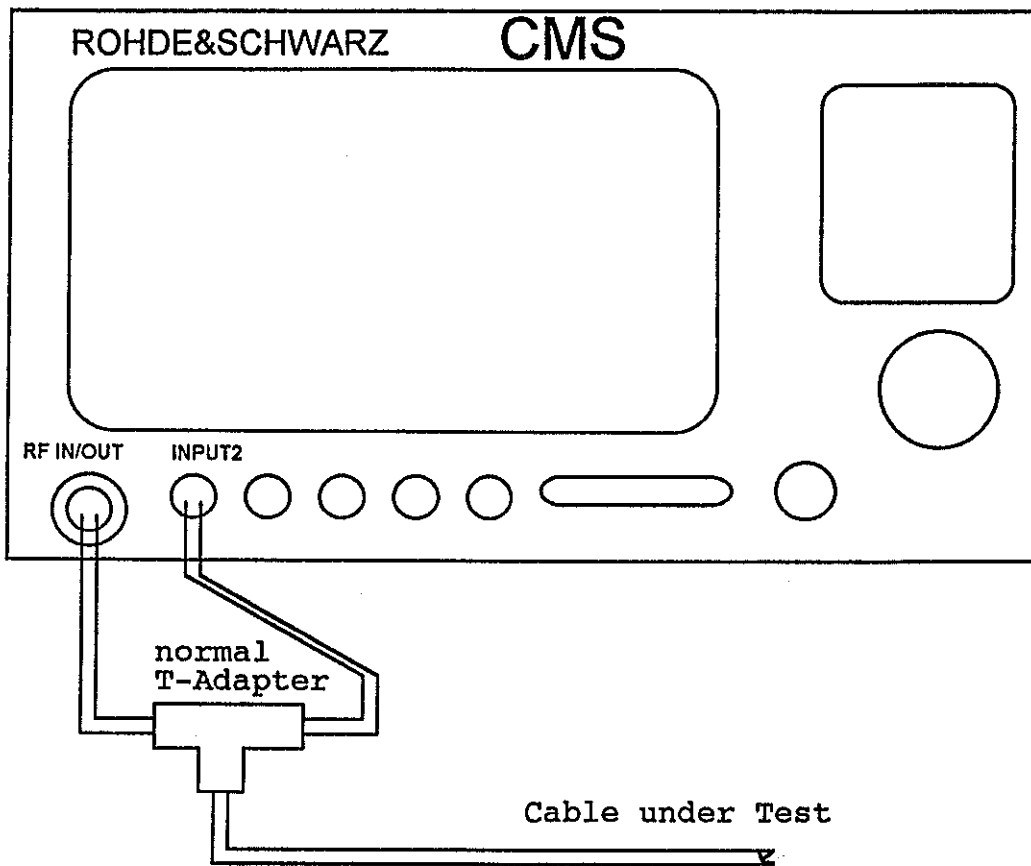
Fig. 1.3 Connection of the CMS for cable fault test

After the cable softkey has been pressed, the CMS activates the tracking mode and the following presettings are made:

starting frequency: 0.4 MHz
stop frequency: 200 MHz
RF input: INPUT2
reference level: -27 dBm
RF transmitter level: -37 dBm

In addition, the FREEZE key is activated so that recording is stopped after the first build-up of the display and the picture can be analyzed by the user.

Depending on whether there is a short circuit or an open circuit, the curves will be different:
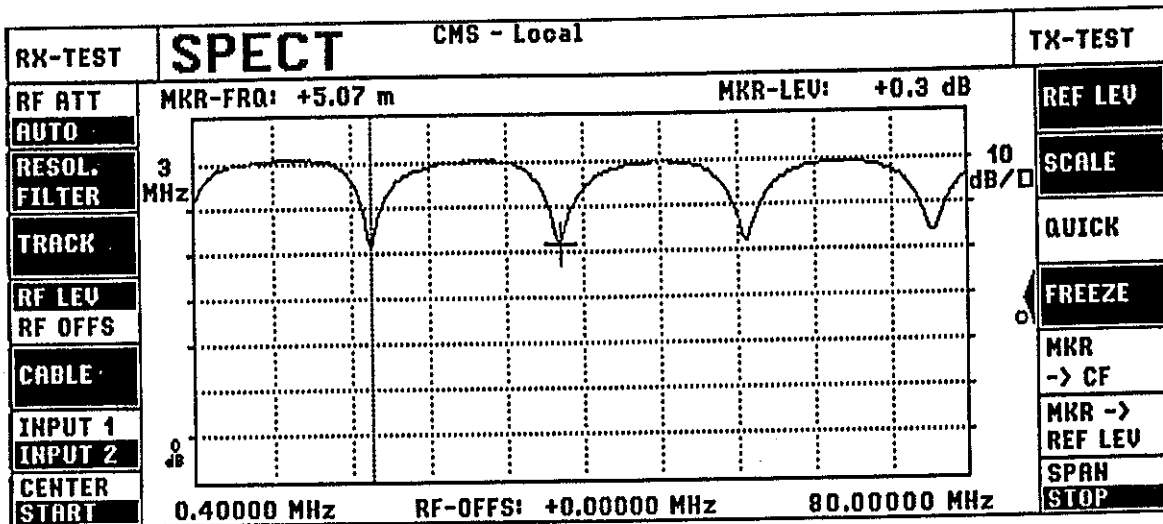
Fig. 1.4 Short circuit at a distance of 5 m.
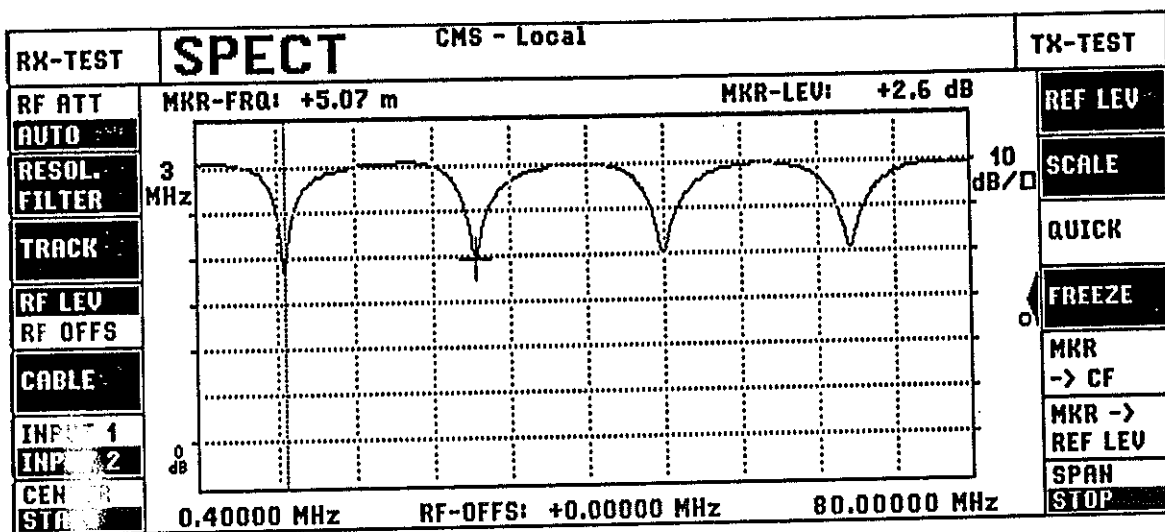
Fig. 1.5 Open circuit at a distance of 5 m.

In the case of a short circuit, the recording shows a notch near the zero frequency (Fig. 1.4), while in the case of an open circuit the first notch only occurs in the half-distance frequency range (Fig. 1.5).

The distance to the open circuit or the short circuit is determined by placing the reference marker in a notch using the VAR rotary knob and hardkeys SHIFT REF ENTER. Now an adjacent notch is approached using the VAR rotary knob. The distance can be read in the upper area of the display in the unit meters.

With the cursor on the CABLE softkey, the reduction factor can be entered on the keyboard. The reduction factor is the ratio of the propagation speed of electromagnetic waves in a cable of a defined material to that in the air. Reducing the speed of a wave corresponds to a reduction of the wavelength.

Reduction factors of approx. 0.5 and 0.95 are encountered in practical applications. CMS allows figures between 0.01 and 1 to be entered.

Reduction factors of the most common cable types:

Cable designation	Reduction factor
RG 58C	0.66
RG 400	0.66
RG 142	0.69
RG 402	0.69
RG 214	0.66
RG 393	0.69
RG 401	0.69
RG 196 A	0.7
GSC 3008	0.7
Pair of coax. CCI cable, small	0.95
Pair of coax. CCI cable, normal	0.95

1.2.5 Function Quick

This key permits to influence the speed of the beam. In the preset status (Quick not active), 400 pixels (corresponding to 400 test points) are displayed each time the display is built up, whereas only 200 pixels are displayed with the Quick key activated. Thus, the speed is reduced to approximately the half.

1.2.6 Function Input 1 / Input 2

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

1.2.7 Function Center / Start / Span / Stop Frequency

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

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

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

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

Table 1.2   Selection of the optimum resolution filter depending on the frequency span entered.

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

1.2.8 Function Reference Level

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

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

If signals are recorded via the connector RF IN/OUT, the reference level can be set at will in the range from -47 dBm to + 47 dBm (+ 50 dBm with CMS-B32).

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

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

1.2.9 Function Scale

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

1.2.10 Function Freeze

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

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

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

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

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

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

The reference marker function can be deactivated by keys SHIFT REF CLEAR. It is also cancelled with every new build-up of the display.

1.2.11 Function Marker Center and Marker Reference Level

These keys cause the marker frequency to be used as center frequency and the marker level as reference level. Thus the user is allowed to position a part of the recorded curve that is important to him into the middle of the picture with only a few keystrokes.

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

1.3   Spectrum Analyzer in IEC-bus Mode

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

The spectrum analyzer menu can be entered using the command:

DISPLAY:MENU 6.0".

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

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

Example:

The controller sends the command:

"SPECTRUM:MARKER? 120MHZ".

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

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

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

"UNIT <unit>".

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

Command	Data	Unit	Return value
SPECTRUM:**AT**TENUATION	Number	DB	<Attenuation dB>
SPECTRUM:**AU**TOATTENUATION			
SPECTRUM:**FI**LTER	SEL__150HZ		
	SEL__6KHZ		
	SEL__16KHZ		
	SEL__50KHZ		
	SEL__300KHZ		
	SEL__1MHZ		
	SEL__3MHZ		
SPECTRUM:**T**RACKING	ON OFF		(only if CMS-B9/-B59 is fitted)
SPECTRUM:**T**RACKING:**O**FFSET	Number	MHZ KHZ HZ	<OffsetFreq Hz> "
SPECTRUM:**Q**UICK	ON OFF		
SPECTRUM:**CE**NTER	Number	MHZ KHZ HZ	<CenterFreq Hz>
SPECTRUM:**SP**AN	Number	MHZ KHZ HZ	<SpanFreq Hz>
SPECTRUM:**STA**RT	Number	MHZ KHZ HZ	<StartFreq Hz>
SPECTRUM:**STO**P	Number	MHZ KHZ HZ	<StopFreq Hz>
SPECTRUM:**R**EFERENCE:**L**EVEL	Number	UV MV V W DBUV DBM	<RefLevel W>
SPECTRUM:**SC**ALE	SEL__2DB		
	SEL__5DB		
	SEL__10DB		
SPECTRUM:**FR**EEZE	ON OFF		
SPECTRUM:**MA**RKER	Number	MHZ KHZ HZ	<MKr Level W> <MkrFreq Hz>
SPECTRUM:**MA**RKER:**R**EFERENCELEVEL	ON OFF		
SPECTRUM:**MA**RKER:**C**ENTERFREQUENCY	ON OFF		

Function Keyboard Lock

The CMS permits to lock the keyboard using an IEC-bus command. This serves to prevent an unauthorized user from intervening in the measurement or changing preset parameters.

The IEC-bus command for locking the keyboard reads as follows:

"KEYBOARD:LOCK ON".

The following message appears in the first status line:

"REMOTE with Lockout"

If an IEC-interface command (goto local - GTL) is used to switch to manual operation, the keyboard is locked as well. The message

"CMS - Local with Lockout"

is displayed in the first status line.

This state permits observing measurement sequences (e.g. with zoom function activated) at the display without settings at the CMS being able to be changed.
This state can only be canceled by sending the unlocking command via the IEC-bus controller or by switching off/on the CMS.

The IEC-bus command for unlocking the keyboard reads as follows:

"KEYBOARD:LOCK OFF".

The following message appears in the first status line:

"REMOTE-Local by <STOP>".

Remark: After switching on the CMS, the keyboard is always unlocked.

Settling Option (not for CMS50)

1) Description of the Controls and Display Elements
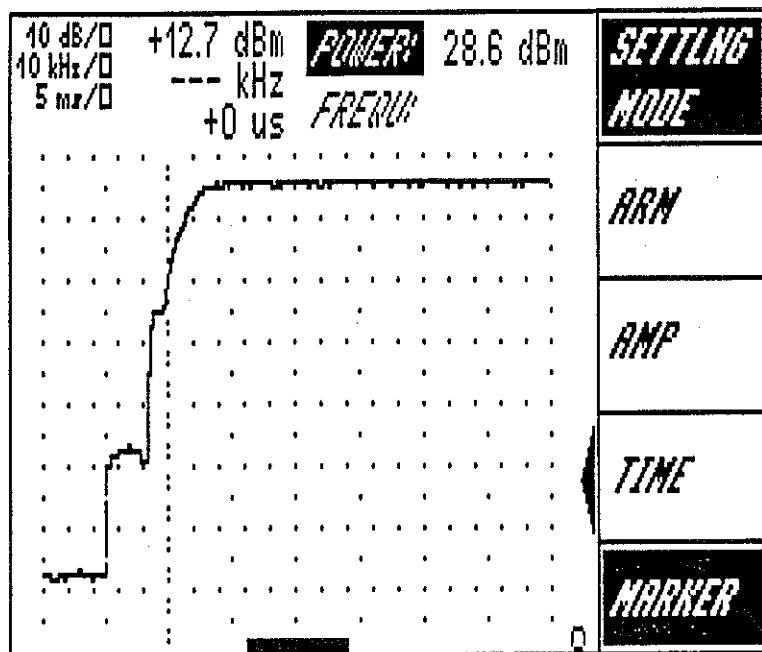
The Settling option permits to record the behaviour of a mobile phone with respect to power and frequency while being switched on/off and over.

The Settling submenu can be reached as the second submenu via the key SCOPE MODE in the Tx test main menu.

The Settling submenu consists of five softkeys: SETTLING MODE, ARM, AMP, TIME and MARKER.

SETTLING MODE

Selection between power and frequency recording. After entering the Settling submenu, POWER is always set.

ARM

By pressing this key, the CMS is set to the ready status. The key is shaded, and the occurrence of the trigger event is waited for. A message in the status line indicates the trigger threshold required for triggering the event. By pressing the key again, the ready status can be cancelled. The status line displays the message 'Settling cancelled'.

AMP

This key is used to set the amplitude scale for recording. It can be varied using the rotary knob.

Depending on the setting of the SETTLING MODE key, the amplitude is varied for recording power or frequency.

After a curve has been recorded, it can be zoomed in the y-direction using the rotary knob, provided that the active cursor is positioned on this key.

TIME

This key permits to set the time scale for recording. It can be varied using the rotary knob.

The setting applies to power and frequency recording and is therefore independent of the setting of the SETTLING MODE key.

After a curve has been recorded, it can be zoomed in the x-direction using the rotary knob, provided that the active cursor is positioned on this key.

MARKER

This key permits to vary the marker position within a recorded curve using the rotary knob. The x and y-value of the marker position is indicated in the display.

The following display elements are provided in the Settling submenu:

- Amplitude scale in dB/div for recording the power
- Amplitude scale in kHz/div for recording the frequency
- Time scale in s/div. This applies to the power and frequency curve.
- Marker position. The amplitude values are indicated for the power and the frequency curve separately. The x-position of the marker (time) applies to both curves. As long as no curve has been recorded yet, --- is indicated as the marker position.
- Setting of the SETTLING MODE key. Possible settings are POWER and FREQU.

2) Power Measurement

This measurement uses a change of the RF level as trigger event.

Before entering the Settling menu, switch from COUNT to SET RF and set the RF frequency of the test item.

When the Settling menu is entered, all data recorded before are deleted and the SETTLING MODE key is set to the POWER position.

The measurement can be made both via RF input 1 and via RF input 2.

The measurement is started by pressing the ARM key. The key is shaded, and the 2nd status line displays a message, indicating the RF level used for triggering the trigger event. The CMS automatically detects whether RF power is applied to the connector and decides whether to measure settling or decaying of power.

The trigger level is determined as follows:

Type of meas.	Power settling	Power decay
RF Input 1	5 dBm	Measured power -20 dB
RF Input 2	-70 dBm	Measured power -20 dB

In order for the trigger level not to be too far in the noise when the power decays, it cannot become smaller than -1 dBm for measurements via RF input 1 and smaller than -76 dBm for measurements via RF input 2.

As long as the trigger event has not yet occurred, the CMS is in the free-running mode, ie the signal curve at the RF connector is indicated in the display of the oscilloscope without trigger.

After the trigger event has occurred, the message 'Trigger found' is output in the 2nd status line.

The end of recording is indicated by the message 'End of sampling'. Its duration depends on the setting of the time scale and may be up to 40 seconds with 1s/div.

With the message 'End of sampling', the ARM key is unshaded, and the marker line is positioned in the first third, in the middle or in the last third of the curve, depending on the mode of measurement settling or decaying. The rotary knob symbol is set to the MARKER key. It is then possible to follow the recorded curve using the rotary knob and read off the respective marker values in the display.

Besides, it is possible to expand the recorded curve by varying the amplitude or time scale. The amplitude scale can be zoomed at will in the y-direction, whereas, in the x-direction, two steps up and down are possible starting from the setting during recording.

The user can abort recording at any time by pressing the ARM key again, leaving the Settling menu or actuating any other function which is not associated with the Settling measurement. The message 'Settling cancelled' is produced and the already recorded data are cleared.

A recorded curve can be cleared by pressing the CLEAR key if the active cursor is positioned on the keys AMP, TIME or MARKER.

3) Frequency Measurement

With this measurement, a change of the RF frequency is used as the trigger event. The measurement sequence is similar to that of the power measurement.

The SETTLING MODE key must be set to the FREQU. position.

The trigger level is set to ± 8 kHz by the CMS irrespective of the power applied to the RF connector.

4) Combined Power and Frequency Measurement

To enable simultaneous indication of the power and frequency curve in the display, two measurements must be recorded. A combined measurement is automatically performed when a curve is already visible which was recorded before switching over the SETTLING MODE key.

The following combined measurement sequences are possible:

SETTLING MODE 1st measurement	Power is applied to CMS	Type of 2nd measurement	Trigger level of 2nd measurement Input 1	Input 2
FREQU	no	Settling	±8 kHz	±8 kHz
FREQU	yes	Switchover	±8 kHz	±8 kHz
POWER	no	Settling	5 dBm	-70 dBm
POWER	yes	Decay	Power at CMS -20 dB	

The setting of the SETTLING MODE key for the first measurement determines whether power or frequency variation is used as trigger event. After recording of the curve, the SETTLING MODE key must be actuated to enable the second measurement to be performed. The trigger level of the second measurement is always equal to the trigger level of the first measurement. This is necessary for the two records to feature a time relationship to each other. Therefore, the test item must be equally operated for both records.

The power curve is indicated by a continuous line, whereas the frequency curve is represented by a dotted line.
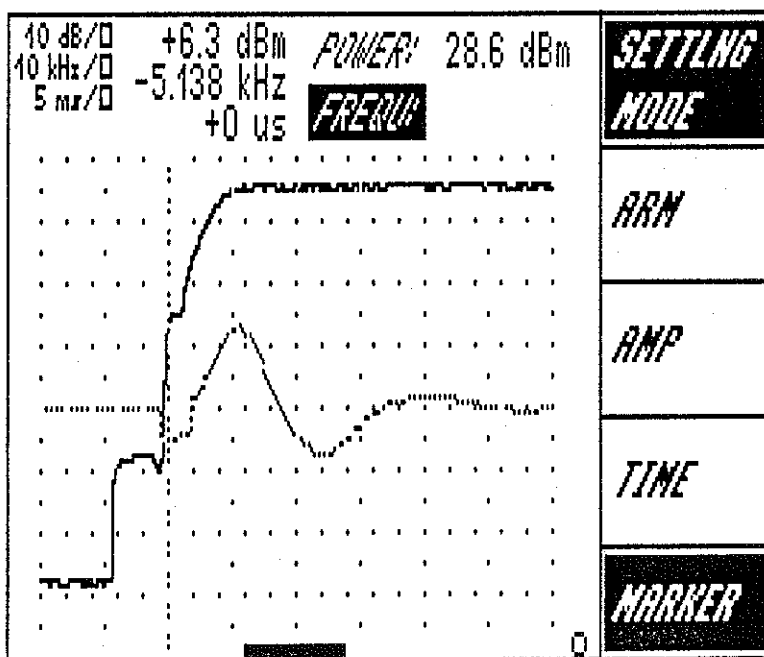
Both curves can be cleared simultaneously by pressing the CLEAR key, if the active cursor is set to the MARKER key. The SETTLING MODE key automatically changes to the POWER position.

If the active cursor is positioned on the AMP or TIME key, only one of the two curves can be cleared by pressing the CLEAR key depending on the setting of the SETTLING MODE key.

If the message 'End of sampling' is displayed in the status line at the end of recording, this message must be cleared first by pressing the CLEAR key before a curve can be cleared.

Clearing the curves:
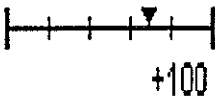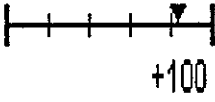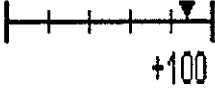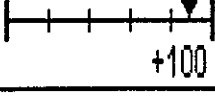
Key	Active cursor	SETTLING MODE	Cleared curves
clear	MARKER	---	both
clear	AMP/TIME	POWER	power curve
clear	AMP/TIME	FREQU.	frequency curve

Appendix

	Default	Maximum value	Minimum value
SETTLING MODE	POWER	---	---
Amplitude scale: Power measurement Frequency measurement	10 dB/Div 10 kHz/Div	20 dB/Div 50 kHz/Div	1 dB/Div 500 Hz/Div
Time scale	5 ms/Div	1 s/Div	0.05 ms/Div

Harmonic Measurement (not for CMS50)

The harmonic measurement permits to determine the power of the first to fourth harmonic of an RF carrier. The frequency of the nth harmonic is equal to n times the frequency of the RF carrier.

```
┌──────────┬──────────────────────────────┐
│ COUNT    │                              │
│ SET RF  o│   156.75000 MHz              │
├──────────┤                              │
│ POWER    │                              │
│ ACP     )│   CARRIER:  27.5 dBm         │
├──────────┼──────────────────────────────┤
│ ALL      │   HARMONICS:                 │
│          │                              │
├──────────┤                              │
│ 1st      │   69.5 dB   |-+-+-+-▼-+-|     │
│          │                      +100    │
├──────────┤                              │
│ 2 nd     │   84.7 dB   |-+-+-+-+-▼|      │
│          │                      +100    │
├──────────┤                              │
│ 3 rd     │   88.9 dB   |-+-+-+-+-+▼|     │
│          │                      +100    │
├──────────┤                              │
│ 4 th     │   89.2 dB   |-+-+-+-+-+▼|     │
│          │                      +100    │
└──────────┴──────────────────────────────┘
```

The harmonic measurement is to be found in the second submenu of the ACP measurement. Before entering the harmonic submenu, COUNT must be switched to SET RF and the RF frequency of the carrier to be examined set.

