3.2.6 Fine Level Setting

Setting (receiver test):

Frequency 32 MHz:	[3] [2] [MHz] [f]
Switch off modulation:	[0] [kHz] [INT1]
Output level 5.1 dBm:	[5] [.] [1] [dBm] [Vo]

Test setup:

Connect power meter to RF IN/OUT 77.

Test:

Once the level setting has been applied to the VAR spin wheel (takes place automatically when the last setting of the output level is made), reduce the level without interruptions in 199 0.1-dB steps by rotating the wheel counterclockwise. Check the jumps in level on the power meter. The reductions must be monotonous.

The deviation from the correct value must be $< \pm 1$ dB at -4.9 dBm and $< \pm 2.0$ dB at -14.8 dBm.

If the lowest value of the fine variation range is dropped below by mistake, key in the output level of 5.1 dBm again and then rotate the VAR spinwheel counterclockwise again.

3.2.7 Harmonics Ratio

Setting (receiver test):

Level 10 dBm: [1] [0] [dBm] [Vo]

Switch off modulation: [0] [kHz] [INT1]

Set frequencies between 0.1 and 1000 MHz, preferably the following frequencies:

501 MHz [5] [0] [1] [MHz] [f]

354 MHz
251 MHz
177 MHz
126 MHz
89 MHz
63 MHz
45 MHz
32.5 MHz
1 MHz

Test setup:

Connect RF analyzer to RF IN/OUT 77.

Test:

The harmonics ratio must be > 30 dB.

3.2.8 Non-harmonics Ratio

Setting (receiver test):

Level 10 dBm: [1] [0] [dBm] [Vo]

Switch off modulation: [0] [%] [INT1]

Test setup:

Connect RF analyzer to RF IN/OUT 77.

Test:

The table indicates the frequency setting and the non-harmonics to be looked for:

Frequency setting	Non-harmonics frequency
31.249 MHz	37.502 MHz and 6.253 MHz

The permissible ratio to the carrier is > 60 dB.
The ratio is inherently much better in the frequency range 31.25 MHz < f < 500 MHz which is not tested.

3.2.9 Spurious FM

Setting (receiver test):

Switch off modulation: [0] [kHz] [INT1]

Level 0 dBm: [0] [dBm] [Vo]

Frequency 499.9 MHz: [4] [9] [9] [.] [9] [MHz] [f]

1000 MHz: [1] [0] [0] [0] [MHz] [f]

Further significant frequencies: 830/820/660/650/
500.0004 MHz

Test setup:

Connect modulation meter to RF IN/OUT 77.

Test:

Measure the spurious FM by connecting the CCITT filter and switching on the rms evaluation on the modulation meter. The spurious FM must be < 6 Hz with f < 500 MHz and < 12 Hz with f ≤ 1000 MHz.

RMS evaluation: bandwidth 30 Hz to 20 kHz

f < 500 MHz ≤ 16 Hz spurious FM ┐ Internal
f ≤ 1000 MHz ≤ 32 Hz spurious FM ┘ tolerance

3.2.10 Spurious AM

Setting (receiver test):

Switch off modulation:	[0] [%] [INT1]
Level 0 dBm:	[0] [dBm] [Vo]
Frequency 30 MHz:	[3] [0] [MHz] [f]

Test setup:

Connect modulation meter to RF IN/OUT 77.

Test:

Measure the spurious AM by connecting the CCITT filter and switching on the RMS evaluation on the modulation meter. The spurious AM must be < 0.02%.

RMS evaluation: Bandwidth 30 Hz to 20 kHz
Spurious AM < 0.3% (internal tolerance)

3.2.11 FM Modulation

3.2.11.1 Internal FM

3.2.11.1.1 RF Frequency Response of the Modulation Deviation

Setting (receiver test):

Modulation 25 kHz: [2] [5] [kHz] [INT1]

Modulation frequency 800 Hz: [8] [0] [0] [Hz] [AF INT1]

Level 0 dBm: [0] [dBm] [Vo]

Set the following RF values:

31.25001 MHz [3] [1] [.] [2] [5] [0] [0] [1] [MHz] [f]

32.98 MHz	40.293 MHz	50.766 MHz
32.728 MHz	41.235 MHz	51.952 MHz
33.493 MHz	42.198 MHz	53.167 MHz
34.276 MHz	43.185 MHz	54.409 MHz
35.077 MHz	44.194 MHz	55.681 MHz
35.897 MHz	45.227 MHz	56.983 MHz
36.736 MHz	46.284 MHz	58.315 MHz
37.595 MHz	47.366 MHz	59.678 MHz
38.473 MHz	48.473 MHz	61.0725 MHz
39.373 MHz	49.606 MHz	62.5 MHz

Test setup:

Connect modulation analyzer to RF IN/OUT 77.

Test:

The RF frequency response of the measured deviation must not be more than ±2%.

If this frequency response is exceeded (e.g. as a result of aging or temperature drift), it can be calibrated again using special function [D] [2] [SPEC] .

3.2.11.1.2 AF Frequency Response of the Modulation Deviation

Setting (receiver test):

Modulation depth 25 kHz: [2] [5] [kHz] [INT1] or [EXT]

RF frequency: 44.194 MHz: [4] [4] [.] [1] [9] [4] [MHz] [f]

Level 0 dBm: [0] [dBm] [Vo]

Set the following AF values or feed into connector MOD EXT 82

150 Hz [1] [5] [0] [Hz] [AF INT1]

300 Hz
1 kHz
4 kHz
25 kHz

Test setup:

Set the modulation analyzer to a suitable AF bandwidth and connect to RF IN/OUT 77.

Test:

The AF frequency response of the measured deviation may be

up to ±3% dB for f < 150 Hz,
up to 8% (±4%) for 150 Hz <f <300 Hz and 30 kHz <f <100 kHz,
and 3% (±2.5%) for 300 Hz <f <30 kHz.

The frequency response cannot be adjusted.

3.2.11.1.3 FM Errors

Setting (receiver test):

RF frequency 44.149 MHz: [4] [4] [.] [1] [4] [9] [MHz] [f]

Level 0 dBm: [0] [dBm] [Vo]

AF frequency 1 kHz: [1] [kHz] [AF INT1]

Set the following modulation deviations:

50 kHz [5] [0] [kHz] [INT1]

20 kHz	3.2 kHz	0.2 kHz
10 kHz	1.6 kHz	0.1 kHz
5 kHz	0.8 kHz	50 Hz
	0.4 kHz	25 Hz

Test setup:

Set the modulation analyzer to an AF bandwidth of 300 Hz to 3 kHz and connect to RF IN/OUT 77.

Test:

The variation in the set modulation deviations 50 kHz to 0.4 kHz must not be larger than 5% of the correct value taking into account the frequency responses determined in Sections 3.2.11.1.1 and 3.2.11.1.2.

Because of the spurious FM (approx. 4 Hz peak spurious FM at the set RF frequency, 300 Hz to 3 kHz AF bandwidth, value not guaranteed), the variation from the correct deviation for the modulation deviations 200 Hz to 25 Hz may be larger by this amount.

3.2.11.1.4 FM Distortion

Setting (receiver test):

RF frequency 44.149 MHz	[4] [4] [.] [1] [4] [9] [MHz] [f]
Level 0 dBm:	[0] [dBm] [Vo]
AF 1 kHz:	[1] [kHz] [AF INT1]
Frequency deviation 25 kHz:	[2] [5] [kHz] [INT1]

Test setup:

Connect modulation analyzer with distortion meter to RF IN/OUT 77.

Test:

The modulation distortion must be < 1%.