After opening the menu, the measurement is started automatically. The absolute power of the RF carrier is indicated opposite to the ACP key.

There are two possible ways of measuring harmonics:

If the key ALL is active, the four harmonics are measured cyclically one after the other. If the key ALL is not active, only the power of the currently selected harmonic is measured.

The power unit of the harmonic is determined by the unit of the fundamental. This can be selected by pressing a unit key if the active cursor is positioned on the ACP key.

The following units are possible for the harmonic measurement:

Unit of the fundamental	Unit of the harmonics
mV/V	mV/V
µW/mW/W	µW/mW/W
dBµV	dBµV
dBm	dB

Harmonics Measurement in IEC-BUS operation (not for CMS50)

The harmonics submenu can be opened using the IEC-bus command

"DISPLAY:MENU 1,5".

The measured values of the individual harmonics are read using command

"ACP?".

Which harmonic is measured has to be selected before using one of commands

"ACP:HARM:FIRST" --- "ACP:HARM:FOURTH".

Command	Data	Unit	Return value
ACP	?	UV MV V W DBUV DBM DB	<measured value>
ACP:HARM:FIRST	---	---	---
ACP:HARM:SECOND	---	---	---
ACP:HARM:THIRD	---	---	---
ACP:HARM:FOURTH	---	---	---

ATIS / CDCSS

The following tone sequence generations and decodings are implemented as of software version V4.75:

- CDCSS coding
- CDCSS decoding: requires option CMS-B27 and CMS-B33
- ATIS coding: requires option CMS-B27
- ATIS decoding: requires option CMS-B27

Function Description

- **ATIS**
  ATIS is an automatic transmitter identification system, i.e., after the transmission key of the mobile phone has been released, an identification message is sent. This identification message must be repeated at least once every 5 minutes with a relatively long transmit mode.

  - Data message: 360 Bit
  - Data modulation: FSK with a baud rate of 1200 Bit/s
    0 corresponds to 2100 Hz; 1 corresponds to 1300 Hz
  - RF modulation: phase modulation with a modulation index of 2.0 rad

- **CDCSS**
  CDCSS is a digital code parallel to speech whose identification is used by an addressed mobile phone to make itself ready to receive information. The end of the transmit mode is announced by sending a turn-off code so that the receiver can turn off without disturbing noise effects.

  - Data message: 23 bits with continuous repetition
  - Bit length: 7.44 ms
  - Modulation: Direct carrier shift keying with a settable deviation, depending on the class of mobile phone

The following 83 octal codes are permissible

023	072	152	244	343	432	606	723
025	073	155	245	346	445	612	731
026	074	156	251	351	464	624	732
031	114	162	261	364	465	627	734
032	115	165	263	365	466	631	743
043	116	172	265	371	503	632	754
047	125	174	271	411	506	654	
051	131	205	306	412	516	662	
054	132	223	311	413	532	664	
065	134	226	315	423	546	703	
071	143	243	331	431	565	712	

Supplement as to Section 2.4.4 (Main Menu TX Test)

Option CMS-B27 serves to select standard 15 for CDCSS decoding or standard 16 for ATIS decoding using softkey DECODE under function DECODE in submenu 2.

● **Function DECODE CDCSS (Standard 15): Requires Option CMS-B27 and CMS-B33**
The decoding of the CDCSS code is activated by pressing the DECODE/ENTER keys. A cyclically repeating CDCSS signalling message in the subaudio range is expected. If one of the 83 permissible messages is received, it is displayed as a 3-digit octal number. The inverted message possibly corresponding is displayed additionally with a # as a prefix (example: 023 = #047).

If none of the 83 defined CDCSS codes was received, the decoded bit sequence is displayed as a 3-digit hexadecimal value, with a ! as a prefix.

If no signal is received within the TIMEOUT time, – – – is displayed.

Note:
The CDCSS signal can be analyzed as an AF measurement via input AF/SCOPE or as an FM-demodulated signal via socket INPUT 1 and/or INPUT 2.

● Decode CDCSS: Submenu 1
Submenu 1 has no function for CDCSS.

● Decode CDCSS: Submenu 2
Softkey EVAL BNDWTH and softkey MAX PAUSE have no function.

● **Function DECODE ATIS (Standard 16): Requires Option CMS-B27**
Pressing keys DECODE/ENTER activates the decoding of the ATIS code. A single signalling message according to ATIS regulation (BAPT 225 ZV 4-1/53A) is expected. The decoded ATIS self-identification from the message received is displayed as a 10-digit decimal number.

This value is divided up into several blocks, separated by blanks. In detail, the value is composed of the following components: waterway identification (1-digit), nationality classification figure (3-digit), the second letter of the call signal (2-digit) and the remaining numbers of the call signal (4-digit). An identity identification could be as follows:

```
9   049   01   1234
 \     \
  \     \
Rhine   Germany
```

The following additional error messages can be displayed in the status line:

● ATIS-MESSAGE FAIL (bit error within the message).
● PARITY CHECK ERROR (error check signal not completely correct).
● ATIS-TIMEOUT.

If no signal is received within the ATIS timeout of 6 minutes,
– – – is displayed.

● Decode ATIS: Submenu 1
Submenu 1 has no function for ATIS.

● Decode ATIS: Submenu 2
Softkey EVAL BNDWTH and softkey MAX PAUSE have no function.

Supplement as to Section 2.5.4 (Main Menu RX Test)

Standard 15 for CDCSS coding or standard 16 for ATIS coding can be selected using the CODE softkey under function CODE in submenu 1.

- **Function CODE CDCSS (Standard 15)**
  After activating softkey CODE, a 3-digit octal number which has to correspond to one of the 83 CDCSS codes can be entered. Prefix # has to be put in front of the octal number for inverted codes. Acknowledgement using the ENTER key effects a cyclic transmission of the CDCSS code via modulation generator 2 whose deviation can be selected as already known.

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

  - Code CDCSS: Submenu 1
    In submenu 1, only softkey CODE is relevant for CDCSS, the remaining softkeys have no function.

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

    Softkey TRANSM END serves to set the time between the start of the turn-off code and the cutting off of the transmitter.
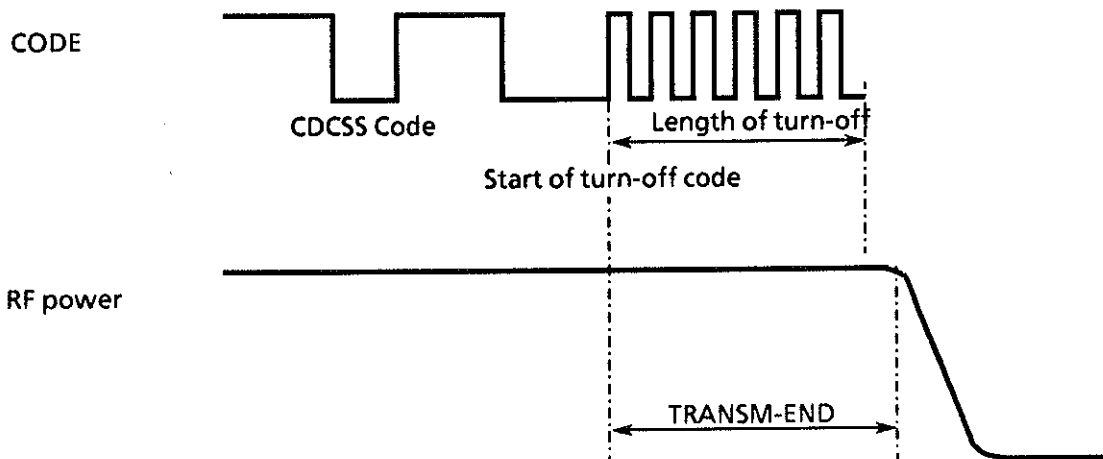
- **Function CODE ATIS (Standard 16): Requires Option CMS-B27**
  After the CODE softkey has been activated, a 10-digit decimal number can be entered as an ATIS self-identification code. The entire ATIS message including error check signal is added to the above entry.

  Pressing the ENTER key effects a single transmission of the ATIS message as an FSK modulation via the RF output, with the modulation index of 2 rad demanded in the ATIS regulation being preselected automatically (independently of the value displayed).

  - Code ATIS: Submenu 1
    In submenu 1, only softkey CODE is relevant for ATIS, the remaining softkeys have no function.

  - Code ATIS: Submenu 2
    Submenu 2 has no function for ATIS.

VSWR - Voltage Standing Wave Ratio

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

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

The measuring head, which is inserted between transmitter and antenna, determines the forward and reflected voltage. An analysis of the data supplied by the measuring head is effected in the CMS, with an additional indication of the ratios of the two voltages. For these analyses, one of the following options is required: CMS-B5 or CMS-B39.

VSWR measurement is executed within the TX test. The VSWR measurement is activated by opening the 2nd submenu under the <POWER> softkey.

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

RX-TEST	**TX-TEST** CMS - Local		↓	LOCK
COUNT SET RF	**100.00000** MHz	1.0000 kHz 1.00 mV AF LEV 0.3000 kHz 0.00 mV		RF 1 LEV 1
POWER FORW	*25.12 W*			AF 2 LEV 2
	⊢——┼——┼—▼—┼——┼——┤ +50	DEMOD AMP: .05 kHz/☐ TIME: 0.2 ms/☐		SCOPE MODE
POWER REFL	*0.012 W*			BEST RANGE
	⊢——┼——┼—▼—┼——┼——┤ +0.025			AMP
VSWR	*1.044*			TIME
	⊢——┼——┼——┼——┼——┤ +1.0 +3.5			Y POS
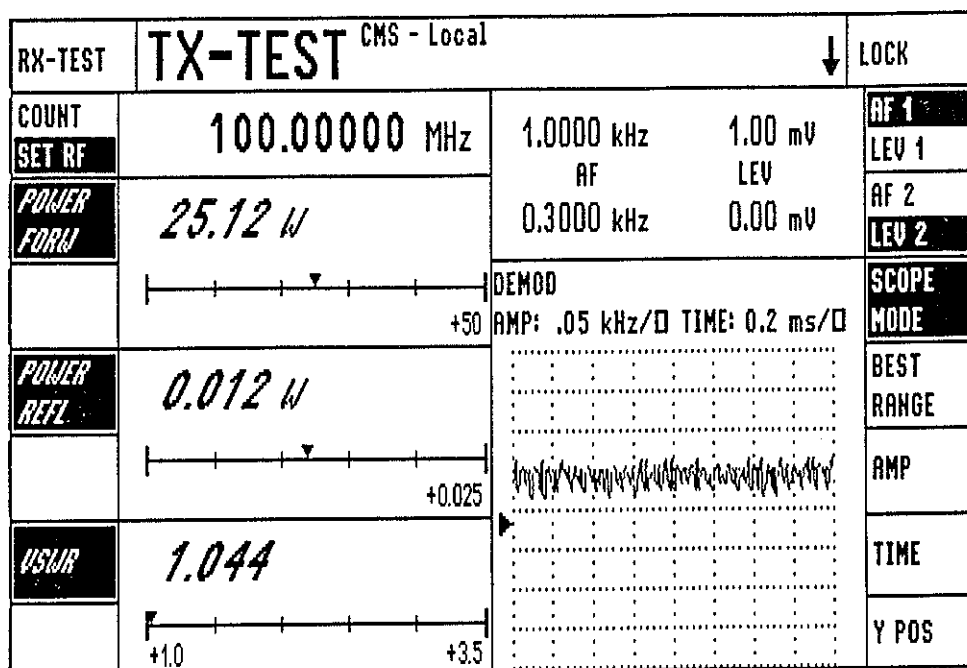
Functions "TOL" and "REF" cannot be used for the indication of the VSWR value. A change of unit is neither possible in the indication of this value which has no unit. Further, the analog bar scaling of the VSWR result always starts with 1.

Applications of the

RADIOCOMMUNICATION SERVICE MONITOR CMS

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.
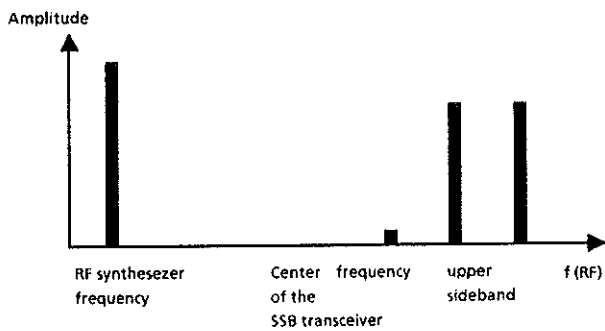
Make the following settings for transceivers using the __LSB__:

- 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.

Amplitude

RF synthesezer frequency   Center frequency of the SSB transceiver   upper sideband   f (RF)

Amplitude

lower sideband   Center frequency of the SSB transceiver   RF synthesezer frequency   f (RF)
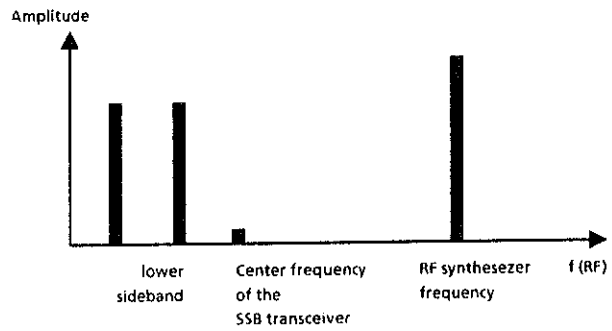
● Feed the dual tone AF signal, applied to the transceiver loudspeaker, to the AF voltmeter.

● 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

Minus sign

Every number is positive unless a minus sign is entered.
Input of tone sequences:
With DTMF   #
With all other codes   F

Decimal point

Input of tone sequences:
with DTMF   *
with all other codes   E

ENTER
ON

● Terminating key for all inputs which do not have or require a dimension or quasi-dimension.

● Switching-on the functions which were switched off by OFF.

CLEAR
OFF

● Abortion of commenced input strings.

● Switching-off of functions

● Switching-off of functions such as REF, RANGE, VAR, TOL.

● Deletion of a deletable message in the 2nd status line.

VAR

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

*)   depending on model or option

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.

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).

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.

RECALL
STORE

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

17

RESET
MENU ↓

RESET: Set instrument to its factory-setting. Autorun control programs are not cleared in this way.

Menu ↓: Enables searching for submenus together with the active cursor in the display

18

REF
MENU ↑

REF: Entered or measured values are declared as reference values.

MENU ↑: Transfer to higher-level menu.

19

RANGE
VAR

RANGE: Storing of full-scale value with analog display.

VAR: Definition of setting increment when using VAR spinwheel.

20

- TOL
+ TOL

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

21

CONTRAST

Adjustment of screen contrast.

*) depending on model or option

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. Input resistance depends on the model or option.

25

MOD GEN*)
OUTPUT

Output of AF generator. Output resistance depends on the model or option.

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

$\triangle$ 1 V$_{MAX}$
~50 Ω
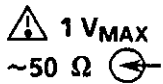
Second RF input; high sensitivity, therefore suitable for remote measurements.

29

RF IN/OUT

$\triangle$ 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.

*) depending on model or option

46

PRINTER PARALLEL INTERFACE *)

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

47

Alternatively, depending on the model and/or option fitted:

CONTROL

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

DC MEASUREMENT

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
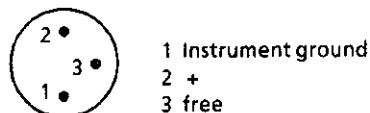
Note:

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.

2.3　Operation

The instrument functions are possible in three main operating modes:

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

2.3.1　Power-Up Status

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

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

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

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

2.3.2　Controls

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

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

2.3.2.1　Softkeys

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

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

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

2.3.2.2　Hardkeys

2.3.2.2.1 Function-based Hardkeys

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

Function-based hardkeys:

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

Examples of hardkey applications:

RANGE

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

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

RANGE/CLEAR
Autoranging becomes active again.

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

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

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

VAR

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

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

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

VAR/CLEAR
Cancellation of fixed assignment.

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

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

VAR/0/ENTER
Selection of minimum increment.

Exceptions:

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

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

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

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

REF

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

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

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

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

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

REF/CLEAR
Return to absolute dimension.

Identification of relative displays:

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

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

The 0 point is always on the left.

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

TOL

Entered tolerance values have two effects:

- Limits are entered on the scale of the analog display. They serve for optical orientation during adjustments.

- They enable an evaluation during autorun control depending on the result:
  tolerance in or tolerance out.

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

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

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

+/- TOL/CLEAR
Deletion of tolerance markers.

Special features:

The two tolerance markers are not always visible.

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

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

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

MENU ↓ (DOWN)

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

Dimension keys

For settings:

Number/dimension
Setting of value including dimension.

Dimension
Conversion of set value into selected dimension.

With measurements:

Dimension
Representation of measured value in selected dimension.

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

Exception:

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

ENTER, ON

The ENTER key terminates input strings.

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

CLEAR, OFF

The 4 functions of CLEAR are:

● Abortion of a commenced input string.

● Switching-off of hardkey functions such as REF, RANGE, VAR or TOL.

● Switching-off of set values; particularly suitable for relative settings with a logarithmic scale since the number "0" has the meaning "Reference value" in this case and not the meaning "Off".

● Deletion of a deletable message in the second status line.

2.3.2.2.2 Mode-related Hardkeys

The instrument can be operated in 6 different modes:

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

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

IEC/IEEE bus mode (Remote) *)

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

Autorun control: RUN mode

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

Autorun control: HOLD mode

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

*) depending on model or option

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

RETURN
Entering the AUTORUN menu of autorun control.

Autorun control: LEARN mode

START
Start of LEARN mode.

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

Autorun control: AUTORUN menu

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

2.3.2.2.3 Independent Hardkeys

The hardkeys described here always have the same meaning.

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

CLEAR
Cancels an unintentional input of SHIFT.

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

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

STORE
This key has 2 functions:

- In the autorun control (LEARN mode), completely entered commands are stored in autorun control programs. The STORE key has a terminating function in this case.

- In addition, instrument states are transferred to the memory using the STORE key.

Syntax: STORE/number/ENTER

Numbers 1, 2 or 3:
Internal storage of complete instrument settings.

Frequencies for AF1 are stored only if the function AF COUPL (submenu DIST/SINAD, DIST) is off.

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

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

RECALL
The RECALL function corresponds to the STORE function.

- The internally-stored instrument status is set by entering
  RECALL/number (single-digit)/ENTER

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

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

Example:

10/MHz	STORE	STORE/3/ENTER	STORE
Set 10 MHz	Imple-mentation in an autorun control program	Store 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.

---

*) depending on model or option

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

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

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

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

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

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

2.3.2.4 Display

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

Status lines

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

Softkey inscriptions

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

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

Representation of measured and set values

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

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

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

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

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

Active cursor   VAR symbol
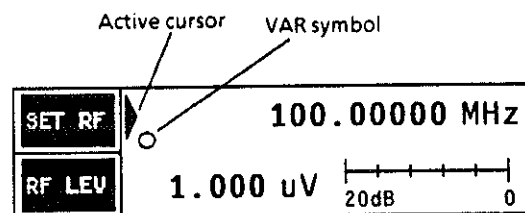
Fig. 2.3-1 Active cursor and VAR symbol

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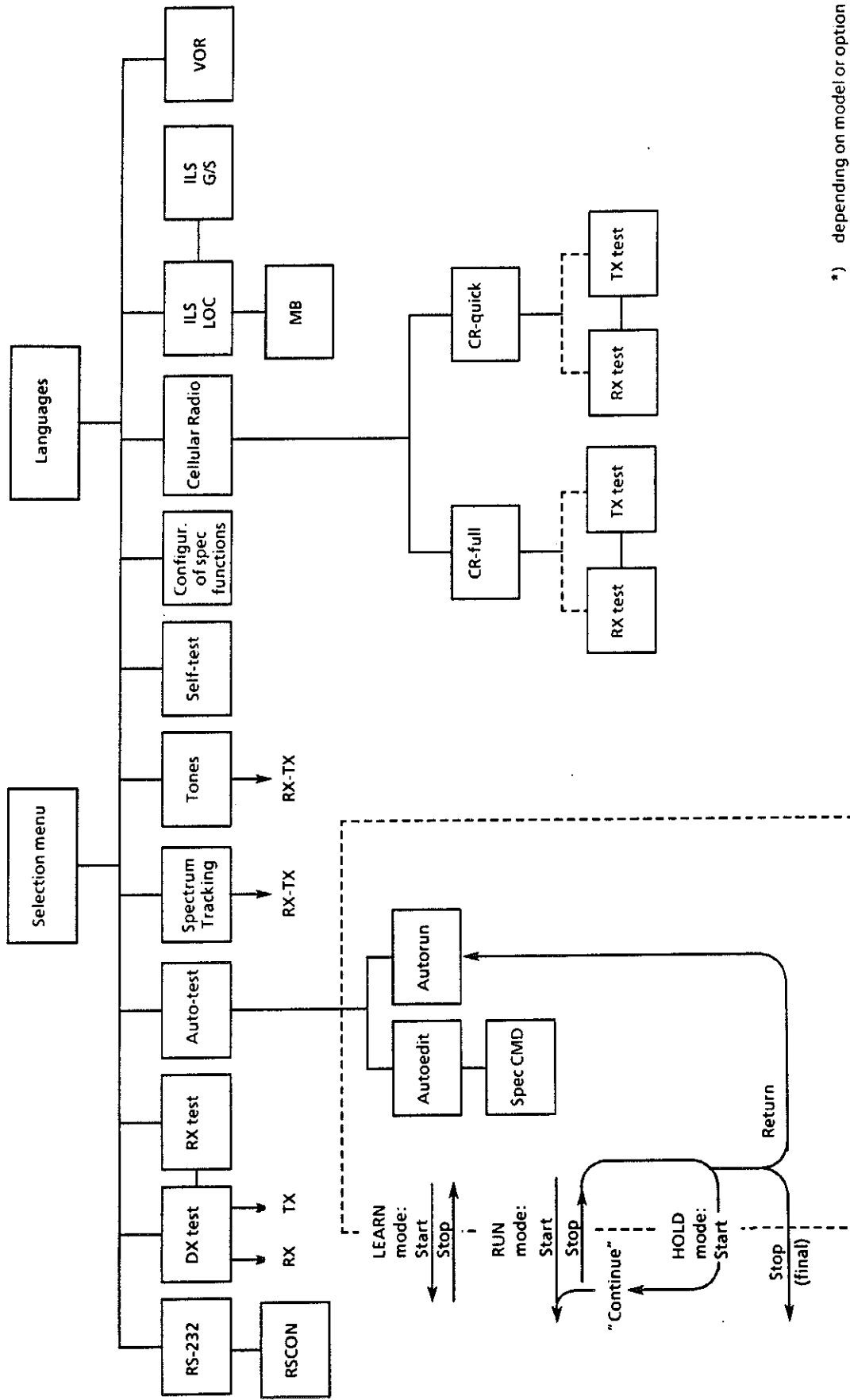
Fig. 2.3-2 Menu structure

*) depending on model or option

2.3.4   Error Reaction

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

2.3.5   Connection of the Device under Test (DUT)
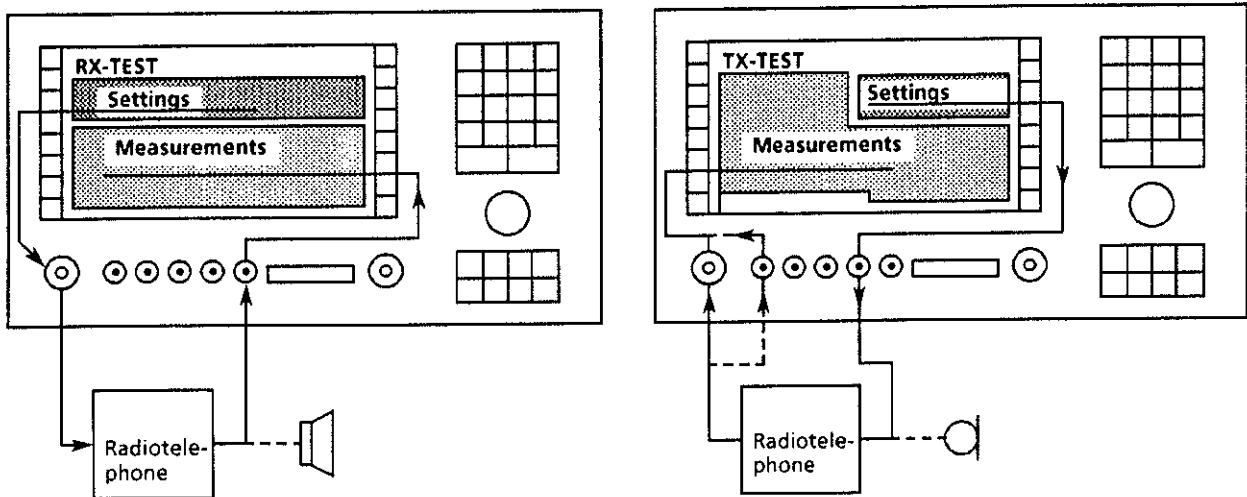
Fig. 2.3-3 Connection of the device under test

2.3.6   Selection Menu

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

0	RX-TEST	SELECT CMS - Local		TX-TEST	8
1	TONES			AUTOTST	9
2	DX-TEST	RADIOCOMMUNICATION		CR	10
3	SPECT			VOR	11
4		SERVICE MONITOR		ILS/MB	12
5	SERIAL				13
6	NATION	GB			14
7	CONFIG			SELFCHK	15

Fig. 2.3-4 Selection menu

2.4 Transmitter Test (TX-Test)

0	RX-TEST	TX-TEST CMS - Local	↓	LOCK	8
1	**COUNT** SET RF	0.00000 MHz	1.0000 kHz 1.00 mV AF LEV	**AF1** LEV1	9
2	**POWER**	--- W ⊢┼─┼─┼─┼┤ +0.025	0.3000 kHz 0.00 mV	**AF2** LEV2	10
3	**DEMOD** PK HLD	--- kHz ⊢┼─┼─┼─┼┤ RMS +0.025	DEMOD AMP:0.5 kHz/☐ TIME:0.2 ms/☐ ◀	**SCOPE MODE**	11
4	**DECODE** COUNT	ZVEI1 ---		BEST RANGE	12
5	**FILTER**	OFF		AMP	13
6	**DIST** S/N	---% ⊢┼─┼─┼─┼┤ 1.000 kHz +0.025		TIME	14
7	**INPUT1** INPUT2	0.0 dB 0.0 dB EXT ATT		Y POS	15

Fig. 2.4-1 Main menu TX-TEST

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

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

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

2.4.1 RF Measurement

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

COUNT Function

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

The 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.
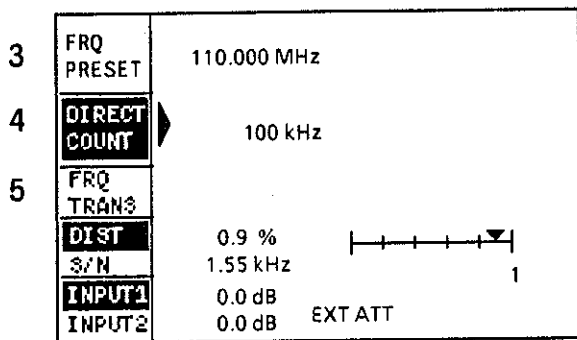
Fig. 2.4-2 COUNT submenu

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 narrow-band 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 trans-mitter frequencies as CMS receiver frequency.

SET RF Function

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

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

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

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

SET RF Function: Submenu

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

Fig. 2.4-3 SET RF submenu

Softkey 3: FRQ TRANS
(Frequency transfer function)

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

An activated transfer function has the following effects:

● At the point of switchover from TX→RX, the RX RF frequency is calculated from the RF frequency set or counted in the TX test and the duplex spacing.

● At the point of switchover from RX→TX, the TX RF frequency is calculated from the RF frequency set in the RX test and the duplex spacing, if the RF counter in the TX test is off.

● When the RX RF frequency in the duplex menu is changed, the TX RF frequency continuously follows displaced by the duplex spacing, if the RF counter is off.

● When the TX RF frequency is changed (by RF counter or setting), the RX RF frequency follows displaced by the duplex spacing.

Softkey 4: DUPLEX SPACE

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

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

Softkey 5: REF CHANNEL (Reference channel)

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

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

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

Softkey 7: CH 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 off-set. Reference between channel numbers and frequencies is made when the reference channel is entered.

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

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

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

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

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

2.4.2   Power Measurement

    POWER Function

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

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

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

The dynamic range is depending on the input:
RF IN/OUT: ca. 125 µV (-65 dBm) to 50 V (47 dBm)
RF IN 2   : ca. 22 µV (-80 dBm) to 4mV (-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 measure-ment, the selective RF power measurement also includes the Peak Envelope Power (= PEP). With AM results that are up to 6 dB higher (100%) are therefore obtained.
Calibration of the selective RF power measure-ment 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.

3	PEP		
4	TIME	AUTO FAST SLOW	
5	POWER HOLD		
6	POWER HLD RES		
	INPUT1	0.0 dB	EXT ATT
	INPUT2	0.0 dB	

Fig. 2.4-4 POWER submenu

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

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

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

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

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

ACP Function *)

Adjacent Channel Power Measurement (ACP)

The desired channel and the adjacent channel are measured using the filters described in the specifications (FT 17 TR 2049, ETS 300086) and set in relation to each other.

Measured value (dB) = 10 x log (power of used channel / power of adjacent channel)

The following values are specified for the CMS:
Channel spacing 25 kHz
ACP filter bandwidth 16 kHz
Required spacing 70 dB

Before switching on the adjacent channel power measurement, the desired reference frequency must be entered using the softkey "SET RF".

ACP Function : Submenu

The ACP function has a submenu which appears in the display adjacent to the softkeys 3 to 6.

Fig. 2.4-5 ACP submenu

Softkey 3: ADJCNT CH
Channel select for the first/second and upper/lower adjacent channel.

Softkey 4: CH SPACE
Selecting specified channel spacing with automatic filter switching.

Softkey 5: FILTER
Filter selection when choosing "free" channel spacing.

Softkey 6: FREE CH
Selecting a user-defined channel spacing up to 1000 kHz in 10-Hz steps.

*) depending on model or option

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 hard-keys (RANGE), Section 2.3.2.2.1). The positive

peak value applies if the fixed full-scale value is to be derived from the currently measured value.

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

DEMOD Function: Submenu

The DEMOD function has a submenu which is output in the fields in the display next to softkeys 4 to 7.
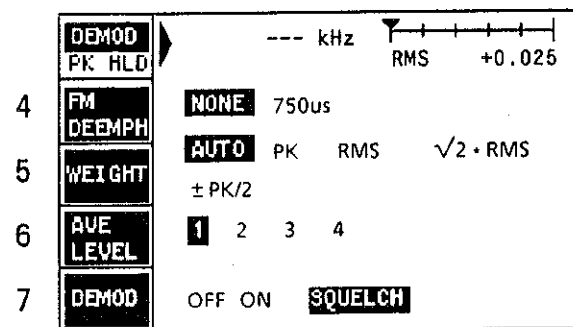
Fig. 2.4-6 DEMOD submenu

Softkey 4: FM DEEMPH (deemphasis)

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

Softkey 5: WEIGHT (rectifier)

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

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

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

PK: Simultaneous positive and negative peak-value measurements.

RMS: Real RMS measurement.

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

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

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

Softkey 6: AVE LEVEL (averaging factor)

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

1: One measurement determines the result.

2: The result is the average of two measurements.

3: The result is the average of three measurements.

4: The result is the average of four measurements.

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

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

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

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

Softkey 7: DEMOD (demodulator)

Softkey 7 offers the following alternatives:

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

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

Applications:

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

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

PK HLD Function

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

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

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

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

See Section 2.9 for further special functions.

2.4.4 AF Measurement

Softkey 4 is assigned two functions:

DECODE (tone sequence decoding)
COUNT (frequency measurement of de-
modulated or beat signal)

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

DECODE Function

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

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

DECODE Function : Submenu 1

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

Fig. 2.4-7 DECODE submenu 1

*) depending on model or option

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

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

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

Softkey 3: PREV (Page down)

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

Softkey 4: TONE NUMBER *)
(Printing of individual lines)

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

Softkey 7: NEXT (Page up)

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

DECODE Function: Submenu 2

Fig. 2.4-8 DECODE submenu 2

Softkey 3: DECODE (tone sequence standard)

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

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

Standards 1 to 9 are the most common single-tone sequences. To differentiate between un-modified 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.
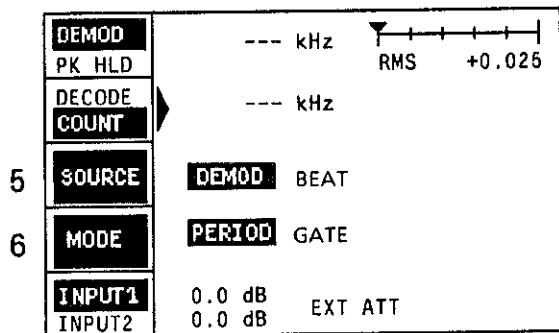
Fig. 2.4-9 COUNT submenu

Softkey 5:   SOURCE (Signal source)

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

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

There are two alternatives:

Period counting
Gate time counting

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

Gate time counting is less sensitive to noisy signals.

2.4.5   Filter Selection

FILTER Function

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

FILTER Function: Submenu 1

The FILTER function branches to two submenus, which are both output in the display fields next to softkeys 4 and 7.
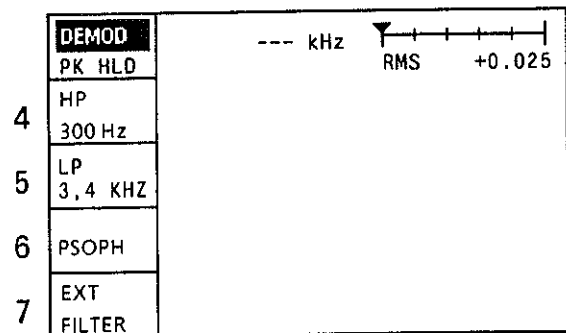
Fig. 2.4-10 FILTER submenu 1

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

Switching the 300-Hz highpass on and off.

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

Switching the 3.4-kHz lowpass filter on and off.

Softkey 6:   PSOPH (psophometric filter, 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.

*) depending on model or option

Softkey 7: EXT FILTER *)

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

With the option CMS-B33*) installed, the same is activated and deactivated using EXT FILTER. In this case there is no longer any input and output for the external filter at the rear of the device.

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

Example of an external filter

Connections at the
CONTROL socket

+ 10 V

10 Ω

11

100 µF

33 nF

2.2 µF

LF 156

10 kΩ   10 kΩ

LF 156

2   -   7   6   0.47 µF   42

3   +   4

33 nF

100 µF

R_{ext} = 10 Ω

R_{int} = 100 kΩ

LF 156

9, 12, 26 or 43

44

10 Ω

Dimensioning for a
300-Hz lowpass filter

-10 V

*) depending on model or option

	DEMOD		--- kHz	
	PK HLD		RMS	+0.025
4	NOTCH			
5	RESON			
6	IF	WIDE	NARROW	
7	IF-ATT	AUTO	ON OFF	
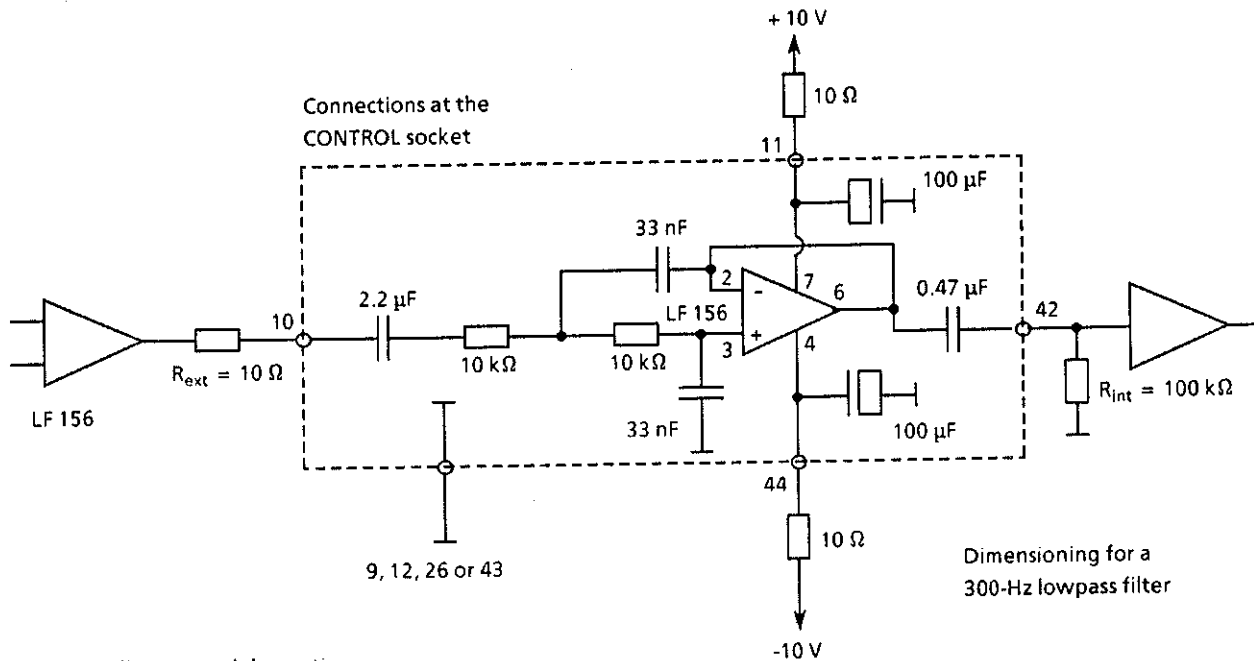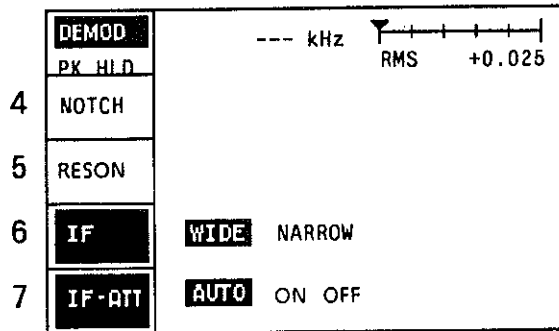
Fig. 2.4-11 FILTER submenu 2

Softkey 4: NOTCH (notch filter)

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

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

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

Softkey 5: RESON (resonance filter)

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

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

Filter combinations*)

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

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

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

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

Notch filter and resonance filter are also being switched off when quitting or selecting a new RX-test and TX-test, since in this case SINAD or DIST measurements automatically continue to run.
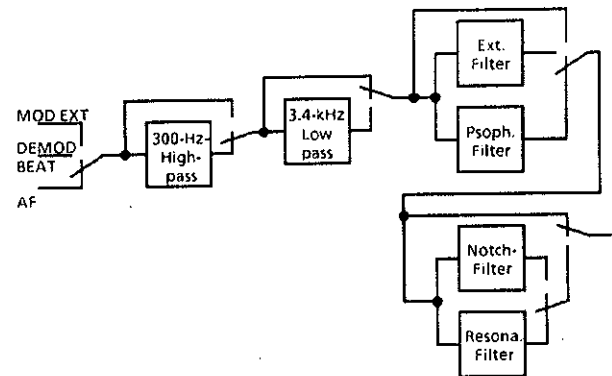
Fig. 2.4-12 Signal paths

*) depending on model or option

Softkey 6: IF (IF filter)

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

Softkey 7: IF-ATT (IF attenuation)

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

2.4.6 Distortion and S/N Measurements

Softkey 6 is assigned two functions:

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

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

DIST Function

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

Dimension

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

Test frequency

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

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

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

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

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

DIST Function: Submenu

The DIST function branches into one submenu, which is ouput in the display fields next to softkeys 5 and 7. Softkey 6 is assigned to the main menu.
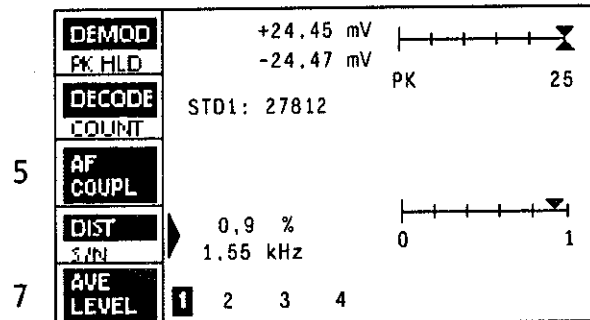
Fig. 2.4-13 DIST submenu

Softkey 5: AF COUPL (test frequency)

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

Application:

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

Softkey 7: AVE LEVEL (averaging factors)

Softkey 7 selects four averaging factors:

1: One measurement determines the result.

2: The result is the average of two measurements.

3: The result is the average of three measurements.

4: The result is the average of four measurements.

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

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

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. 2.4-14 S/N submenu

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.

Softkey 5: GEN 2 (modulation generator 2)

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

Softkey 7: AVE LEVEL (averaging factors)

Softkey 7 selects four averaging factors:

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

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

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

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

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

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

2.4.7   Input Switchover

```
INPUT 1/INPUT 2 Function
```

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

2.4.8   Lock

```
LOCK Function
```

Softkey 8 is assigned a simple changeover key function.

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

Application:

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

2.4.9   Modulation Generators

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

```
AF 1/AF2 Function
```

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

Variation function

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

Reference function

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

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

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

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

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

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

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.

---

*) depending on model or option

The CONT function has a submenu which is displayed in the fields next to softkeys 11 to 15.
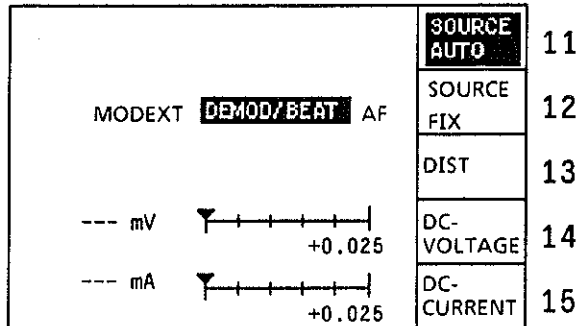
Fig. 2.4-15 SCOPE MODE submenu

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.
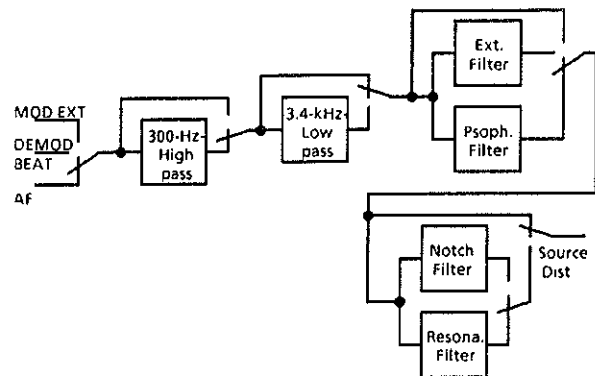
Fig. 2.4-16 Signal paths

Softkey 14: DC-VOLTAGE *)

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 *)

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.

*) depending on model or option

2.5　Receiver Test (RX-Test)

0	TX-TEST	**RX-TEST** CMS - Local			LOCK	8
1	SET RF	**100.00000 MHz**	1.0000 kHz　　2.80 kHz		AF1 MOD1	9
2	RF LEV	**1.000 uV** ├─┼─┼─┼─┤ 20 dB　　+0	AF　　　　　MOD 0.3000 kHz　　0.00 kHz		AF2 MOD2	10
3	AF LEV	**0.0 mV** Y─┼─┼─┼─┤ RMS　　+0.25	AF AMP:50 mV/□ TIME:0.2 ms/□		SCOPE MODE	11
4	CODE COUNT	ZVEI1　　1234567890ABCDEF			BEST RANGE	12
5	FILTER	OFF			AMP	13
6	SINAD DIST	--- dB　 Y─┼─┼─┼─┤ 1.000 kHz　　+0.025			TIME	14
7	S/N	--- dB　 Y─┼─┼─┼─┤ +0.025			Y POS	15

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

SET RF Function: Submenu

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.

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. 2.5-2 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

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.

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.

3	BNDWTH MEAS		
4	SQULCH MEAS		
5	QUIET	▶ 17 dB	SEARCH VAL.
		20 dB	FOUND VAL.
7	LEVEL	PD	EMF

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 radio-telephone. This is the squelch switch-off point.

3. The RF level is decreased until the AF level on the radiotelephone is switched off again. The squelch hysteresis is the difference between the two RF levels.

4. Squelch inset and squelch hysteresis are displayed.

Softkey 5: QUIET
(quieting measurement)

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

The measurement is run as follows:

1. Initial setting: RF frequency = receiver center frequency. RF level = off. The receiver squelch is switched off.

2. The AF noise level is measured.

3. The RF level is increased until the AF noise level has decreased by the number specified as the quieting criterion.

4. This RF level is displayed as result.

Softkey 7: LEVEL
(EMF-PD switchover)

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

2.5.3   AF Level Measurement

    AF LEV Function

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

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

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

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

The AF LEV function has a submenu which is output in the fields in the display next to softkeys 4 to 7.
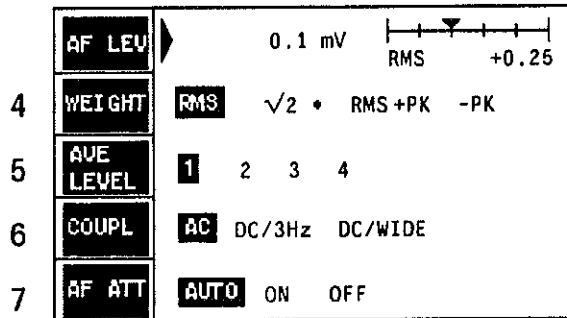
Fig. 2.5-4 AF LEV submenu

Softkey 4: WEIGHT

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

RMS:	Real RMS weighting
$\sqrt{2} * RMS$:	Real RMS weighting multiplied by 1.41.

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

+ PK:	Positive peak weighting
- PK:	Negative peak weighting

Softkey 5: AVE LEVEL (averaging factor)

Softkey 5 can be used to select an averaging factor for RMS and $\sqrt{2} * RMS$ weighting. Four averaging possibilities are provided.