3.2.11.2 External FM

3.2.11.2.1 External Modulation with Standard Level

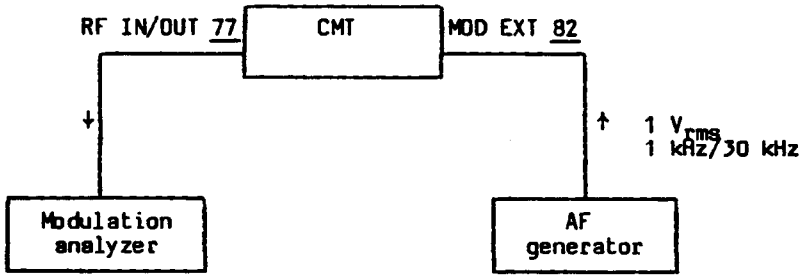
Setting (receiver test):

RF frequency 44.149 MHz: [4] [4] [.] [1] [4] [9] [MHz] [f]

Level 0 dBm: [0] [dBm] [Vo]

Frequency deviation 25 kHz: [2] [5] [kHz] [AF EXT]

Test setup:



AF bandwidth: 300 Hz to 3 kHz
300 Hz to 200 kHz

Test:

Connection of 30 kHz or 1 kHz with 1 V_{rms} ±1% to MOD EXT 82 of the CMT results in the same deviation from the correct value (< 5%) as in Section 3.2.11.1.3.

3.2.11.2.2 External Modulation with Calibration

Setting:

Test setup:] As in Section 3.2.11.2.1

Test:

Set an AF generator to 1 kHz and various levels between 100 mV_{rms} and 2.5 V_{rms}, preferably approx. 2 V, 1 V, 0.5 V, 0.25 V, 0.125 V. Press key EXT CAL after each change in level and read the modulation value.

The modulation follows the AF level until key EXT CAL is pressed. The correct value is then set again.

A calibration error of < 5% (internal tolerance) may occur in addition to the deviation from the correct value (< 5%).

The guaranteed data sheet values with respect to the modulation do not include the external modulation with calibration.

3.2.11.3 Multitone Modulation

Setting (receiver test):

RF frequency 44.149 MHz:		[4] [4] [.] [1] [4] [9] [MHz] [f]
Level 0 dBm:		[0] [dBm] [Vo]
Mod. frequency 1:	0.97 kHz	[0] [.] [9] [7] [kHz] [AF INT1]
Mod. frequency 2*:	0.179 kHz	[0] [.] [1] [7] [9] [kHz] [AF INT2]
Mod. frequency 3:		(is determined by the external modulation generator and must be set to 5.6 kHz)
Mod. deviation 1:	5 kHz	[5] [kHz] [INT1]
Mod. deviation 2*:	5 kHz	[5] [kHz] [INT2]
Mod. deviation 3:	5 kHz	[5] [kHz] [EXT]

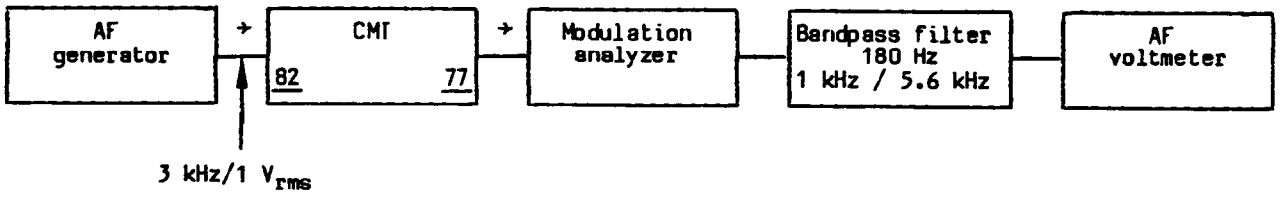
Two of the three modulation sources are specifically switched off for pure tone modulation.

Example:

Modulation with source 2 by switching off source 1 and source 3:	[0] [kHz] [INT1] [0] [kHz] [EXT]

* With option CMT-B7: 2nd AF synthesizer

Test setup:



Test:

The relationship between modulation deviation and voltage is first determined on the AF voltmeter using a modulation analyzer. Set the three modulation values in succession as pure tone modulation with the corresponding bandpass filter.

The modulation analyzer indicates the total deviation (peak value evaluation on the modulation analyzer) in the case of simultaneous 3-tone modulation. The individual deviations can be checked during the 3-tone modulation using the selectable bandpass filter.

The maximum variation from the correct value with the total deviation and the individual deviations must be < ±5% in each case.

The systematic measuring error on the bandpass filter must be additionally taken into account.