1: One measurement determines the result.

2: The result is the average of two measurements.

3: The result is the average of three measurements.

4: The result is the average of four measurements.

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

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

Application:

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

Averaging is not carried out for peak weighting.

Softkey 6: COUPL (AC/DC coupling)

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

AC coupling:	Only AC voltages ≥ 50 Hz are measured.
DC/3Hz:	Pure DC measurement. AC components above 3 Hz are suppressed.
DC/WIDE:	AC and DC components are RMS or peak weighted together.

Softkey 7: AF ATT (input divider)

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

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

Selection is possible using softkey 7 between:

AUTO:	Automatic adaptation to measured value
ON:	A dynamic range of 24 dB is lost at small measured values.
OFF:	Top limit of measuring range approx. 1.4 V.

2.5.4   Code, Count

Softkey 4 is assigned two functions:
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; it is then started by activating softkey 4 CODE in the main menu RX-test. The sequence comprises the following steps:

1. Transmission of previously selected tone sequence.

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

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

Softkey 7: FRQ DEVI (frequency deviation)

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

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

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.

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.
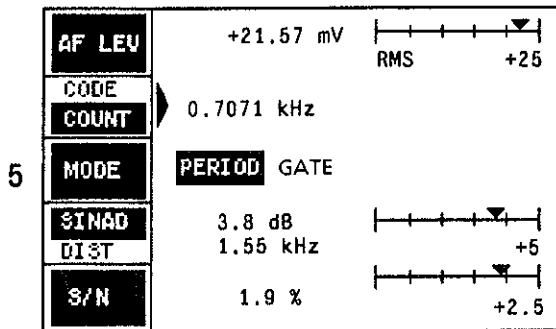
Fig. 2.5-7 COUNT submenu

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.
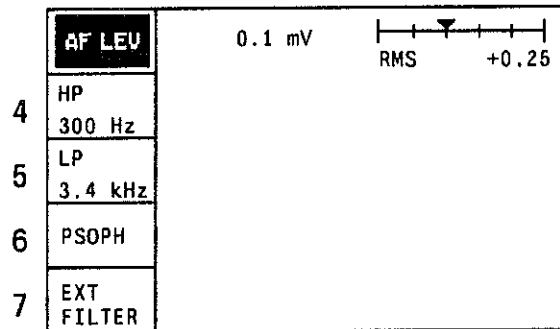
Fig. 2.5-8 FILTER submenu 1

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)*)

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

---

*)   depending on model or option

Softkey 7: EXT FILTER *)

Switching the external filter on and off. An input and output for the external filter are fitted to the rear of the device (CONTROL connector 47; pin 10 = input/ pin 42 = output). With the CMS-B33*) option installed, the same is switched on and off using EXT FILTER. Input and output for external filter are no longer available at the rear of the device (see also example of filter in section 2.4.5).

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

FILTER Function: Submenu 2
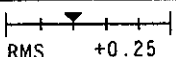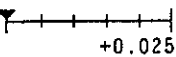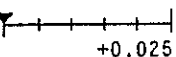
Fig. 2.5-9 FILTER submenu 2

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.

Since the resolution of the set frequencies cannot always be set as required, the frequency that is actually set is displayed.

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. As with the notch filter, the frequency that is actually set is displayed.

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.

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

---

*) depending on model or option

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.

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

Test frequency

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

Automatic search routine

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

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

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

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

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

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

Fig. 2.5-10 SINAD/DIST submenu

Softkey 3: AF COUPL (test frequency)

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

Application:

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

Softkey 4: WINDOW (abort window)

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

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

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

Application:

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

Softkey 7: AVE LEVEL (averaging factors)

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

1: One measurement determines the result.

2: The result is the average of two measurements.

3: The result is the average of three measurements.

4: The result is the average of four measurements.

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

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

2.5.7 S/N Measurement

    S/N Function

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

Dimension

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

The full-scale value can also be influenced in the analog display for the S/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 fileds next to softkeys 3 to 7.

3	GEN2	UNUSED	USED
4	EXT	UNUSED	USED
5	WINDOW	2.0 dB	
6	LEVEL SEARCH	STOP	CONTINUE
7	AVE LEVEL	1 2 3 4	

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 LEVEL (averaging factors)

Four averaging factors can be selected using softkey 7:

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

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

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

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

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

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

2.5.8 Lock

LOCK Function

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

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

Application:

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

2.5.9 Modulation Generators

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

AF1/AF2 Function

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

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

Variation function

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

Reference function

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

MOD1/MOD2 Function

The modulation is entered using softkey 9/number/dimension or ENTER. The operating mode of the instrument is determined by the dimension selected for the 1st modulation generator.

Selection of the dimension % sets the CMS to AM mode, selection of the dimension kHz or Hz to FM mode and selection of the dimension rad to ϕM mode.

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

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

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

MOD1/MOD2 Function: Submenu

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

Fig. 2.5-12 MOD1/MOD2 submenu

Softkey 11: MOD 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 EXT CAL (external calibration)

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

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

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

Softkey 15: AM-COUPL

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

2.5.10 Oscilloscope / DC Measurement

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

2.6 Duplex Test (DX-Test)*)

0	RX-TEST	DX-TEST CMS - Local		TX-TEST	8
1	SET RF	**100.00000** MHz	**0.00000** MHz	COUNT / SET RF	9
2	RF LEV	**1.000** uV 20 dB +0	**---W** -0.25	POWER	10
3	AF LEV	**0.1** mV RMS +0.25	**---kHz** RMS +0.025	DEMOD	11
4	MOD1 / MOD2	2.800 kHz 0.000 kHz	1.3000 kHz 1.00 mV	AF1 / LEV1	12
5	FILTER	OFF	0.3000 kHz 0.00 mV	AF2 / LEV2	13
6	SINAD / DIST	--- dB 1.300 kHz +0.025	NARROW WIDE	IF	14
7	S/N	--- dB +0.025	EXT ATT 0.0 dB 0.0 dB	INPUT1 / INPUT2	15

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.

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. 2.6-2 SET RF submenu

*) depending on option

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 ($\mu V \leftrightarrow dBm \leftrightarrow dB\mu V$).

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

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.
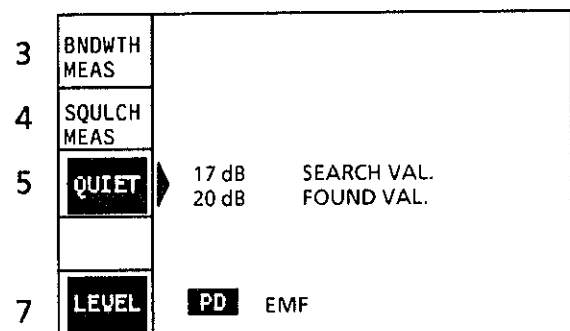
Fig. 2.6-3 RF LEV submenu

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.

The AF LEV function branches to a submenu which is output in the display fields next to soft-keys 4 to 7.
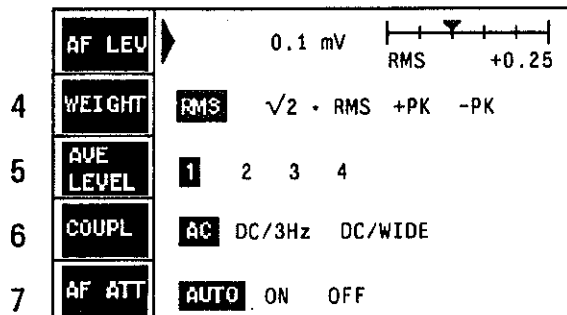
Fig. 2.6-4 AF LEV submenu

Softkey 4: WEIGHT
        (Weighting)

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

RMS: Real RMS weighting

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

        This weighting is used if the peak value is to be determined when modulating with sinewave signals, and 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 √2 * RMS weighting. Four averaging possibilities are provided:

1: One measurement determines the result.

2: The result is the average of two measurements.

3: The result is the average of three measurements.

4: The result is the average of four measurements.

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.
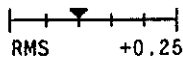
Fig. 2.6-5 FILTER submenu 1

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)*)

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

---

*)   depending on model or option

Softkey 7: EXT FILTER

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

The FILTER submenu 2 is called by pressing the MENU ↓ (DOWN) key.
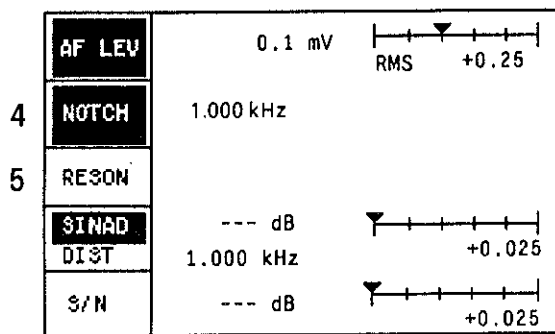
Fig. 2.6-6 FILTER submenu 2

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.

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 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.

*) depending on model or option

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.

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

Test frequency

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

Automatic search routine

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

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

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

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

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

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.
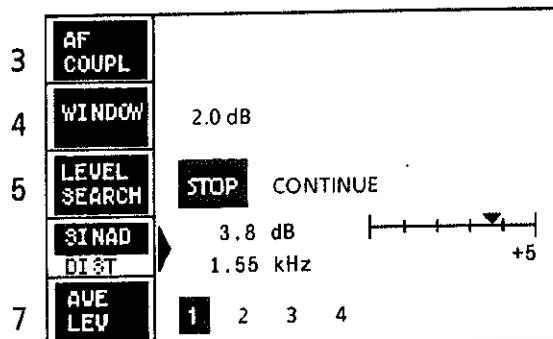
Fig. 2.6-7 SINAD/DIST submenu

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 LEVEL (Averaging factors)

Four averaging factors can be selected using softkey 7:

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

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

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

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

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

In local and IEC bus mode, the single measurements are repeated following a delay 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 modula-
tion value and the dimension to the demodula-
tion mode of the CMS.

If the demodulation mode indicated in the dis-
play 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 modula-
tion 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 con-
trast 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 under-
stood 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 Monitor/Tracking*)

0	RX-TEST	SPECT	CMS-Local		TX-TEST	8
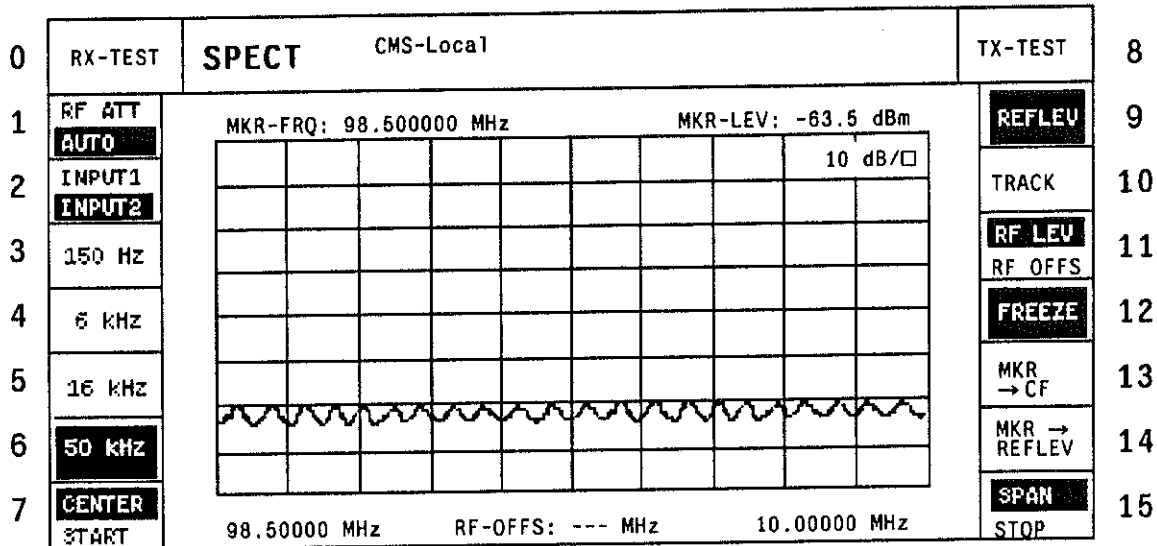
Fig. 2.7-1 Main menu SPECT

Starting from the main menu display in the selection menu, the main menu SPECT (spectrum monitor) can be entered by pressing the SPECT softkey. Display is always 10 dB/DIV.

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 monitor 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.

*) depending on option

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 as EXT-ATT: -- dB.

2.7.3 Measurement Filter

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

Softkeys 3, 4, 5 and 6 are used to select four filter bandwidths. This selection however depends 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.

Please note that the spectrum monitor of the CMS does not have any overload capability. In the case of intermodulation measurements on SSB-transmitters (dual tone), for example, a reference level that has been increased by 6 dB must therefore be selected.

2.7.6   Freeze Mode

FREEZE Function

The so-called "Freeze" mode is switched on and off by pressing softkey 12.

In the Freeze mode the picture is frozen after the sweep has been terminated; it is now possible to vary the X-position of the marker (identified by a cross) as required using the spinwheel VAR.

During Freeze mode it is possible to listen to the frequency defined by the marker provided that the level is sufficiently high (squelch switched on). FM only is used.

The corresponding marker frequency and the RF-level at this position is then additionally displayed.

The marker frequency displayed can be defined as centre frequency by way of softkey 13 (MKR → CF). Softkey 14 (MKR → REFLEV) serves to turn the indicated marker level into the reference level.

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

2.7.7 Tracking Mode*)
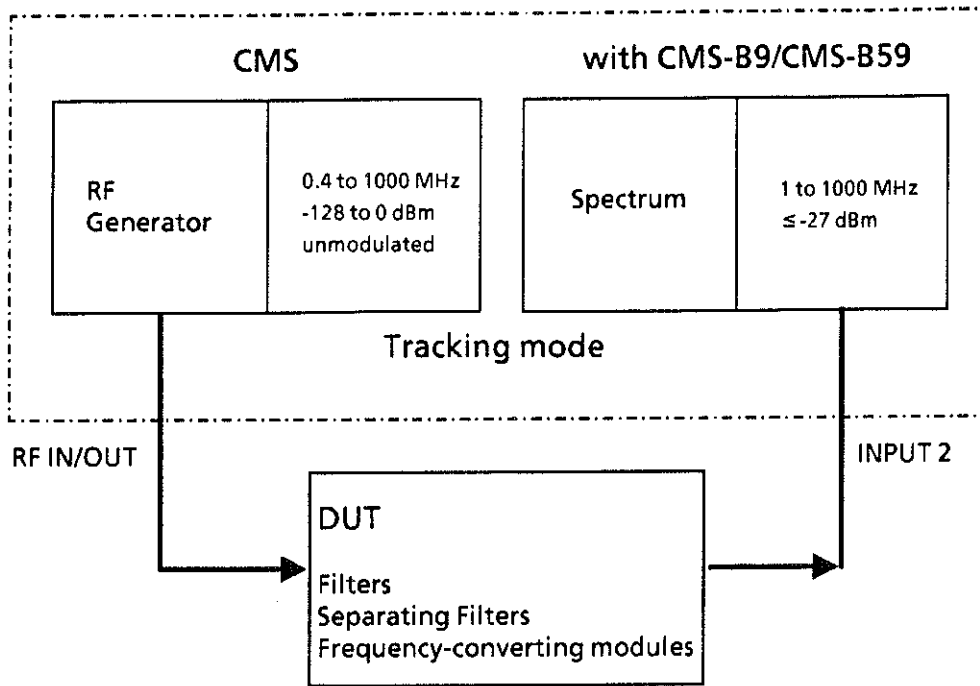
The frequency offset between the RF generator and the spectrum evaluation filter is user-definable from 0 to max. ± 999 MHz (dependent upon selected center frequency and display width).

Evaluation dynamics: 50 dB (1 to 500 MHz)
                            45 dB (500 to 1000 MHz)

As in Spectrum mode, four evaluation filters are available:
150 Hz, 6 kHz, 16 kHz and 50 kHz for user-definable display widths from 0 to 10 MHz.

TRACK Function	RF LEV/RF OFFS Function

By pressing softkey 10 tracking mode (tracking generator) is switched on and off. In this mode an RF signal is output to the RF IN/OUT socket in correspondance with the selected span and the level can be displayed at the RF IN 2 socket. This serves eg to display filter frequency responses.

Softkey 11 is used to set the level at the RF IN/OUT socket.
The RF OFFS function allows to define the difference in frequency between the RF IN/OUT socket and the RF IN2 socket, eg for measurements on frequency-converting modules. The measured value may either be positive or negative.

*) depending on option

2.8   Definition Menu for Tones

0	RX-TEST	**TONES**	CMS - Local				TX-TEST	8

1	STD RESET	Std.01 ZVEI1			INDEPENDENT	COUPLED	DECODE → CODE	9
2	NO SPC LENGTH	1 70 ms	0: Fix.Frq. 4:EEA 8: CCITT		10000 ms		DECODE TIME	10
3	OTHER PAUSE	70 ms 0 ms	1: ZVEI 1 5:EIA 9: NATEL 2: ZVEI 2 6:VDEW 10:DTMF 3: CCIR 7:EURO 11:VDEW d				1stTONE 2ndTONE	11
4	TONE 0 TONE 1	2400.0 Hz 1060.0 Hz	0.0 Hz 0.0 Hz	2000.0 Hz 2200.0 Hz	0.0 Hz 0.0 Hz		TONE 8 TONE 9	12
5	TONE 2 TONE 3	1160.0 Hz 1270.0 Hz	0.0 Hz 0.0 Hz	2799.9 Hz 810.0 Hz	0.0 Hz 0.0 Hz		TONE A TONE B	13
6	TONE 4 TONE 5	1400.0 Hz 1530.0 Hz	0.0 Hz 0.0 Hz	970.0 Hz 886.0 Hz	0.0 Hz 0.0 Hz		TONE C TONE D	14
7	TONE 6 TONE 7	1670.0 Hz 1830.0 Hz	0.0 Hz 0.0 Hz	2599.9 Hz 0.0 Hz	0.0 Hz 0.0 Hz		TONE E TONE F	15

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

2.8.2   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 un-modified 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 7.

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.

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

MEAS TIME means the time during which the peak value meter evaluates all the voltage peaks occurring. ATTACK TIME is the time by which evaluation is delayed after command execution.
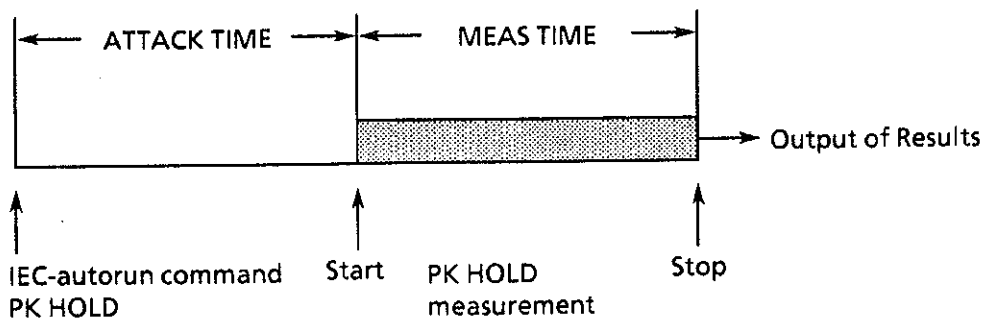
2.9.2 IEC/IEEE Bus *)

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. Standard setting is address 24.

2.9.3 Display Illumination

ILLUM Function

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

ON: Illumination of the CMS remains activated.

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

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

2.9.4 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.

*) depending on model or option

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

2	**RELAIS SET**	FO: 1111 0000
3	**HEX/ DEC**	**HEX** DEC
4	RX/TX CTRL	
5	**TTL IN/OUT**	A84: 1010 1000 0100
6	**HEX/ DEC**	**HEX** DEC
7	**IN/OUT CTRL**	**IN_IN** IN__OUT OUT__IN OUT__OUT

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:	0F 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

    relays are set
    relays not influenced
    individual relays are to be set
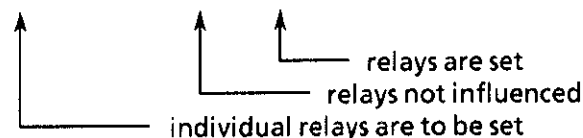
3. Resetting individual relays: range of values between   0 and 255 + 512 (200 and 2FF Hex)

    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

                        ↑   ↑   ↑
                        | | └──── relays are reset
                        | └──────── relays not influenced
                        └──────────────────── individual relays are to be reset
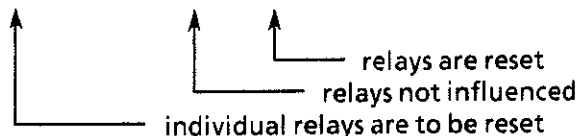
Note: **Some options do not have 8 relays. In this case relays not available are marked by X.**

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 4095 (0 and FFF Hex)

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

    e. g.: setting all TTL lines.
        previous setting: 255 Hex = 0010 0101 0101 B
        entered value: 0 00F Hex = 0000 0000 1111 B
        new setting: 25F Hex = 0000 0000 1111 B

                            ↑   ↑   ↑   ↑
                            | | | └──── TTL lines are set
                            └───────────────────── TTL lines are to be set
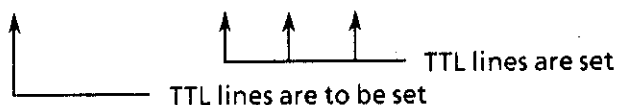
2. Setting individual TTL lines: range of values between   0 and 4095 + 4096 (1000 and 1FFF Hex)

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

    e. g.: setting all less significant 4 TTL lines, leaving all more significant lines unaffected.
        previous setting: 255 Hex = 0010 0101 0101 B
        entered value: 1 00F Hex = 0000 0000 1111 B
        new setting: 25F Hex = 0010 0101 1111 B

                            ↑   ↑   ↑   ↑
                            | | | └──── TTL lines are set
                            | └─────────── TTL lines not influenced
                            └──────────────────── individual TTL lines are to be set
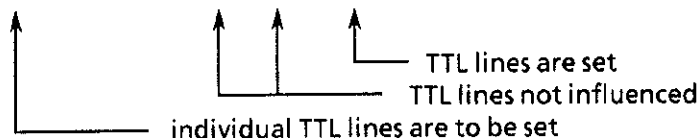
3. Resetting individual TTL lines: range of values between 0 and 4095 + 8192 (2000 and 2FFF Hex)

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

e. g.: resetting all less significant 4 TTL lines, leaving all more significant lines unaffected.
    previous setting: 255 Hex = 0010 0101 0101 B
    entered value: 2 00F Hex = 0000 0000 1111 B
    new setting: 25F Hex = 0010 0101 0000 B

TTL lines are reset
TTL lines not influenced
individual TTL lines are to be reset

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.
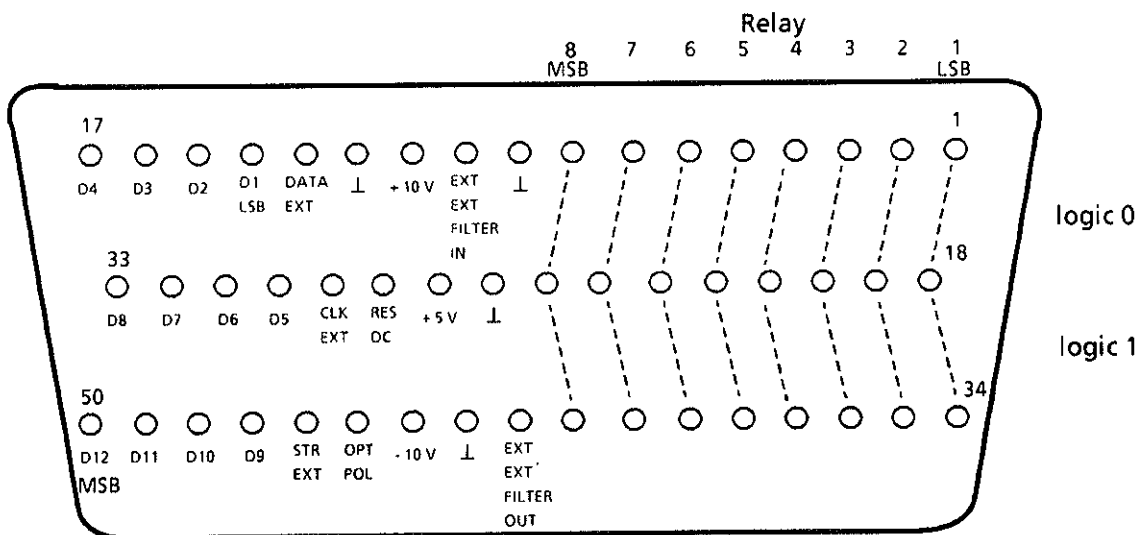
Fig. 2.9-4   Pin assignment of connector CONTROL

2.9.5 ZOOM

```
ZOOM Function
```

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

2.9.6 LO Frequency LO/HIGH

```
LO HIGH Function
```

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

2.9.7 Selection of Printer

```
PRINTER TYPE Function
```

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

2.9.8 600-Ω AF Transformers*)

```
AF-TRANSF Function
```

One 600-Ω transformer 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 AF voltmeter and modulation generator are appropriately corrected in this mode.

2.9.9 AF Voltmeter (Reference Resistance)

```
AF VOLTM Function
```

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

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

2.9.10 External Reference Frequency*)

```
REF FRQ EXTERN Function
```

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

2.9.11 Acoustic Acknowledgement

```
KEY BEEP Function
```

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

2.9.12 Warnings

```
WARNING Function
```

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

2.9.13 Master Reset

```
MASTER RESET Function
```

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

*) depending on model or option

2.10   Remote Control*)

The IEC/IEEE bus interface corresponds to the IEC 625-1 or IEEE 488.1 standard and to IEEE 488.2 also approved of by the IEC commission. This standard describes data transfer formats and common commands etc.
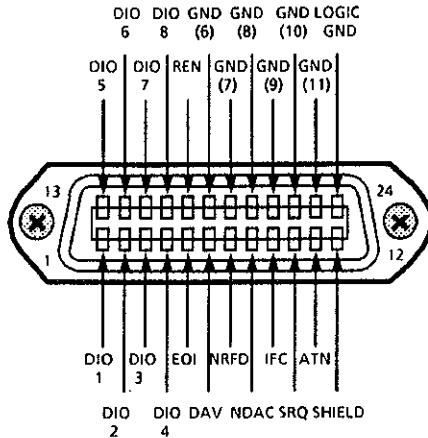
Fig. 2.10-1 Pin assignment of socket *48*

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:

*) depending on model or option

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:

Interface message

ASCII character

Decimal
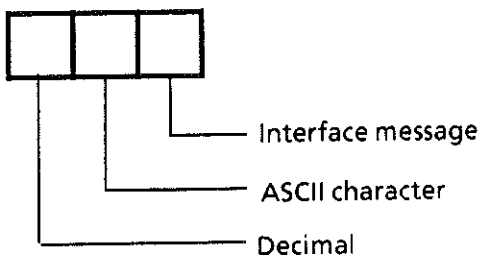
2.10.4 Device Messages

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: *POWER:RF?*

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

- Header and number

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

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

- Header and string

  Example: *FREQUENCY:AF:I1 ON*

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

Lower case/upper case letters:

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

Spaces:

Additional spaces may be inserted at the following points:

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

Decimal numbers:

The following notations are permissible for decimal numbers:

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

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

- With or without exponent to base 10, "E" or "e" is used as the exponent character.
  e. g. *.451, 451E-3, +4.51e-2*

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

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

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

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

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

Hexadecimal and binary numbers:

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

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

Binary number
e.g. #b101011, #B11001

String entries:

The following notations are permissible for string entries:

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

Command line

(;)

(,)

(') — ASCII character — (')→

(") — ASCII character — (")→

(#) — (H) — Hexadec. number →

(#) — (B) — Binary number →

(SP) — Numeric value (dec.) — Unit →

○ — (SP) — Header

(?)

(SP) — Terminator

Numeric value (decimal)

(+) (-) — (Digit) — (.) — (Digit)

(Digit)

(E) (e) — (+) (SP) (-) — (Digit)

├──── Mantissa ────┼──── Exponent ────┤
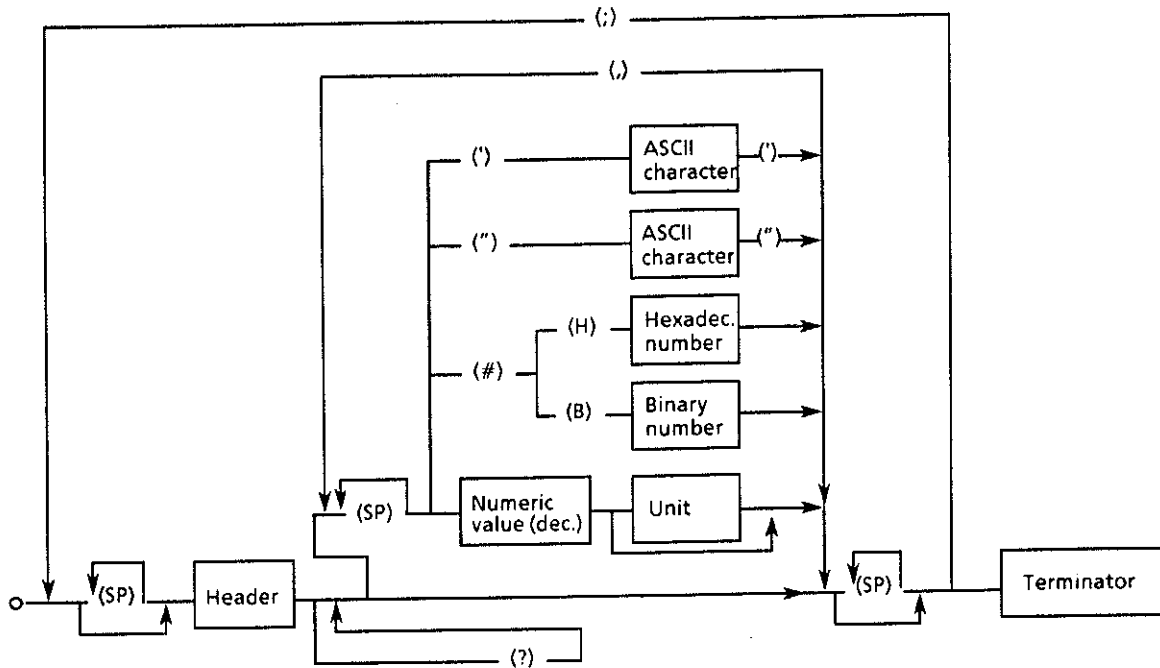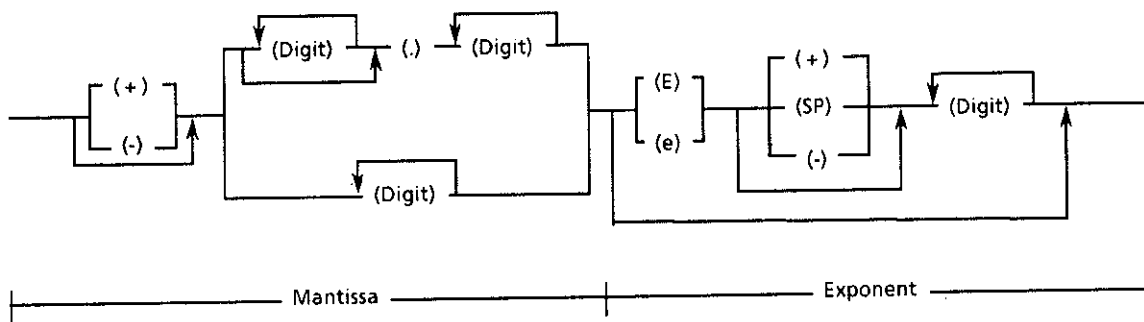
SP: Any character with ASCII code 0 to 9 and 11 to 32 decimal, especially space.

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 of the units specified in Table 2.10-8 (V, A, W, OHM, S, Hz, RAD, PCT, DB).

Special Cases in the Talker Mode

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

- Demodulation: DEMODULATION?

  Two results are output. However, the second result makes only sense with peak weighting of the demodulated signal. Otherwise a zero is output as second result.

- Search Routines

  In the case of all search routines two results in accordance with the following table are output.

Search Routine	1st Result	2nd Result
Bandwidth Measurement	Actual value of bandwidth	Actual value of delta frequency
Squelch	Act. value of Switch Off RF	Actual value of Squelch Hysteresis
Quieting	Actual value of Quiet	Actual value of RF Level
Sinad/Dist/SN	Actual value of Sinad/SN	Actual value of RF Level
Modulation Sensitivity	Nominal value of Demod	Actual value of AF Level 1

- Read out contents of decoded telegram: DECODE:NUMBER?

  The contents of the decoded telegram can be output using DECODE:NUMBER? 0 to 40. The number specifies which entry in the measurement buffer is to be output. Each entry in the buffer consists of three values:

  1st   Time in seconds
  2nd   Frequency in Hz
  3rd   Deviation in percent from the nominal value

Output message line
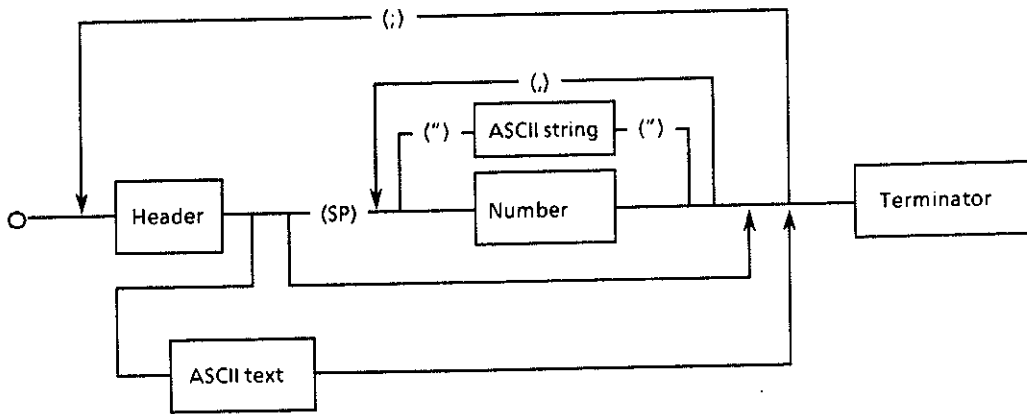
Number
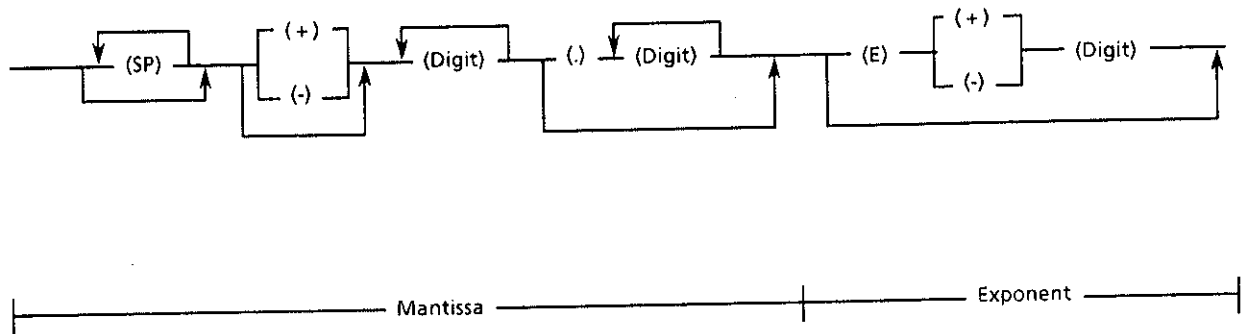
SP: Space (ASCII code 32 decimal)
ASCII text: Reply to command *IDN? (see table 2.10-7)

Fig. 2.10-3 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
*PRε	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	alphanumeric	**Identification Query** The following identification text is sent via the IEC/IEEE bus as a reply to the IDN? command. Example: Rohde&Schwarz, CMS,0,X.XX Rohde&Schwarz = manufacturer CMS = model 0 = reserved for serial number, (not used with CMS) X.XX = firmware version (e.g. V1.00)
*PSc?	1	0 or 1	**Power On Status Clear Query** To read the status of the Power On Clear Flags, see *PSC in Table 2.10-6
*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.
*STв?	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.
*TSт?	1	0 to 255	**Self-Test Query** The output value "0" indicates the duly completion of the self-test.
*ISт?	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)

ROHDE&SCHWARZ, CMS, x, x , x , x , x, x, x , x , x, x, x , x , x

- FFSK modem
- Autorun control
- AF amplifier
- V/I measurement
- Relay/TTL expansion
- DTMF/printer
- Ext. filter
- C-message filter
- CCITT filter
- OCXO
- CR signalling
- Adj. channel power filter
- Duplex synthesizer
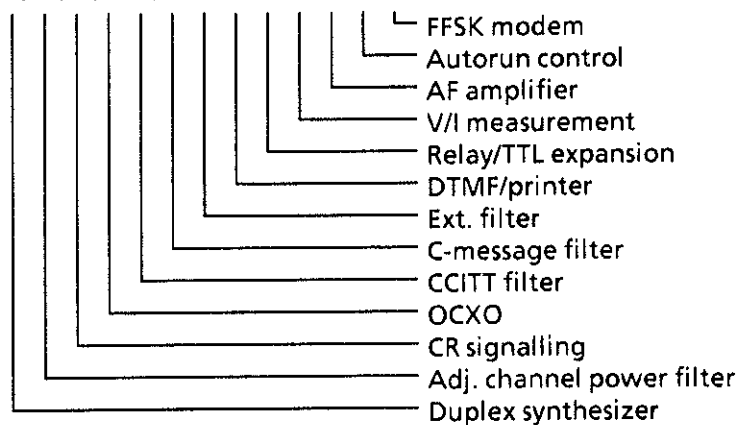
x = 1: option fitted
x = 0: option not fitted

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 OFF	---	Step size of set values
X:REFERENCE	no. ON OFF	---	Measured or set value becomes reference
X:TOLERANCE:UPPER X:TOLERANCE:LOWER	no. ON OFF	---	Output of tolerance markers in the analog display
X:RANGE	no. ON OFF	---	Full-scale value of analog display
RESET	---	---	Reset to original state
PRESET	---	---	Reset to a defined state
STORE:STATE	number (1-3)	---	Storing of device state
STORE:FREQUENCY	number (10-29)	---	Storing of RF frequency
RECALL:STATE	number (1-3)		Recall of device state
RECALL:FREQUENCY	number (10-29)		Recall of RF frequency
HARDCOPY	---	---	Hardcopy of screen contents
DISPLAY:MENU	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 OFF	---	The output of the IEC bus header is switched on or off.

Main menu		Submenu			
Index	Name	Index	Name	Index	Name
0	Selection menu	0	no submenu	20	RX-CODE 1
1	TX-Test menu	1	TX-SET-RF	21	RX-CODE 2
2	RX-Test menu	2	TX-POWER	22	RX-FILTER 1
3	Duplex-Test	3	TX-COUNT	23	RX-FILTER 2
4	TONES menu	4	ACP1 (ACP)	24	RX-SINAD
5	TONES AF1/AF2	6	DEMOD	25	RX-S/N
6	SPECTRUM menu	7	TX-AF-COUNT	26	RX-MOD 1
7	CONFIG menu	8	DECODE1	28	CONFIG search routine
13	SELFCHECK menu	9	DECODE2	30	CONFIG Control
14	CR-SEL menu	10	TX-FILTER 1	66	VOR/ILS/SCOPE
15	CR main menu	11	TX-FILTER 2		
16	Modem menu	12	DISTORTION		
17	VOR	13	TX-S/N		
18	ILS-LOC	14	TX-LEVEL		
19	ILS-GS	15	TX-SCOPE		
20	Marker Beacon	17	RX-RF-LEVEL		
21	R232	18	RX-AF-LEVEL		
22	R232 Config.	19	RX-AF-COUNT		

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:**A**F:**R**XTEST		M**H**Z K**H**Z H**Z**	Counting the AF frequency of the AF voltmeter
COUNT:**A**F:**R**XTEST:**R**EFERENCE	number **ON OF**F	M**H**Z K**H**Z H**Z**	
COUNT:**A**F:**R**XTEST:**T**OLERANCE:**L**OWER	**ON OF**F	M**H**Z K**H**Z H**Z**	
COUNT:**A**F:**R**XTEST:**T**OLERANCE:**U**PPER	**ON OF**F	M**H**Z K**H**Z H**Z**	
COUNT:**A**F:**R**XTEST:**P**ERIOD	**P**ERIOD **G**ATE	---	Operating mode of the AF counter
POWER:**R**F		W **D**BM	Power measurement
POWER:**R**F:**TO**LERANCE:**U**PPER	number **ON OF**F	W **D**BM	
POWER:**R**F:**TO**LERANCE:**L**OWER	number **ON OF**F	W **D**BM	
POWER:**R**F:**R**EFERENCE	number **ON OF**F	W **D**BM	
POWER:**R**F:**R**ANGE	number **ON OF**F	W **D**BM	
POWER:**R**F:**P**EP	**ON OF**F		
DEMODULATION	number	**P**CT M**H**Z K**H**Z H**Z R**AD	Selection of demodulation type
DEMODULATION:**T**OLERANCE:**U**PPER	number **ON OF**F	**P**C T M**H**Z K**H**Z H**Z R**AD	DEMOD measurement and search routine
DEMODULATION:**T**OLERANCE:**LOW**ER	number **ON OF**F	**P**CT M**H**Z K**H**Z H**Z R**AD	
DEMODULATION:**R**ANGE	number **ON OF**F	**P**CT M**H**Z K**H**Z H**Z R**AD	
DEMODULATION:**R**EFERENCE	number **ON OF**F	**P**CT M**H**Z K**H**Z H**Z R**AD	
DEMODULATION:**D**EEMPHASIS	**N**ORMAL **S**EL—750	---	Deemphasis: no deemphasis or 750 µs
DEMODULATION:**W**EIGHTING	**A**UTO **PK RMS RMS _ S**QRT 2 **PK2**	---	Weighting: peak, RMS RMS· √2, average of pos. and negative peak
DEMODULATION:**A**VERAGING	**SEL _ 1 SEL _ 2 SEL _ 3 SEL _ 4**	---	Averaging
DEMODULATION:**C**ONTROL	**S**QUELCH **ON OF**F	---	Demodulation: Squelch on, off
PEAKHOLD		**P**CT M**H**Z K**H**Z H**Z R**AD	Selection of demodulation mode and retaining max. value
PEAKHOLD:**T**OLERANCE:**U**PPER	number **ON OF**F	**P**CT M**H**Z K**H**Z H**Z R**AD	
PEAKHOLD:**T**OLERANCE:**L**OWER	number **ON OF**F	**P**CT M**H**Z K**H**Z H**Z R**AD	
PEAKHOLD:**R**EFERENCE	number **ON OF**F	**P**CT M**H**Z K**H**Z H**Z R**AD	
PEAKHOLD:**R**ANGE	number **ON OF**F	**P**CT M**H**Z K**H**Z H**Z R**AD	

Command	Data	Units	Function
ACP:FILTER	ON OFF SEL — 16KHZ SEL — 14KHZ SEL — 8 — 5KHZ	---	Filter selection when choosing any channel spacing
ACP:CHANNELSPACE	SEL — 25KHZ SEL — 20KHZ SEL — 12 — 5KHZ SEL — 10KHZ	---	Selecting specific channel spacings
ACP:TOLERANCE:LOWER	number ON OFF	UV MV V DBUV W DBM DB	Setting lower tolerance markers for adjacent channel measurement
ACP:TOLERANCE:UPPER	number ON OFF	UV MV V DBUV W DBM DB	Setting upper tolerance markers for adjacent channel measurement
ACP:RANGE	number ON OFF	UV MV V DBUV W DBM DB	Selecting measurement range
ACP:FREECHANNEL	number ON OFF	MHZ KHZ HZ	Selecting any channel spacing
ACP:ADJACENT:CHANNEL	PLUS — 2 PLUS — 1 MINUS — 1 MINUS — 2	---	Selection of channel for the first/second and upper/lower adjacent channel

Command	Data	Units	Function
DECODE	---	---	Decoding of selective call
DECODE:**ST**ANDARD	number	---	Selection of standard (see Section 2.4.4)
DECODE:**D**IGITREPEAT	**ON OF**F	---	Digit repeat
DECODE:**B**ANDWIDTH	number	**P**CT	Evaluation bandwidth
DECODE:**P**AUSE	number	**S M**S **U**S	Tolerable pause
DECODE:**SO**URCE	**D**EMOD **A**FVOLT	---	Selection of source
DECODE:**N**UMBER	number	---	Tone number
CODE	string	---	Transmitting of selective call
CODE:**ST**ANDARD	number	---	Selection of standard (see Section 2.4.4)
CODE:**MSGR**EPEAT	number	---	Number of telegrams to be transmitted
CODE:**REP**EATTONE	**ON OF**F	---	Tone repetition
CODE:**A**CKTEST	**ON OF**F **R**F_OFF	---	Acknowledgement test
CODE:**F**R_TUNE	number	**P**CT	Frequency deviation
CODE:**SP**ECIAL:**N**UMBER	number	---	Selection of extra tone
CODE:**SP**ECIAL:**L**ENGTH	number	**S M**S **U**S	Length of extra tone
CODE:**O**THER:**L**ENGTH	number	**S M**S **U**S	Duration of other tones
CODE:**D**IGITPAUSE	number	**S M**S **U**S	Time elapsing between the tones
CODE:**MSGP**AUSE	number	**S M**S **U**S	Time elapsing between the telegrams
CODE:**RES**ET	---	---	Resetting the original prameters
FILTER:**T**XTEST	**ON OF**F	---	Switching on/off the selected filters in TX-Test
FILTER:**T**XTEST:**H**P	**ON OF**F	---	High pass filter in TX-Test
FILTER:**T**XTEST:**L**P	**ON OF**F	---	Low pass filter in TX-Test
FILTER:**T**XTEST:**P**SOPHOMETRIC	**ON OF**F	---	Psophometric filter in TX-Test
FILTER:**T**XTEST:**N**OTCH	number **ON OF**F	**M**HZ **K**HZ **H**Z	Notch filter in TX-Test
FILTER:**T**XTEST:**R**ESONANCE	number **ON OF**F	**M**HZ **K**HZ **H**Z	Resonance filter in TX-Test
FILTER:**T**XTEST:**E**XTERNAL	**ON OF**F	---	External filter in TX-Test
FILTER:**T**XTEST:**I**F	**WI**DE **NA**RROW	---	IF filter