3.2.12 AM Modulation

3.2.12.1 Internal AM

3.2.12.1.1 Frequency Response of the Modulation Depth

Setting (receiver test):

RF frequency	30 MHz:	[3] [0] [MHz] [f]
	1000 MHz:	[1] [0] [0] [0] [MHz] [f]
Level 0.1 dBm:		[0] [.] [1] [dBm] [Vo]
Modulation depth 80%:		[8] [0] [%] [INT1]

Set the following AF values:

50 Hz		[5] [0] [Hz] [AF INT1]
300 Hz	1 kHz	
	4 kHz	
	25 kHz	

Test setup:

Adjust the modulation analyzer to a sufficiently large AF bandwidth and connect to RF IN/OUT 77.

Test:

The AF response of the measured modulation depth must be less than 3% (± 1.5%). It cannot be adjusted.

3.2.12.1.2 AM Error

Setting (receiver test):

RF frequency 30 MHz:	[3] [0] [MHz] [f]
Level 0.1 dBm:	[0] [.] [1] [dBm] [Vo]
AF frequency 1 kHz:	[1] [kHz] [AF INT1]

Set the following modulation depths:

5%	[5] [%] [INT1]

10%, 30%, 80%

Test setup:

Adjust the modulation analyzer to an AF bandwidth of 300 Hz to 3 kHz and connect to RF IN/OUT 77.

Test:

The deviation of the set modulation depth must not exceed 5% of the set value taking into account the frequency response determined in Section 3.2.11.1.1. The AM can be adjusted using potentiometer R503 on the output stage module.

3.2.12.1.3 AM Distortion

Setting (receiver test):

RF frequency 30 MHz:	[3] [0] [MHz] [f]
Level 0.1 dBm:	[0] [.] [1] [dBm] [Vo]
AF frequency 1 kHz:	[1] [kHz] [AF INT1]
Modulation depth 30%:	[3] [0] [%] [INT1]
Modulation depth 80%:	[8] [0] [%] [INT1]

Test setup:

Connect modulation analyzer with distortion meter to RF IN/OUT 77.

Test:

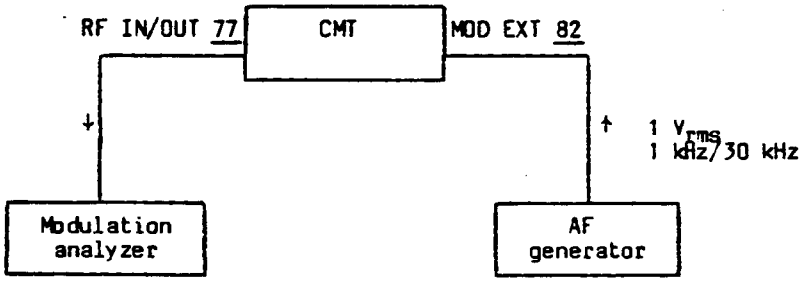
The distortion must be < 1% with 30% modulation depth and < 1.5% with 80 % modulation depth.

3.2.12.2 External AM

Setting (receiver test):

RF frequency 30 MHz:	[3] [0] [MHz] [f]
Level 0.1 dBm:	[0] [.] [1] [dBm] [Vo]
Modulation depth 80%:	[8] [0] [%] [INT1]

Test setup:



AF bandwidth: 300 Hz to 3 kHz
300 Hz to 200 kHz

Test:

The same deviation from the correct value (< 5%) as in Section 3.2.12.1.2 must be obtained when 30 kHz or 1 kHz with 1 V_{rms} ±1% are applied to MOD EXT 82 of the CMT.

3.2.12.2.1 Calibration with Multitone Modulation

The external modulation is tested and calibrated using a modulation depth of 80% as in Section 3.2.11.2.2.

The multitone modulation with modulation depths of 25% for each modulation source and with an RF level of 0.1 dBm is tested in an analogous manner to Section 3.2.11.3.

The performance test with respect to external modulation with calibration and multitone modulation is already complete if these characteristics are measured for either AM or FM since the signal path is the same for both types of modulation.

3.2.13 Phase Modulation

Setting (receiver test):

RF frequency 44.149 MHz: [4] [4] [.] [1] [4] [9] [MHz] [f]

Level 0 dBm: [0] [dBm] [Vo]

Phase deviation 2.5 rad: [2] [.] [5] [rad] [INT1]

Set the following AF values:

300 Hz [3] [0] [0] [Hz] [AF INT1]

1 kHz, 3 kHz, 6 kHz

Test setup:

Set the modulation analyzer to phase modulation and a sufficiently large AF bandwidth and connect to RF IN/OUT 77.

Test:

The deviation from the correct value must be < 7% (corresponds to FM error (5%) + additional frequency response of 2%).

3.2.14 Response Threshold of the Automatic Receiver/ Transmitter Setting

Setting (receiver test, LOCK key not pressed):

RF frequency 100 MHz: [1] [0] [0] [MHz] [f]

Level 0 dBm: [0] [dBm] [Vo]

Test setup 1:

Apply a DC voltage of any polarity to RF IN/OUT 77 and increase continuously from 0 V to 6 V.

Test 1:

The switchover can be heard between 2 and 5 V and the LED on the RXTX key changes from green to red.

Test setup 2:

Using a power transmitter, apply an RF power of 0 to 2 W at frequencies of 25 and 1000 MHz to RF IN/OUT 77.

Test 2:

The overvoltage protection must respond between 0.1 and 1 W.

The response threshold can be adjusted using R34 on the attenuation set drive.

3.2.15 Modulation Generator

3.2.15.1 Frequency Setting and Accuracy

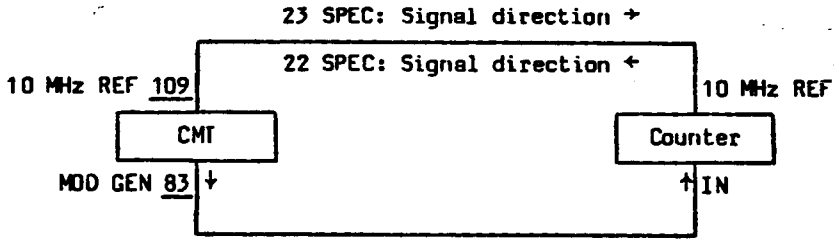
Setting (transmitter test):

AF 1000 mV: [1] [0] [0] [0] [mV] [Vo]

Set the following AF values:

Set AF value (kHz)	Frequency read on AF counter (kHz)
22.32	22.3215
22.31	22.309
22.30	22.2965
22.27	22.272
22.22	22.222
22.12	22.124
21.93	21.93
21.55	21.552
20.83	20.833

Test setup:



Test:

The table indicates the actually set frequencies. The determined frequency error is only produced by the resolution of the meter.

3.2.15.2 Distortion of the Modulation Generator

Setting (transmitter test)

Level	100 mV:	[1] [0] [0] [mV] [Vo]
	5000 mV:	[5] [0] [0] [0] [mV] [Vo]
Frequencies:	20 Hz 301 Hz 1 kHz 4.001 kHz 25 kHz	[2] [0] [Hz] [AF INT 1]

Test setup:

Connect distortion meter to MOD GEN 83.

Test:

Measure the distortion at high impedance (approx. 100 kΩ) and under load (350 Ω at 500 mV and 50 Ω at 100 mV). The distortion must be below 0.5% for f < 10 kHz and below 1% for f > 10 kHz.

3.2.15.3 Output Voltage of the Modulation Generator

Setting (transmitter test):

Frequency 1 kHz: [1] [kHz] [AF INT1]

Set the following output voltages:

5100 mV [5] [1] [0] [0] [mV] [Vo]

5080 mV	2540 mV
5060 mV	2000 mV
5020 mV	1000 mV
4940 mV	500 mV
4780 mV	200 mV
4460 mV	100 mV
3820 mV	50 mV

Test setup:

Connect AF voltmeter to MOD GEN 83.

3.2.15.3.1 Frequency Response of the Modulation Generator

Setting (transmitter test):

Output voltage 1000 mV: [1] [0] [0] [0] [mV] [Vo]

Set the following frequencies:

20 Hz [2] [0] [Hz] [AF INT1]

150 Hz
299 Hz
301 Hz
1000 Hz
3999 Hz
4001 Hz
10000 Hz
25000 Hz
30000 Hz

Test:

The total error from Sections 3.2.15.3 and 3.2.15.3.1 must be less than 3% for f < 25 kHz.