Command	Data	Units	Function
FILTER:RXTEST	ON OFF	---	Switching on/off the selected filters in RX-Test
FILTER:RXTEST:HP	ON OFF	---	High pass filter in RX-Test
FILTER:RXTEST:LP	ON OFF	---	Low pass filter in RX-Test
FILTER:RXTEST:PSOPHOMETRIC	ON OFF	---	Psophometric filter in RX-Test
FILTER:RXTEST:NOTCH	number ON OFF	MHZ KHZ HZ	Notch filter in RX-Test
FILTER:RXTEST:RESONANCE	number ON OFF	MHZ KHZ HZ	Resonance filter in RX-Test
FILTER:RXTEST:EXTERNAL	ON OFF	---	External filter in RX-Test
ATTENUATION:IF	ON OFF AUTO	---	Attenuation of IF control
DISTORTION:TXTEST	number	PCT MHZ KHZ HZ DB	Distortion measurement of demodulated signal
:TOLERANCE:UPPER	number ON OFF	PCT MHZ KHZ HZ DB	
:TOLERANCE:LOWER	number ON OFF	PCT MHZ KHZ HZ DB	
:RANGE	number ON OFF	PCT MHZ KHZ HZ DB	
DISTORTION:TXTEST:AFCOUPLED	ON OFF	---	
		---	The frequency of the modulation generator is identical with the distortion measurement frequency.
DISTORTION:TXTEST:AVERAGING	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:**O**FF	---	---	
DC:VOLTAGE	number	MV V	DC voltage measurement
DC:VOLTAGE:**RE**FERENCE	number **ON OF**F	MV V DB	
DC:VOLTAGE:**RA**NGE	number **ON OF**F	MV V DB	
DC:VOLTAGE:**T**OLERANCE:**U**PPER	number **ON OF**F	MV V DB	
DC:VOLTAGE:**T**OLERANCE:**L**OWER	number **ON OF**F	MV V DB	
DC:CURRENT	number	MA A	DC current measurement
DC:CURRENT:**RE**FERENCE	number **ON OF**F	MA A DB	
DC:CURRENT:**RA**NGE	number **ON OF**F	MA A DB	
DC:CURRENT:**T**OLERANCE:**U**PPER	number **ON OF**F	MA A DB	
DC:CURRENT:**T**OLERANCE:**L**OWER	number **ON OF**F	MA A DB	

IEC-bus-command for the SCOPE mode

Command	Data	Units	Function
SCOPE:**C**ONTINUE	**ON OF**F	---	ON: Activation of the scope OFF: FREEZE mode
SCOPE:**C**ONTINUE:**A**UTO	---	---	Automatic selection of source
SCOPE:**C**ONTINUE:**S**OURCE	**M**ODEXT **D**EMOD—BEAT **A**F	---	Defined selection of source
SCOPE:**C**ONTINUE:**D**ISTORTION	---	---	Selection of source: notch filter, resonance filter
SCOPE:**B**ESTRANGE	**ON OF**F	---	Selection of best measuring range
SCOPE:**A**MPLITUDE	number	---	Amplitude setting
SCOPE:**T**IME	number	---	Time setting
SCOPE:**Y**POSITION	number	---	Y position

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 Tones:TONE1 Tones:TONE2 Tones:TONE3 Tones:TONE4 Tones:TONE5 Tones:TONE6 Tones:TONE7 Tones:TONE8 Tones:TONE9 Tones:TONEA Tones:TONEB Tones:TONEC Tones:TONED Tones:TONEE Tones:TONEF	number number number number number number number number number number number number number number number number	MHz KHz Hz MHz KHz Hz MHz KHz Hz MHz KHz Hz MHz KHz Hz MHz KHz Hz MHz KHz Hz MHz KHz Hz MHz KHz Hz MHz KHz Hz MHz KHz Hz MHz KHz Hz MHz KHz Hz MHz KHz Hz MHz KHz Hz MHz KHz Hz	Assignment of tones to frequencies
Tones:AF:I10 Tones:AF:I11 Tones:AF:I12 Tones:AF:I13 Tones:AF:I14 Tones:AF:I15 Tones:AF:I16 Tones:AF:I17 Tones:AF:I20 Tones:AF:I21 Tones:AF:I22 Tones:AF:I23 Tones:AF:I24 Tones:AF:I25 Tones:AF:I26 Tones:AF:I27	number number number number number number number number number number number number number number number number	MHz KHz Hz MHz KHz Hz MHz KHz Hz MHz KHz Hz MHz KHz Hz MHz KHz Hz MHz KHz Hz MHz KHz Hz MHz KHz Hz MHz KHz Hz MHz KHz Hz MHz KHz Hz MHz KHz Hz MHz KHz Hz MHz KHz Hz MHz KHz Hz	Assignment of tones to frequencies for standard 0 (variation series for modulation generators 1 and 2)

Command	Data	Units	Function
CONFIGURATION:**AF**:**T**RANSFORMER		SEL_600_OHM	NORMAL
CONFIGURATION:**R__**REFERENCE	number	OHM	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	NECP6,7 EPSON PDN CM-Z22	---	Printer type
CONFIGURATION:**SCR**EEN: LIGHTING	**ON OF**F SEL__5__MIN SEL__1__H		Lighting of the CMS is switched on/off or switched on for 5/60 min
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: LIMIT:**M**EASURE	number	S Ms Us	Measuring time
CONFIGURATION:**RO**UTINE: LIMIT:**A**TTACKTIME	number	S Ms Us	Wait time until meas. start
CONFIGURATION:**CO**NTROL:**T**TL	number	---	Input and/or output of the TTL interfaces
CONFIGURATION:**CO**NTROL:**T**TL:**V**ARIATION	number	---	
CONFIGURATION:**CO**NTROL:**T**TL:**RE**LAYS	number	---	Programming of the relays
CONFIGURATION:**CO**NTROL:**T**TL:**RE**LAYS :**V**ARIATION	number	---	
CONFIGURATION:**CO**NTROL:**I**NOUT	IN__IN IN__OUT OUT__IN OUT__OUT	---	Programming of the TTL interface
CONFIGURATION:**CO**NTROL:**RX** TX	**ON OF**F	---	Setting most significant relays via RX - TX switchover
LANGUAGE	ENGLISH SWEDISH DEUTSCH ITALIAN FRENCH SPANISH	---	Language switchover
CONFIGURATION:**LO**:**H**IGH	**ON OF**F	---	LO frequency

Command	Data	Units	Function
SPECTRUM:**AT**TENUATION	number	**D**B	RF input attenuation
SPECTRUM:**R**EFERENCE:**L**EVEL	number	**M**V **U**V **W DBM** **DBU**V	Reference level
:VARIATION	number **ON OF**F	**M**V **U**V **W DBM** **DBU**V	
SPECTRUM:**STO**P	number	**M**HZ **K**HZ **H**Z	Stop frequency
SPECTRUM:**SP**AN	number	**M**HZ **K**HZ **H**Z	Frequency span
SPECTRUM:**STA**RT	number	**M**HZ **K**HZ **H**Z	Start frequency
SPECTRUM:**C**ENTER	number	**M**HZ **K**HZ **H**Z	Center frequency
SPECTRUM:**FI**LTER	**SEL__150 Hz** **SEL__6 K**HZ **SEL__16 K**HZ **SEL__50 K**HZ	---	Resolution filter
SPECTRUM:**AU**TO ATTENUATION	---	---	Automatic RF input attenuation

Command	Data	Units	Function
SERVICE:**B**ATTERY	**ON OF**F		Battery voltage measurement
CALIBRATION:**PO**WER	---	---	Calibration of power meter
CALIBRATION:**PE**AK	---	---	Calibration of peak meter
CALIBRATION:**C**YCLIC	**ON OF**F	---	Cyclic calibration
CALIBRATION:**D**ISTORTION	---	---	Distortion calibration
CALIBRATION:**DE**TECTOR:**R**MS	---	---	Calibration of RMS detector
CALIBRATION:**M**ODULATION:**F**ILTER	---	---	Calibration of AF synthesizer filters
CALIBRATION:**M**ODULATION: **G**ENERATOR	---	---	Calibration of offset and amplitude of the AF synthesizers
CALIBRATION:**S**YNTHESIZER	---	---	Calibration of synthesizer deviation
SERVICE:**B**ATTERY	---	---	Battery voltage

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).

```
                                                    ── Power On
                                                    ── User Request
                                                    ── Command Error
                                                    ── Execution Error
                                                    ── Device-dependent Error
                                                    ── Query Error
                                                    ── Request Control
                                                    ── Operation Complete
```

Bit number	7	6	5	4	3	2	1	0	Event Status Register *ESR?
Significance	128	64	32	16	8	4	2	1	

AND AND AND AND AND AND AND AND

Bit number	7	6	5	4	3	2	1	0	Event Status Enable *ESE value *ESE?
Significance	128	64	32	16	8	4	2	1	

(OR)

not empty ── Output buffer

	RQS								
	MSS	ESB	MAV						
Bit number	7	6	5	4	3	2	1	0	Status Byte *STB?
Significance	128	64	32	16	8	4	2	1	

AND   AND AND AND AND AND AND

Bit number	7	r s v	5	4	3	2	1	0	Service Request Enable *SRE value *SRE?
Significance	128		32	16	8	4	2	1	

(OR)

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

0		**S E L F C H K**	CMS - Local State			8
1	PEAK CAL			---V	BATT CHECK	9
2	RMS CAL				CYCL CAL	10
3	DIST CAL					11
4	POWER CAL					12
5	MODGEN ADJUST					13
6	MODGEN FILTER					14
7	SYNTH CAL					15

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.

2.11.10 Limits of Calibration Values

Calibration	Calibration value	Min.	Max.	Unit
PEAK CAL	Output Offset	- 20	+ 20	mV
	Gain	0.9	1.1	./.
	Input Offset			
	(Path AF AC)	- 30	+ 30	mV
	(Path Demod)	- 30	+ 30	mV
	(Path Dist)	- 30	+ 30	mV
	(Path Psoph)	- 30	+ 30	mV
	(Path Hp)	- 30	+ 30	mV
	(Path Lp Demod)	- 30	+ 30	mV
	(Path Lp AF AC)	- 30	+ 30	mV
RMS CAL	Output Offset	- 20	+ 20	mV
	Gain	0.9	1.1	./.
	Input Offset			
	(Path AF AC)	- 50	+ 50	mV
	(Path Demod)	- 50	+ 50	mV
	(Path Dist)	- 50	+ 50	mV
	(Path Psoph)	- 50	+ 50	mV
	(Path Hp)	- 50	+ 50	mV
	(Path Lp Demod)	- 50	+ 50	mV
	(Path Lp Af AC)	- 50	+ 50	mV
DIST CAL	Offset	- 40	+ 40	mV
	Gain	0.9	1.1	./.
POWER CAL	Offset	- 20	+ 20	mV
MODGEN ADJUST	Offset	- 270	+ 270	mV
	Amplitude	125	1550	mV
MODGEN FILTER	min/max Filter Correction Value at internal Modulation (GEN)	4152	7118	./.
	for f > 20 kHz		14236	./.
	min/max Filter Correction Value at MODGEN Output	4152	7118	./.
	for f > 20 kHz		14236	./.
SYNTH CAL	min/max Deviation Correction Value at Oscillator 1	5	254	./.
	min/max Deviation Correction Value at Oscillator 2	5	254	./.
BATT CHECK	Voltage	3.0	5.0	V

2.11.11 Error Messages

Battery Check

- error 1 : Voltage error - falling below
- error 2 : Voltage error - exceeding
- error   : General error

ADC Calibration

- error 1 : Offset error
- error 2 : Gain error
- error 3 : Offset error of DC amplifier
- error   : General error

Peak Detector Calibration

- error 1 : Offset error
- error 2 : Gain error
- error 3 : Offset error in AF AC   path
- error 4 : Offset error in Demod path
- error 5 : Offset error in Dist. path
- error 6 : Offset error in CCITT   path
- error 7 : Offset error in Hp   Pfad
- error 8 : Offset error in Lp Demod   path
- error 9 : Offset error in Lp AF AC path
- error   : General error

Modgen Filter Calibration

- error 1 : Freq. response error Modgen 1 - falling below
- error 2 : Freq. response error Modgen 1 - exceeding
- error 3 : Freq. response error Modgen 2 - falling below
- error 4 : Freq. response error Modgen 2 - exceeding
- error   : General error

Modgen Generator Calibration

- error 1 : Offset error
- error 2 : Amplitude error
- error   : General error

RMS Detector Calibration

- error 1 : Offset error
- error 2 : Gain error
- error 3 : Offset error in AF AC   path
- error 4 : Offset error in Demod path
- error 5 : Offset error in Dist path
- error 6 : Offset error in CCITT   path
- error 7 : Offset error in Hp   path
- error 8 : Offset error in Lp Demod   path
- error 9 : Offset error in Lp AF AC path
- error   : General error

Distortion Detector Calibration

- error 1 : Offset error
- error 2 : Gain error
- error   : General error

Power Meter Calibration

- error 1 : Offset error - exceeding
- error 2 : Offset error - falling below
- error   : General error

RF-Synthesizer Deviation Calibration

- error 1 : Deviation corr. value Osc. 1 - falling below
- error 2 : Deviation corr. value Osc. 1 - exceeding
- error 3 : Deviation corr. value Osc. 2 - falling below
- error 4 : Deviation corr. value Osc. 2 - exceeding
- error   : General error

3 Performance Test

Note: *For troubleshooting we recommend you the Service Manual with the order No. 840.8616.24-03-*

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 $\leq 1 \cdot 10^{-9}$ 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:
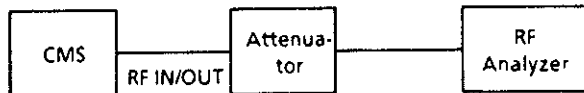
- Receiver test: 30 MHz, unmodulated
- Set the RF analyzer to the 10-μV range (1 dB/div) 30 MHz center with 15 kHz bandwidth.

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 5%.

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, FM deviation 10 kHz.

- The modulation distortion is below 1%.

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: -10 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: -10 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: -10 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:
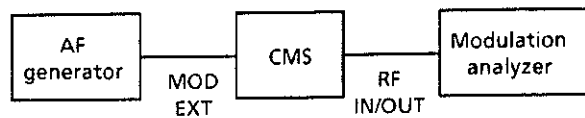
- Receiver test: -10 dBm, 30 MHz , external AM modulation with 1.41 V_p and 80 % AM

- 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:
  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:
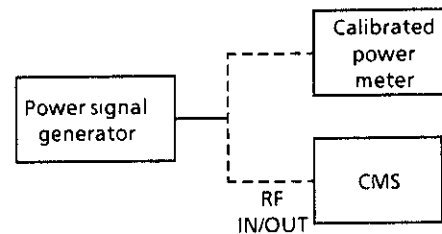
- Transmitter test: call power measurement by pressing the POWER softkey

- 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:
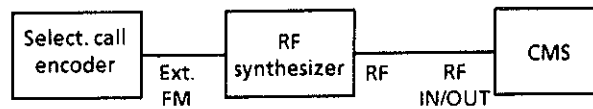
- Transmitter test: Decode

- 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	Measurement 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	Measurement 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	%
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 Frequencies	3.2.10				
	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	Measurement 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	Measurement 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	Measurement 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 measurement	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).
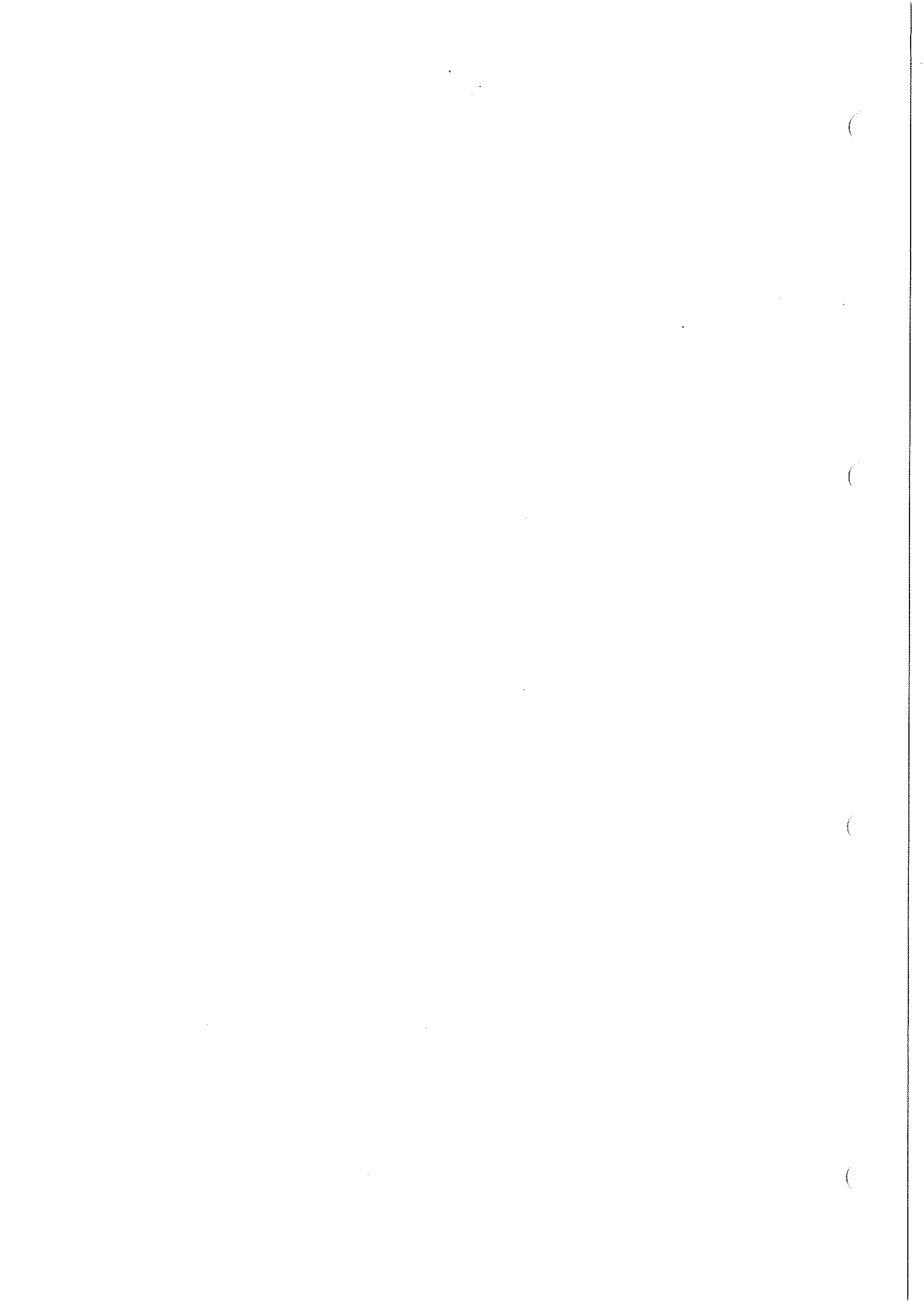
ROHDE&SCHWARZ

Bilder

Figures

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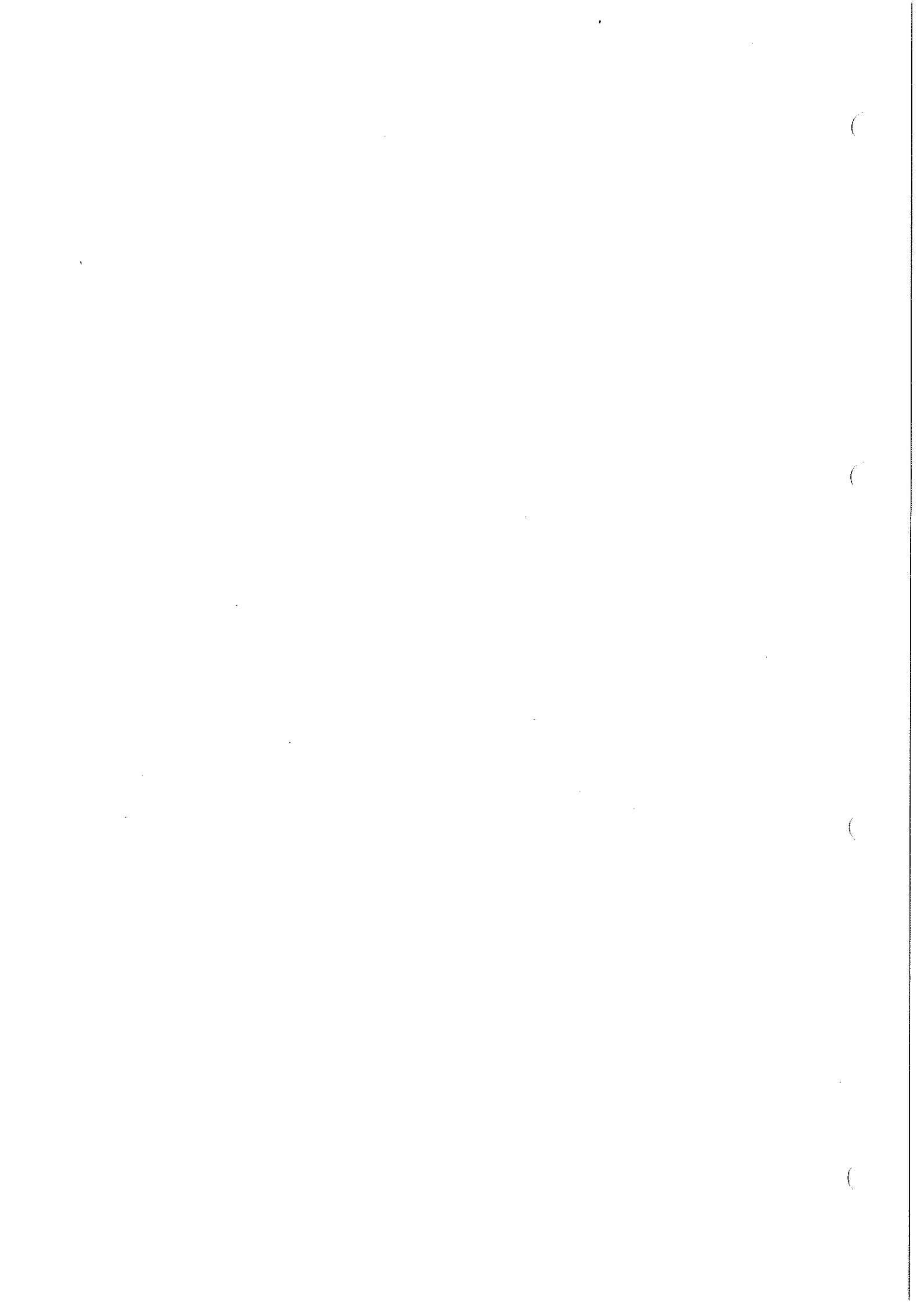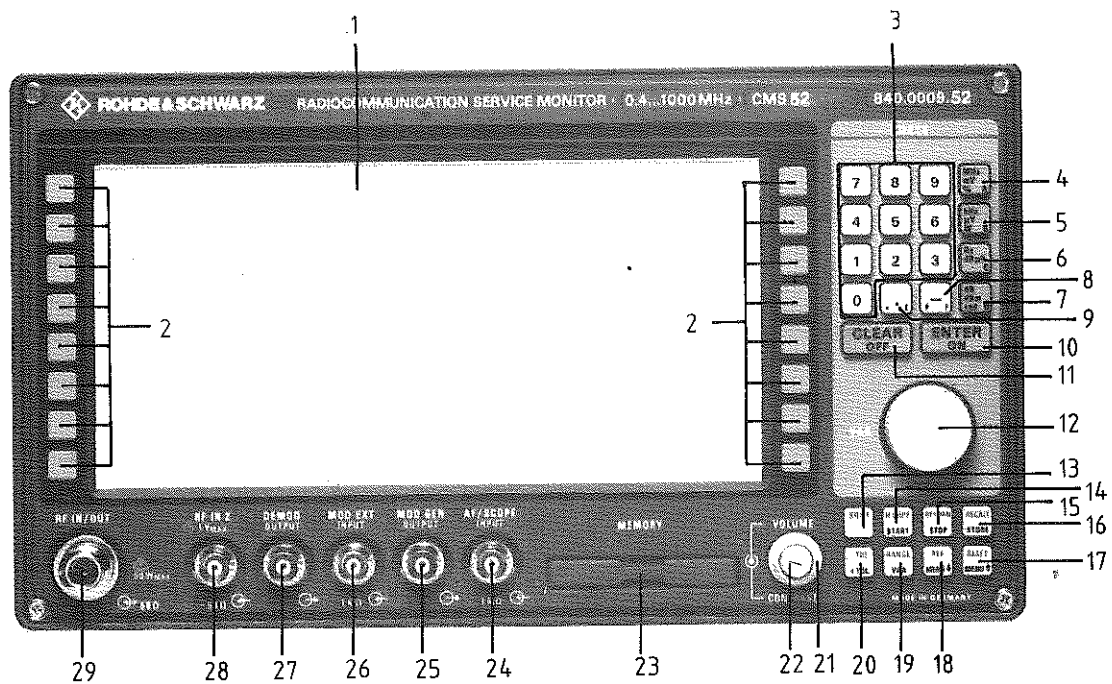
Bild 2-1 Frontansicht
Fig. 2-1 Front view

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

Autorun / Printer Control

(depending on model or option)

1

Contents

List of Figures

Autorun Control

Note: The electronic components on the memory card are insensitive to discharge pulses, only when R&S cards with protective sheathing are used.