Internal tolerance for f > 25 kHz: ±6%.

3.2.15.4 Frequency Setting and Accuracy of the 2nd AF Synthesizer (Option CMT-B7)

Setting:

Special function [122] [SPEC] is used to output at MOD GEN 83 a double tone generated using two frequencies with the same levels.

Test setup:

The test setup corresponds to that in Section 3.2.15.1 except that a selectable filter to suppress one of the two tones is connected between MOD GEN of the CMT and the input of the meter.

Select the same frequency on the 2nd AF synthesizer as was selected for the 1st modulation generator in Section 3.2.15.1. Set the selectable filter such that these frequencies are in the passband. Select the frequencies for the 1st modulation generator such that they fall in the stopband of the filter.

Test:

Test the set frequencies using the frequency meter as in Section 3.2.15.1.

3.2.16 AF Voltmeter

3.2.16.1 AF Frequency Response

Setting (receiver test):

Call AF level measurements by pressing the AF LEVEL key.
Call SLOW mode using [26] [SPEC] .

Test setup:

Apply a signal with an amplitude of 1 V and frequencies between 50 Hz and 20 kHz to AF VOLTM 84.

Test:

Record the frequency response in order to determine the AF voltmeter error.

The AF measurement can be accelerated using special function [25] [SPEC] . The bottom cut-off frequency is 150 Hz in this case. An additional frequency response of ±5% may occur in addition (internal tolerance).

This mode is switched off again for the other measurements using [26] [SPEC] .

3.2.16.2 Measuring Accuracy Depending on the Input Level

Setting:

(as in Section 3.2.16.1)

Test setup:

Apply voltages between 5 mV and 5 V with a frequency of 1 kHz to AF VOLTM 84.

Test:

The total error of the level measuring accuracy and the frequency response must not exceed ±3% + 1 digit. Calibration with a high-precision **external** signal is possible using [D] [30] [SPEC] .

Use: See list of special functions, Section 2.

3.2.16.3 Frequency Response of the CCITT Filter

Setting:

As in Section 3.2.16.1 except that the CCITT RX key must be additionally pressed.

Test setup:

Apply an AF signal of 3 V/800 Hz to AF VOLTM 84.

Test:

Record the frequency response at the following frequencies:

Frequency Hz	Attenuation dB	Tolerance ±dB
50	-63	2
100	-41	2
150	-29	2
200	-21	2
300	-10.6	1
400	-6.3	1
500	-3.6	1
600	-2.0	1
800	0	Reference
1000	1	1
1200	0	1
1500	-1.3	1
2000	-3.0	1
2500	-4.2	1
3000	-5.6	1
3500	-8.5	2
4000	-15	3
5000	-36	3
6000	-43	-
>6000	<-43	-

The applied AF signal of 3 V/800 Hz is declared as the reference value by entering [3] [V] [REF] [LEVEL] and the measurements are displayed in dB referred to this setting.

Set the frequencies listed in the table. To prevent measuring errors, ensure that a low-distortion (< 0.01%) test signal is used, especially with low frequencies. The tolerances listed in the table must not be exceeded by more than the error determined in Section 3.2.16.1.

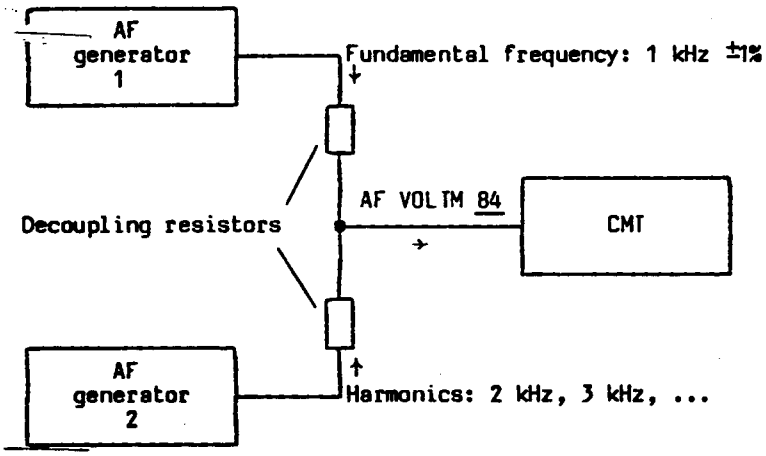
Potentiometer R388 on the analog unit module is used to adjust the gain of the CCITT filter, preferably with respect to the reference.