The Autorun Control in the CMS Radiocommunication Service Monitor allows the user to store and execute program sequences entered via front panel controls and to generate test reports printed out on an external printer. Battery-backed 32-Kbyte memory cards (CMS-Z1) or 128-Kbyte memory cards (CMS-Z2) serve as program library and storage media for test reports.

Menu structure:

```
                    ┌─────────────────┐
                    │       CMS       │
                    │ selection menu  │
                    └─────────────────┘
                             │
                    ┌─────────────────┐
                    │    AUTO TST     │
                    └─────────────────┘
                    │                  │
           ┌─────────────────┐   ┌─────────────────┐
           │    AUTO EDT     │   │    AUTO RUN     │
           └─────────────────┘   └─────────────────┘
           │               │         │
   ┌──────────┐   ┌──────────┐   ┌──────────┐
   │  SPEC-1  │   │  SPEC-2  │   │  ALPHA   │
   └──────────┘   └──────────┘   └──────────┘
```
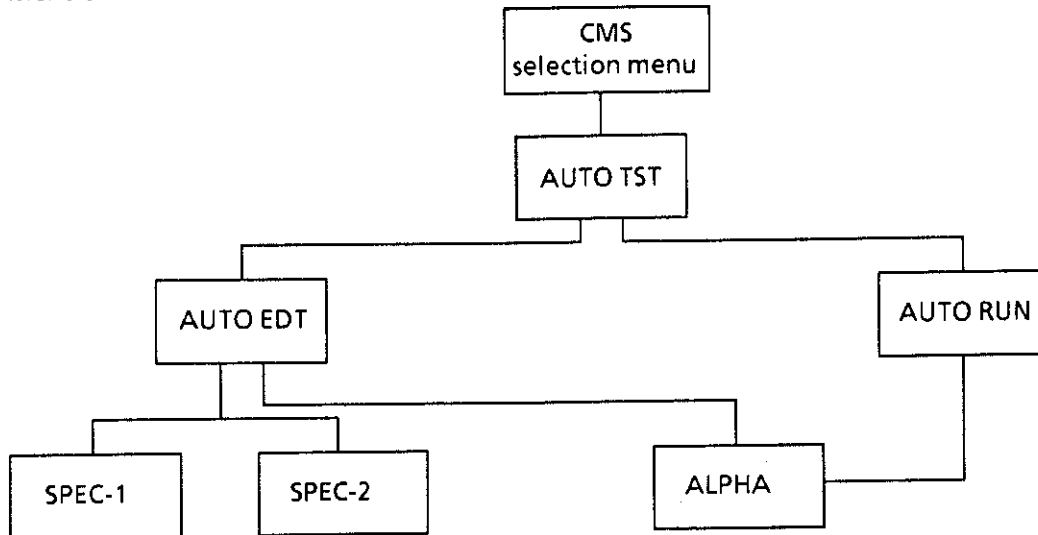
# 1   Generation of Programs on the CMS

Actuation of softkey 9 in the CMS selection menu calls the main menu AUTOTEST (see Fig. 1).

0	AUTOEDT	AUTOTST	CMS - Local						AUTORUN	8
1	SELECT	PROG-INT	PROG-CARD 00	REPORT 00	OTHER 00	FREE INT 04	22544 FREE CARD 0			9
2	DIR								DELETE	10
3	PRINT								FORMAT	11
4	TYPE									12
5	COPY <- MEMCARD									13
6	COPY -> MEMCARD								PAGE UP	14
7	APPND<- MEMCARD								PAGE DOWN	15

Fig. 1   Main menu AUTOTEST

This menu comprises all the softkeys required for storing, loading and display of programs.

Pressing softkey 0 (AUTOEDT) gives access to submenu AUTOEDT (see Fig. 2).

0	SPEC-1	**AUTOEDT** CMS - Local		AUTOTST	8
1	COMMENT	0000: PROGRAM 0 ▓0001▓		DELETE PROGR	9
2	AUTORUN				10
3	SPEC-2		○	█GOTO█ █LINE█	11
4				LINE UP	12
5	DELETE LINE			LINE DOWN	13
6	CUT BUFFER			PAGE UP	14
7	INSERT BUFFER			PAGE DOWN	15

Fig. 2   Submenu AUTOEDT

Programming is initated by pressing the START hardkey, and the CMS switches back to the selection menu (or the menu selected last in the LEARN mode). Any command entered then and stored via hardkey STORE corresponds to one program line for the started sequential program. The individual commands are commented in the first status line as IEC bus commands. Actuation of hardkey STOP permits the user to leave the LEARN mode, i.e. programming is stopped and the CMS returns to the AUTOEDT menu. The programmed commands are then listed in the display in the same sequence as entered. Each command line is preceded by a number.

Example: Following power-up the CMS is set to the selection menu

AUTOTST		→	Select Autorun Control
AUTOEDT		→	Select LEARN mode
START		→	Start programming
TX-TEST	STORE	→	Select transmitter test
AF1		→	Select AF generator 1
1 kHz	STORE	→	Frequency setting 1 kHz
SHIFT AF1		→	Select AF level generator 1
25 mV	STORE	→	Level setting 25 mV
DEMOD		→	Select demodulation
MENU ↓		→	Select submenu DEMOD
WEIGHT		→	Select peak weighting
WEIGHT	STORE	→	Select RMS weighting
MENU ↑		→	Leaving submenu DEMOD
COUNT	STORE	→	Select frequency count
POWER	STORE	→	Select power measurement
DEMOD	STORE	→	Select demodulation measurement
RX-TEST	STORE	→	Select the receiver test
STOP		→	Stop programming

Stop of programming switches the CMS back to the AUTOEDT menu. All the commands previously entered in the LEARN mode are listed in the display:

```
0000:   PROGRAM  0
0001:   DISPLAY:MENU              01,00
0002:   FREQUENCY:AF:I1              1000.00 Hz
0003:   LEVEL:AF:I1                  +25000 uV
0004:   DEMODULATION:WEIGHTING    RMS
0005:   COUNT:RF
0006:   POWER:RF
0007:   DEMODULATION
0008:   DISPLAY:MENU              02,00
0009:
```

Line 0 always identifies the number of the program. This line is automatically inserted. A maximum of about 1200 lines is possible. The cursor is positioned in the last empty line; respectively marked lines can be deleted or additional lines be inserted.

Maximally 14 lines are read out in the display per display page. Softkeys 14 PAGE UP and 15 PAGE DOWN are used for page turning. The softkeys 12 LINE UP and 13 LINE DOWN permit to shift the cursor by one line, respectively. Softkey 11 GOTO LINE moves the cursor to a defined position.

To delete the complete program sequence, the softkey 9 DELETE PROGR is pressed. Before deletion, the CMS prompts the user by the message "ARE YOU SURE?", which is acknowledged for program deletion by pressing hardkey ENTER or aborted using hardkey CLEAR.

1.1 Insertion of Additional Program Lines

The user wishes to activate the lowpass filter of the CMS in the program example of previous Section 1 before performing the measurements. To this end, the cursor is shifted to the command line that is to be preceded by the additional commands (line 5 in this example). Then the hardkey START is pressed to restart programming. The CMS is switched back to the menu which was active on completion of programming or on start-up of the program sequence.

GOTO LINE 5 ENTER	→	Select command line to be preceded by additional commands
START	→	Start programming
TX-TEST	→	Change to transmitter test
FILTER	→	Activate filter selection
MENU ↓	→	Select submenu FILTER 1
LP 3.4 kHz STORE	→	Select lowpass filter
MENU ↑	→	Leave submenu
STOP	→	Stop programming

The last key actuation which stops programming resets the CMS to the AUTOEDT menu. The display then shows the following program sequence:

```
0000:  PROGRAM  0
0001:  DISPLAY:MENU              01.00
0002:  FREQUENCY:AF:I1              1000.00 Hz
0003:  LEVEL:AF:I1                   +25000 uV
0004:  DEMODULATION:WEIGHTING    RMS
0005:  FILTER:TXTEST:LP          ON
0006:    COUNT:RF
0007:  POWER:RF
0008:  DEMODULATION
0009:  DISPLAY:MENU              02,00
0010:
```

Line 5 FILTER:TXTEST:LP ON is additionally included in the program sequence and the program has been renumbered. Lines can be inserted as long as the CMS is set to LEARN mode. The cursor is not shifted in this case but remains on the command line to which it is set.

1.2 Clearing and Shifting of Command Lines

To delete a line in the active program sequence, the cursor must be set to the respective line and softkey 5 DELETE LINE is pressed. The line numbers of the following lines are renumbered accordingly and the cursor remains in the same position, i.e. the next command line.

To clear several lines, the cursor is set to the beginning of the lines to be deleted and softkey 6 CUT BUFFER is pressed. Then the cursor is moved to the end of the lines to be deleted and softkey 6 CUT BUFFER is actuated again. The selected characters are then highlighted in inverse display. For moving the cursor the softkeys 11 to 15 and the spinwheel can be used. Maximally 42 lines starting from the start position of the cursor can be deleted at a time. If more lines are selected for deletion, the error message "cut buffer full" appears.

When softkey 6 CUT BUFFER is pressed the first time, CUT BUFFER is highlighted in inverse display to indicate that the delete function is active. Actuation of any other key except softkeys 11 to 15 disables the delete function again.

Pressing softkey 6 the second time resets the softkey labelling to normal display, but softkey 7 INSERT BUFFER is shown in inverse display. At the same time, the selected lines disappear from the program and the command sequence is renumbered.

However, the lines disappeared from the screen are not irrevocably lost but are temporarily stored in a buffer. Only by activating the delete function again, i.e. pressing softkey 6 CUT BUFFER again, these lines are cleared from the program for good.

Intermediate storage can also be used for shifting or copying of command lines. Any lines stored in the buffer can be inserted in one or several positions in the program sequence (except before line 0), which must be marked by cursor before.

In the example program from Section 1.1, the user wishes to copy the lines 1 to 4 into the sequence after line 9 and then delete them again:

GOTO LINE 1 ENTER	→	Mark beginning of lines to be copied
CUT BUFFER	→	Activate buffer
GOTO LINE 5 ENTER	→	Mark end of lines to be copied*
CUT BUFFER	→	Fill buffer and clear lines
INSERT BUFFER	→	Resinsert lines
GOTO LINE 10 ENTER	→	Mark line from where to insert the lines
INSERT BUFFER	→	Insert lines

* *Note: For copying n lines, n + 1 lines must be marked.*

The complete program thus reads as follows:

```
0000:   PROGRAM   0
0001:   DISPLAY:MENU              01.00
0002:   FREQUENCY:AF:I1             1000.00 Hz
0003:   LEVEL:AF:I1                  +25000 uV
0004:   DEMODULATION:WEIGHTING    RMS
0005:   FILTER:TXTEST:LP          ON
0006:   COUNT:RF
0007:   POWER:RF
0008:   DEMODULATION
0009:   DISPLAY:MENU              02.00
0010:   DISPLAY:MENU              01.00
0011:   FREQUENCY:AF:I1             1000.00 Hz
0012:   LEVEL:AF:I1                 +25000 uV
0013:   DEMODULATION:WEIGHTING    RMS
0014:
```

The selected lines can be inserted in the program at other positions as often as required. The respective position where to add the lines is always marked by the cursor.

Lines 10 to 13 are to be deleted again:

GOTO LINE 10 ENTER	→	Mark beginning of lines to be deleted
CUT BUFFER	→	Activate buffer
GOTO LINE 14 ENTER	→	Mark end of lines to be deleted
CUT BUFFER	→	Fill memory

Lines 10 to 13 are thus removed again from the program and the program is reset to its original sequence.

1.3 Adding Comments in the Program

It may be useful in the course of a program run to supply additional information for the user in the second status line, for instance to switch on the radio transmitter of the mobile phone. Softkey 1 COMMENT in the AUTOEDT menu gives access to submenu ALPHA (see Fig. 3) for input of additional comments for the program.

```
 0  |   |  ALPHA        AUTOTEST LEARN - <STOP> to Edit    |          |   8
 1  |   |  COMMENT: ▌                                      | TEXT     |   9
    |   |                                                  | CURSOR   |
 2  |   |                                                  |          |  10
 3  |   |                                                  |          |  11
    | CHAR |   0  1  2  3  4  5  6  7  8  9  .             |          |
 4  | CURSOR|  A  B  C  D  E  F  G  H  I  J               |          |  12
    |      |   K  L  M  N  O  P  Q  R  S  T               |          |
 5  |   |      U  V  W  X  Y  Z        "  `  '            |          |  13
    |   |      =  +  -  *  /  \  <  >  (  )               |          |
 6  |   |      [  ]  %  &  ¡  .  ,  ;  :  !               |          |  14
    | DELETE |  ?  $  @  #  _  µ DEL Bp CR LF            | DELETE   |
 7  | BACKW |                                            | FORW     |  15
```

Fig. 3   Submenu ALPHA

For input of characters first the softkey 4 CHAR CURSOR is pressed. The characters required for the comment are selected using the VAR spinwheel and acknowledged by pressing the ENTER key.To modify the entered text (i.e. delete and insert), the softkey 9 TEXT CURSOR is pressed and the TEXT CURSOR (light characters on a dark background) set to the required position using the VAR spinwheel. Then, the letters to the left and the right of the marked location can be deleted by pressing the softkey 7 and softkey 15, respectively. Actuation of CLEAR deletes the complete comment.
To insert a new text in the comment, again as described above the softkey 4 CHAR CURSOR is pressed and the required respective characters are input.

Using the STORE key, the contents of the entered comment line are stored in the program. Also several lines can be stored without leaving the ALPHA menu. Max. 34 characters per line can be entered.

Softkey MENU ↑ or softkey 8 only permit leaving the menu without storing the comment line in the program.

In the example program in Section 1.2, the user wishes to insert the comment "switch on transmitter" before the line 6:

GOTO LINE 6 ENTER   →   Mark the line to be preceded by a comment
COMMENT   →   Access to submenu ALPHA

Select the individual characters of "SWITCH ON TRANSMITTER" using the VAR spinwheel and press the hardkey ENTER after each character to acknowledge entry.

STORE   →   Store the line "SWITCH ON TRANSMITTER"
MENU ↑   → Return to the AUTOEDT menu

The program reads as follows:

```
0000:   PROGRAM  0
0001:   DISPLAY:MENU                01.00
0002:   FREQUENCY:AF:I1               1000.00 Hz
0003:   LEVEL:AF:I1                    +25000 uV
0004:   DEMODULATION:WEIGHTING      RMS
0005:   FILTER:TXTEST:LP            ON
0006:   ------switch on transmitter-------
0007:   COUNT:RF
0008:   POWER:RF
0009:   DEMODULATION
0010:   DISPLAY:MENU                02,00
0011:
```

Line 6 reads out the comment "switch on transmitter". Comments are characterized by "--" characters and are always centered. These comments can also be added for better readability of the programs. However, during the program run they are also displayed in the second status line.

1.4   Delays and Stops in the Active Program Run

For certain measurements, e.g. measurements at mobile phones with compandors, delays must be provided in the program sequence. Also, defined stop pauses are required in the program flow to await user reactions on comments. In this case, the pause is terminated and the program continued again by the user by pressing the hardkey START.

As the Autorun Control operates at high speed, in most cases the user is not always able to clearly follow the sequence. To avoid this, the special function also permits the user to insert defined delays between each individual command line.

The submenu SPEC-1 (see Fig. 4) is reached by pressing softkey 0 (SPEC-1) in the AUTOEDT menu

Fig. 4   Submenu SPEC-1

Softkey 9 STOP PAUSE is used to define delays and stops. STOP STORE is entered to set a stop in the program, which is then continued by pressing hardkey START. PAUSE and values between 1 and 10000 serve to effect delays in the program.

Softkey 14 MIN DELAY determines the delays between the execution of the individual commands. Delays of 0 ms (no waiting time) or from 10 ms to 10000 ms can be selected.

No entries are accepted by the CMS during these delays, i.e. the keyboard is disabled.
To return to the AUTOEDT menu, the softkey 8 AUTOEDT is pressed.

In the program example of Section 1.3, a stop is to be inserted after the comment in line 6. This is to allow the user to selectively continue the program run when the transmitter is switched on. Also, a delay of 100 m is to be defined before the DEMOD measurement in line 9. To allow the user to follow the program, a delay of 500 ms is set between the individual commands.

GOTO LINE 1 ENTER	→	Mark the line from where the delays apply
SPEC-1	→	Access to the SPEC-1 menu
MIN DELAY 500 ENTER STORE	→	Insert delay of 500 ms between the individual commands
AUTOEDT	→	Return to the AUTOEDT menu
GOTO LINE 8 ENTER	→	Mark the line to be preceded by a stop
SPEC-1	→	Access to the SPEC-1 menu
STOP STORE	→	Insert stop pause
AUTOEDT	→	Return to the AUTOEDT menu
GOTO LINE 11	→	Mark the line to be preceded by a delay
SPEC-1	→	Access to the SPEC-1 menu
PAUSE 100 ENTER STORE	→	Insert delay of 100 ms
AUTOEDT	→	Return to the AUTOEDT menu

The program example then reads as follows:

```
0000:   PROGRAM  0
0001:   SPECIAL:MINDELAY                      500
0002:   DISPLAY:MENU                  01,00
0003:   FREQUENCY:AF:I1                   1000.00 Hz
0004:   LEVEL:AF:I1                        +25000 uV
0005:   DEMODULATION:WEIGHTING        RMS
0006:   FILTER:TXTEST:LP              ON
0007:   ------Switch on transmitter-------
0008:   SPECIAL:STOP                          0
0009:   COUNT:RF
0010:   POWER:RF
0011:   SPECIAL:PAUSE                       100
0012:   DEMODULATION
0013:   DISPLAY:MENU                  02,00
0014:
```

Each time the CMS returns to the AUTOEDT menu the command lines are renumbered. However, it is not necessary following each command entered in the SPEC-1 menu to return to the AUTOEDT menu. As long as commands are entered in the SPEC-1 menu they are inserted in the program sequence in the current cursor position.

1.5 Repetitions of Program Sections

It is often required to have certain program sections repeated in the sequence if the same measurement is to be carried out with different parameters (e.g. frequency response measurements).

Softkeys 1 to 3 in the SPEC-1 menu are available for this purpose (REPEAT START, REPEAT WHILE und REPEAT STOP).

Repetitions of program sections are generally initiated via REPEAT START X or REPEAT WHILE, X being the number of repetitions ranging from 1 to 10000. REPEAT WHILE initiates a repetition of program sections until a pre-defined condition is fulfilled. To terminate the repetition, always the softkey REPEAT STOP is pressed. If no REPEAT STOP is entered, the complete program is fully executed to the end.

Repetitions can be nested to a depth of five. The following is an example for nesting to a depth of two:

```
REPEAT START 100
    further commands
        REPEAT START 10
            further commands
        REPEAT STOP
    further commands
REPEAT STOP
```

The conditions to stop repetitions initiated with REPEAT WHILE can be defined in the SPEC-1 menu via the softkeys 7 NOT and 15 COND. Softkey 15 COND permits to select the condition, softkey 7 NOT can be used to negate the condition if the display of softkey 7 NOT is backlighted. For instance, REPEAT WHILE NOT WARNING means that the program section selected is repeated as long as no warning is given, while REPEAT WHILE WARNING means that the section is repeated as long as warnings are given.

The following conditions can be selected (all conditions are not negated):

DEMOD-OK	Valid value of demodulated signal
RF-POWER	Power available
ENTER	ENTER key was pressed with WAIT FOR KEY
CLEAR	CLEAR key was pressed with WAIT FOR KEY
ERROR	Error messages
WARNING	Warnings
NO-STOP	always fulfilled during program execution
BCD-3	Control line 3 of Control Interface CMS-B5 set to HIGH
BCD-2	Control line 2 of Control Interface CMS-B5 set to HIGH
BCD-1	Control line 1 of Control Interface CMS-B5 set to HIGH
BCD-0	Control line 0 of Control Interface CMS-B5 set to HIGH
TOL-HIGH	Tolerance of measurement value above the set value
TOL-LOW	Tolerance of measurement value below the set value
TOL-OK	Tolerance of measurement value in the set range
REPEAT:WHILE:NO-STOP	opens an endless loop
REPEAT:WHILE:NOT NO-STOP	this loop is executed exactly once

Note: *If the conditions BCD-0 to BCD-3 are used, the lines must be defined as inputs before.*

With the conditions TOL-LOW, TOL-OK and TOL-HIGH, the contents of the loop are executed once in any case, with all other conditions the validity of the condition must be verified before the line REPEAT WHILE.... A loop is to be executed at least once!

In the following sequence, the program example of Section 1.4 is expanded such that by means of a pre-defined repetition the AF frequency response of the transmitter (in dB) is measured until no more RF power is applied to the CMS. To this end, first a repetition block REPEAT WHILE is inserted before line 12 with the condition RF-POWER and terminated again after line 12:

GOTO LINE 12 ENTER	→	Mark the line where to start the repetition block
SPEC-1	→	Access to SPEC-1 menu
COND	→	Actuate until the RF-POWER display is backlighted
NOT RF-POWER	→	Switch on negation to wait for RF power
REPEAT WHILE STORE	→	Insert repetition block
REPEAT STOP	→	Terminate repetition block
NOT	→	Switch off negation
REPEAT WHILE STORE	→	Insert repetition block
AUTOEDT	→	Return to AUTOEDT menu
GOTO LINE 16 ENTER	→	Mark the line before which to terminate the repetition block
SPEC-1	→	Access to SPEC-1 menu
REPEAT STOP STORE	→	Terminate repetition block

The program now reads as follows:

```
0000:  PROGRAM  0
0001:  DELAY                           500
0002:  DISPLAY:MENU              01,00
0003:  FREQUENCY:AF:I1               1000.00 Hz
0004:  LEVEL:AF:I1                    +25000 uV
0005:  DEMODULATION:WEIGHTING    RMS
0006:  FILTER:TXTEST:LP          ON
0007:  ------switch on transmitter-------
0008:  STOP
0009:  COUNT:RF
0010:  POWER:RF
0011:  STOP                            100
0012:  SPECIAL:REPEAT WHILE NOT RF-POWER
0013:  SPECIAL:REPEAT STOP
0014:  SPECIAL:REPEAT WHILE RF-POWER
0015:  DEMODULATION
0016:  REPEAT STOP
0017:  DISPLAY:MENU              02,00
0018:
```

With the repetition block inserted in program lines 12 to 14, the demodulated signal is then measured until no more RF power is applied to the CMS.

As a next step, the user wishes to measure the frequency response of the demodulated signal of 11 measurement values, starting from 500 Hz in steps of 250 Hz. The reference is 1 kHz.

GOTO LINE 15 ENTER	→	Mark the line where to insert
START	→	Start programming
TX-TEST		
AF1 1000 Hz STORE	→	Frequency of reference measurement
DEMOD STORE	→	Select DEMOD measurement
SHIFT REF ENTER STORE	→	Measured value set as reference
AF1 250 Hz STORE	→	Frequency of modulation generator set to 250 Hz
VAR 250 Hz STORE	→	Select 250 Hz-increment
DEMOD STORE	→	Select DEMOD measurement
STOP	→	Leave LEARN mode
GOTO LINE 19 ENTER	→	Mark the line to be preceded by the repetition block
SPEC-1	→	Access to SPEC-1 menu
REPEAT START 11 ENTER STORE	→	Insert repetition block with 11 repetitions
AUTOEDT	→	Return to AUTOEDT menu
GOTO LINE 22 ENTER	→	Mark the line where to end the repetition block
SPEC-1	→	Access to SPEC-1 menu
REPEAT STOP	→	End repetition block
AUTOEDT	→	Return to AUTOEDT menu

The program thus reads as follows:

```
0000:   PROGRAM  0
0001:   DELAY                              500
0002:   DISPLAY:MENU               01,00
0003:   FREQUENCY:AF:I1              1000.00 Hz
0004:   LEVEL:AF:I1                   +25000 uV
0005:   DEMODULATION:WEIGHTING     RMS
0006:   FILTER:TXTEST:LP           ON
0007:   ------switch on transmitter-------
0008:   STOP
0009:   COUNT:RF
0010:   POWER:RF
0011:   PAUSE                              100
0012:   SPECIAL:REPEAT WHILE NOT RF-POWER
0013:   SPECIAL:REPEAT STOP
0014:   SPECIAL:REPEAT WHILE RF-POWER
0015:   FREQUENCY:AF:I1             1000.00 Hz
0016:   DEMODULATION
0017:   DEMODULATION:REFERENCE
0018:   FREQUENCY:AF:I1              250 Hz
0019:   SPECIAL:REPEAT START 11
0020:   FREQUENCY:AF:I1:VARIATION    250 Hz
0021:   DEMODULATION
0022:   SPECIAL:REPEAT STOP
0023:   SPECIAL:REPEAT STOP
0024:   DISPLAY:MENU               02,00
0025:
```

The repetition block for frequency response measurement starts from line 15. The start value of 500 Hz results from the AF generator setting plus one increment. The increment must be in the repetition block as the value is increased with each repetition.

1.6   Conditional Statements in the Program

Conditional statements with branching can be incorporated in the program using the function IF-ELSE-END IF. The softkeys 4 to 6 (IF, ELSE, END IF) in the SPEC-1 menu give access to this function.

As a rule, a conditional statement is initiated with the IF condition (with the same conditions valid as in Section 1.5) and terminated by END IF. The command ELSE can be set between these two commands, which is executed if the condition is not fulfilled.

```
IF RF-POWER
 Commands a
ELSE
 Commands b
ENDIF
```

In this example, the commands a are executed if RF power is applied and the commands b if no RF power is present. Nesting to a maximal depth of two is permissible.

Repetition blocks and conditional statements can be interleaved in the program. However, they cannot be freely nested at will:

Permissible examples:

```
IF condition 1
   REPEAT START X
      further commands
   REPEAT STOP
ELSE
   REPEAT WHILE NOT condition 2
      further commands
   REPEAT STOP
END IF


REPEAT START X
   IF condition
      further commands
   ELSE
      further commands
   END IF
REPEAT STOP
```

Illegal examples are:

```
REPEAT WHILE condition 1
   IF condition 2
      further commands
REPEAT STOP
   ELSE
      further commands
   END IF
```

Repetition blocks and conditional statements must also be completed.

1.6.1 Conditional Execution of Program Sections

```
  0 │ SPEC-1 │ SPEC-2      AUTOTEST LEARN - <STOP> to Edit      │ AUTOEDT │  8
    │        │                                                  │         │
  1 │ LOOP   │ (LEVEL)                       PROG-CARD PROG-INT │ CALL    │  9
    │ BREAK  │                                                  │         │
  2 │        │                               (PROG-NUMBER)      │ RETURN  │ 10
    │        │                                                  │         │
  3 │        │                                                  │         │ 11
    │        │                                                  │         │
  4 │        │                                                  │ WAIT    │ 12
    │        │                                                  │ FOR KEY │
  5 │        │                                                  │         │ 13
    │        │                                                  │         │
  6 │ CASE   │ OF LOOPINDEX                                      │         │ 14
    │        │                                                  │         │
  7 │ CASE   │ EQ  LE  GE  (VALUE)                               │         │ 15
    │ COND   │ OTHER END                                        │         │
```

Fig. 5   SPEC-2 submenu

The menu SPEC-2 offers extended possibilities of program generation:

Conditional execution of program sections (depending on the loop counter):

In order to be able to perform different settings when a loop is executed repeatedly, softkey 6 and softkey 7 permit to use a case differentiation of the following type:

REPEAT:START oder REPEAT:WHILE   Beginning of loop

The commands are always executed in this case.

CASE:OF:LOOP   Beginning of case differentiation
CASE:COND EQ 3

The commands are only executed in loop 3.

CASE:COND EQ 7

The commands are only executed in loop 7.

CASE:COND OTHER

The commands are executed in all runs except
for loop 3 and 7.

CASE:COND END   End of case differentiation

The commands are always executed

REPEAT:STOP   End of loop

After starting a case differentiation, an appropriate case specification is searched for in the following commands until the end of the case differentiation (CASE:COND:END or end of program), i.e. the command CASE:OF:LOOP (softkey 6) must always be followed by a CASE:COND command (softkey 7) in the next line.

If the condition of a CASE:COND line is fulfilled, the following commands are executed.

The subsequent CASE:COND command (independent of a condition) or the program end terminate the command execution.

Possible case specifications:

EQ	number	loop index = number
LE	number	loop index ≤ number
GE	number	loop index ≥ number
OTHER		any loop index
END		end of case differentiation

Waiting for user entry

If a program run is to depend on decisions of the user, softkey 12 (WAIT FOR KEY) can be used to determine that a user entry is waited for.

During the program run, the user is requested at this place to make an entry, which sets the conditions ENTER and CLEAR as follows:

| User entry	Condition	
	ENTER	CLEAR
ENTER	true	false
CLEAR	false	true
Any other key	false	true

The conditions ENTER and CLEAR can be read out in conditional loops and in IF conditions.

Aborting a loop (softkey 1 : LOOP BREAK)

The LOOP BREAK command allows loop-execution (endless loops or a loop with a high repetition number) to be terminated prematurely when the desired result is obtained.

Normally, the current loop is concerned; however, several nested loops can also be terminated by indicating the appropriate number.

Example:
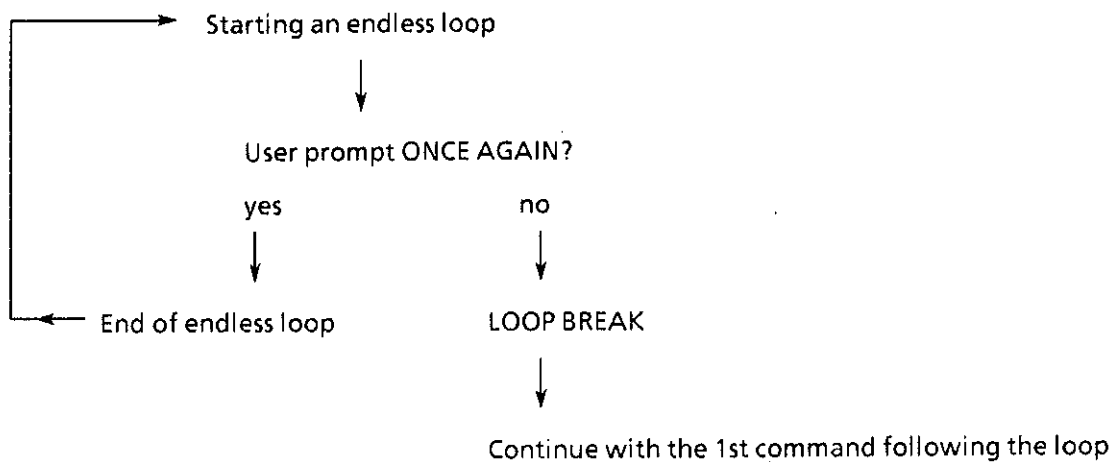
Calling up programs by other programs

Softkey 9 (CALL) can be used to insert a program call (internal or from memory card) into another program.

When syntax testing, a check is made to see whether the program to be called is available; otherwise, a warning is generated. The program generation itself, however, can be terminated by changing to the AUTOTST menu.

During the program run, the execution is continued with the first command of the program indicated. A return to the calling program is possible with a RETURN command or at the end of the called program.

Softkey 10 (RETURN) can be used to return to the calling program prematurely. During the program run, the execution is continued with the next command of the calling program after the call. If there is no calling program, the program execution is terminated as with a program end.

1.7 Printer Control during the Program Run

A printer connected to the CMS to give out test reports can be directly controlled from the program sequence. Softkeys 10 to 13 (PRINT CTRL, PRINT ON, PRINT OFF, PAGE FEED, REPORT FORMAT) in the SPEC-1 menu are used for this purpose.

With softkey 10 PRINT CTRL, control characters can be sent to the printer which are normally not included in the printouts but effect switchover of printer functions, e.g. switching on or off of the underline function.

These control characters can be entered only in the HEX code. Maximally 10 characters per command line are permissible.

The control characters are entered via the keypad (0 to 9 and A to F) and each entry is completed by pressing hardkey STORE.

The printer can be switched on or off during the program run using the softkey 11 (PRINT ON, PRINT OFF). Again, these commands are acknowledged by pressing hardkey STORE.

Softkey 12 is used to effect form feed.

The softkey function 13 REPORT FORMAT can be used to select the format of the printout (SMALL, MEDIUM or LARGE) during the program run (see Section 1.7.2).

Note: *Softkey 5 REPORT TARGET has highest priority in the AUTORUN menu. If the target for the report is set to OFF, all the printer controls in the program are disabled.*

Example: The printer is to be initialized at the beginning of a sequential program (CMS in AUTOEDT menu (command sequence for this printer HEX: 1B 40), the protocol format be set to LARGE and the printer then be switched on. Following further commands, i.e. measurements, the report is to be generated:

SPEC-1	→	Access to the SPEC-1 menu
PRINT CTRL 1 B 4 0 STORE	→	HEX code for initialization
PAUSE 1000 STORE	→	Insert delay before new commands can be sent to the printer
REPORT FORMAT	→	Press softkey until LARGE display is backlighted
STORE	→	Store function
PRINT ON STORE	→	Switch on printer
AUTOEDT	→	Return to AUTOEDT menu

The following command lines are displayed:

```
0006   previous command
0007   PRINT CTRL 1B 40
0008   PAUSE 1000
0009   REPORT FORMAT LARGE
0010   PRINT ON
0011   further commands
```

If the function PRINTER or MEMCARD is selected in the AUTORUN menu using softkey 5 REPORT TARGET, a report header information is generated at each program start and the subsequent program lines are printed out until PRINT OFF is set.

1.7.1   Printing of Reports

All the parameters measured during the program run can be given out to a printer in form of reports or be stored on a memory card. Test reports are printed out in the following form:

```
REPORT:  26     PROGRAM:  03     20-APR-89 09:24     USER: XXXXXX
DEVICE under TEST IDENTIFICATION:...............................

NO          COMMAND          PARAMETER          RESULT          TOL

0001 ------------------TRANSMITTER TEST--------------------
0002 LEVEL:RF             0.1 mV
0003 DEMODULATION                            2.75 kHz          OK
0004 DEMODULATION                            4.45              FAULT
0005 SINAD                20 dB              20.1 dB
---> RF LEVEL                                0.5 uV
0006 LEVEL:RF             ::1MV

9999 TOTAL TOLERANCE                                           FAULT
```

Explanations:

NO:	Line number of active program
COMMAND:	IEC bus format of command
PARAMETER:	Preset parameter settings
RESULT:	Measurement results as specified in the display. In the case of two measurement results (SINAD search routine), the second value is indicated in a subsequent line (marked by →).
TOL:	Tolerance evaluations are listed in the report only for those commands which are immediately followed by +TOL and/or -TOL. OK means no violation of the tolerance range, FAULT means that the tolerance limit is exceeded.
::	In the case of setting values, which are stated only in the course of the active program sequence, the entered value is documented after :: .
Report header:	(see Section 2.1.1).

If the program data in the report include tolerance evaluations, the individual tolerance evaluations are automatically summed up at the end of the report, i.e. the section TOTAL TOLERANCE lists if no (OK) or at least one tolerance violation (FAULT) has occurred during the program run.

1.7.2   Report Formats

The format of the report can be defined by the user before starting the program sequence or from the active program using REPORT FORMAT LARGE, REPORT FORMAT MEDIUM or REPORT FORMAT SMALL. If the program sequence is already started, the user can no longer manually modify the format from the active program. It is neither possible to modify the format of already executed reports.

Three report formats are available:

REPORT FORMAT LARGE: Complete logout of program data, i.e. all commands, comments and measurements are documented.

REPORT FORMAT MEDIUM: Commands pertaining to the autorun control (e.g. changing of menus) and all settings are suppressed. However, setting values which are stated only in the course of the program run are included in the report.

REPORT FORMAT SMALL: Only measurement data are reported.

2 Execution of Programs

A program generated in the AUTOEDT menu can be started from the AUTORUN menu. To access the AUTORUN menu, the softkey 3 AUTORUN is pressed in the AUTOEDT menu.

0	AUTOEDT	**AUTORUN** CMS - Local						AUTOTST	8
1	SELECT	PROG-INT PROG-CARD REPORT OTHER FREE INT 8928							9
		10560 0 00 00 04 FREE CARD 0							
2									10
3	REPORT HEADER	DATE/TIME: Xd-mm-yy HH:MM USER: DUT IDENT:						DATE TIME	11
4	REPORT FORMAT	SMALL MEDIUM LARGE							12
5	REPORT TARGET	OFF PRINTER MEMCARD						PRINTER INIT	13
6	STOP COND	NO-STOP TOL-ERR WARNING ERROR						FORM FEED	14
7	MIN DELAY	0 ms						SPOOLER CLEAR	15

Fig. 6   Submenu AUTORUN

This menu permits to set or modify the parameters required for the program execution. The program execution is started via hardkey START. This can be done in any menu. The currently selected program is started.

Once the program sequence is started, the CMS is in AUTOTEST RUN mode. The first status line reads out the message AUTOTEST RUN - HOLD by <STOP>.

In this mode, the CMS executes all the commands stored in the active program in the sequence as entered.

2.1 Parameters for Program Execution

It is possible before starting the program run to set some parameters which are not yet determined in the actual program setup (cf. Sections 2.1.1 to 2.1.8). Other functions such as COPY additionally require the desired program/report number to be entered directly above the number field.

Information on the selected programs and reports is read out in the two lines between softkeys 1 and 9.

In the CMS the following data types in short-form are available in these two lines:

PROG-INT: CMS-internal programs

PROG-CARD: programs on memory card

REPORT: reports on memory card

OTHER: stored instrument states (= PANEL) and other data types on memory card

The left-hand number below each data type indicates the memory occupied by the data type (in characters), the right-hand number specifies the number of the currently selected program/report.

To the right of the abbreviations

FREE INT: internal program memory,
FREE CARD: memory card,

the size of the available (free) memory is indicated.

2.1.1   Report Header

Each report contains a report header at the beginning, which specifies the current date, the user and a DUT identification. On actuation of softkey 3 REPORT HEADER, the menu REPORT (similar to the ALPHA-Menü) is automatically called up and the user can enter the respective data as described in Section 1.3. To leave the REPORT menu again, the hardkey MENU ↑ is pressed.

In addition, also not the following:
A text can be entered in the fields USER or DUT IDENT or an already existing text be modified by pressing the softkey 9 TEXT CURSOR, if required several times. The field DATE/TIME is selected by pressing softkey 1 DATE/TIME.
In the field DATE/TIME, each numeric value of the date section can be directly set (i.e. incremented or decremented) using the VAR spinwheel. The individual numeric values are selected by pressing the softkey 1 DATE/TIME several times. The softkeys 7, 15 and ENTER have no functions in this case, CLEAR initializes the field.

2.1.2   Report Formats

Softkey 4 REPORT FORMAT is used to select one of the report formats, LARGE, MEDIUM or SMALL (cf. Section 1.7.2). If a format has been selected during program generation, the pre-set format is modified in the program irrespective of the setting of softkey 4 from the position where such a command has been inserted in the active program.

2.1.3   Target Address of Report

Softkey 5 REPORT TARGET selects the target address of the test report, i.e. PRINTER or memory card MEMCARD, or no report (OFF).

In the OFF setting, any printer control commands entered in the program are disabled (cf. Section 1.7).

2.1.4   STOP Conditions

Softkey 6 STOP COND permits to select one of the following conditions: NO STOP, stop in the case of violations of the tolerance range (TOL ERR), stop with warnings (WARNING) or stop of the program with error messages (ERROR).

Irrespective of the setting of softkey 6, any stops entered in the program as commands are executed (cf. Section 1.4).

2.1.5   Delays in the Program

Softkey 7 MIN DELAY has the same function as softkey 14 in the SPEC-1 menu (cf. section 1.4).

The delay set is valid until it is overwritten by a MIN DELAY command stored in the program.

2.1.6 Initialization of the Printer

Softkey 13 PRINTER INIT is used to enter the command sequence for initialization of the connected printer. The characters are entered in the HEX code via the keypad (0 to 9 and A to F). The initialization itself is started using hardkey ENTER.

2.1.7 Form Feed of the Printer

Softkey 14 FORM FEED is used to effect a form feed of the printer, which sets the print head to the next page to the beginning of the first line.

This function is above all useful to coordinate the line counter of the CMS with the connected printer.

2.1.8 Clearing of the Printer Buffer (SPOOLER CLEAR)

All the characters for printout are stored in a buffer (SPOOLER). During printing, these characters are read from the buffer in the sequence as stored. This offers the advantage that no delays are required for printing and that printing is carried out in background mode, i.e. the CMS is immediately ready for user operation again.

To abort printing, the buffer must be cleared using softkey 15 SPOOLER CLEAR.

2.2 Program Suspensions

The active program can be stopped by pressing hardkey STOP, as a result of programmed stops or by one of the stop conditions STOP COND. The first status line displays the message AUTO HOLD - <START><STOP><RETURN>.

The display then shows the menu which was valid before the active program was started, or the menu called up by programming. The CMS is ready for entries of settings, which, however, are not transferred to the program.

To leave the HOLD mode and restart the program, the hardkey START is pressed. The program is continued exactly where it was interrupted.

When hardkey STOP is pressed again, the CMS leaves the AUTOTEST mode and is switched to manual operation in the currently displayed menu.

When hardkey RETURN is pressed in the HOLD mode, the CMS accesses the AUTORUN menu and the report number is incremented by one. This means that the report number must not always be entered before program start. The program can again be executed using hardkey START.

If the user accesses the submenu AUTOEDT from the AUTORUN menu via the AUTOTST menu, the first 14 lines of the program are not displayed as is normally the case but the cursor marks the first command in the program sequence that was not yet executed. If the program has been completely executed, the cursor marks the first free line of the program. However, in the case of error it is easier for the user to verify the cause of error if the program is not completely executed.

3 Management of Programs and Test Reports

All the functions required for the management of program and test reports (loading, saving, printing and display) are accessible from the AUTOTST menu (see Fig. 1). Maximally 100 programs can be stored in the CMS, additional programs must be loaded via memory cards where they are stored.

3.1 Loading of Programs and Reports from the Memory Card

Softkey 1 SELECT in the AUTOTST menu allows to select if a program or a report is to be loaded. The program or report is selected by entering the respective program number. Loading is effected by pressing softkey 5 COPY <-MEMCARD.

It is possible to load several programs from the memory card into the CMS.

3.2 Linking of Programs

Several individual programs can be linked to one program. First one program is loaded and the program to be appended selected using softkey 1. Both programs are linked together by means of the softkey function 7 (APPND <-MEMCARD).

3.3 Storing of Programs and Reports

Programs generated in the CMS can be stored on the memory card using softkey 6 COPY -> MEMCARD. For this purpose, first a program number must be entered via softkey 1. If a program with the same number is already stored on the memory card, the message "DELETE EXISTING REPORT (PROGRAM)?" is given out. Pressing the ENTER key overwrites the already existing program, CLEAR is used for aborting.

3.4 Display of Directory

The programs available in the CMS as well as the programs and test reports stored on the memory card can be displayed via softkey 2 DIR. Via softkey 1 SELECT, the user first has to select again if programs in the CMS or on the memory card are to be displayed.

The display reads out the number and the first line of the programs. Therefore, when generating a program always a comment should be inserted in the first program line to identify the program.

With reports, always the report number and the DUT identification are specified (cf. Section 2.1.1).

If more programs or test reports are available than can be displayed, the softkeys 14 PAGE UP and 15 PAGE DOWN are provided to call up the other programs or reports.

3.5 Display and Printing of Programs

If a program is selected by softkey 1, softkey 4 TYPE can be pressed to have its contents displayed. Paging through the contents is possible by means of softkeys 14 PAGE UP and 15 PAGE DOWN.

Using softkey 3 PRINT, the selected program or report can be printed out on a printer connected to the CMS.

3.6 Clearing of Programs and Reports

Programs and reports can be cleared from the memory card and the CMS using softkey 10 DELETE. First the program or report to be deleted is selected via softkey 1 PROGR REPORT and softkey 9 CMS MEMCARD. Before the program or report is deleted, the user is prompted by "ARE YOU SURE ?". ENTER acknowledges clearing, CLEAR is pressed for aborting.

The entire conte? saved on the memory card or all the programs in the CMS can be cleared by means of softkey 11 FORMAT. Again, softkey 9 is used for selecting. The user is prompted again by "ARE YOU SURE ?", which is acknowledged by ENTER or aborted by CLEAR.