3.2.17 Distortion Meter

Setting (receiver test):

Call distortion measurements by pressing the SINAD.DIST key twice.

Test setup:



Test:

Apply the signal from two AF generators to AF VOLTM 84 of the CMT. The total harmonic distortion THD is determined by the level of the AF generator 2 for the harmonics and the AF generator 1 for the fundamental frequency:

$$THD = \frac{V_{(2kHz)} \times 100\%}{\sqrt{V^2_{(1kHz)} + V^2_{(2kHz)}}} \approx \frac{V_{(2kHz)} \times 100\%}{V_{(1kHz)}} \quad \text{(for THD <10\%)}$$

3.2.17.1 Inherent Distortion

Setting:

(as in Section 3.2.17)

Test setup:

Apply a distortion-free signal of 30 mV to 3 V to AF VOLTM 84.

Test:

The display must not be greater than 0.3%.

3.2.17.2 Display Accuracy of the Distortion Meter

Setting:
(as in Section 3.2.17)

Test setup:

Set distortions up to 50% (preferably the following) with a total voltage of approx. 1 V:

Set distortion %	Permissible measured value %
10	9.2 to 10.8
3	2.5 to 3.5
1	0.7 to 1.3
0.3	0 to 0.6

Test:

The measured value must not exceed the permissible error even if the fundamental frequency is detuned to 990 Hz or 1010 Hz (cut-off bandwidth for the fundamental frequency). The stop-band can be adjusted using potentiometers R556, R558, R566 and R571 on the analog unit module.

3.2.18 SINAD Meter

Setting:

Call SINAD measurements by pressing the SINAD.DIST key once.

Test setup:

(as in Section 3.2.17)

Test:

Testing the measurement limit as a result of stopband attenuation corresponds to the measurement of inherent distortion with 3 V applied to connector AF VOLTM 84.

Display: > 50 dB.

Testing the measurement limit as a result of inherent noise cannot be isolated from stopband attenuation, but essentially corresponds to the measurement of inherent distortion with 30 mV applied to connector AF VOLTM 84.

Display: > 47 dB.

Testing the display accuracy.

Set SINAD values up to 6 dB (preferably the following) with a total voltage of approx. 1 V:

Set value	Permissible measured value
20 dB	19.3 to 20.5 dB
30 dB	28.7 to 30.5 dB
40 dB	37.2 to 40.5 dB
50 dB	46.5 to 50.5 dB

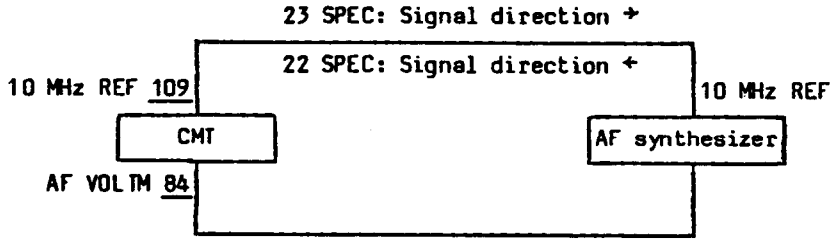
The measured value must not exceed the error even if the fundamental frequency is detuned to 990 Hz or 1010 Hz (cut-off bandwidth of the fundamental frequency). The stopband can be adjusted using potentiometers R556, R558, R566 and R571 on the analog unit module.

3.2.19 AF Counter

Setting (receiver test):

Call AF measurements by pressing the AF EXT key.

Test setup:



Test:

Test the accuracy of the counter at 1 V and with frequencies between 20 Hz and 500 kHz, preferably at 20 Hz, 1 kHz and 4 kHz (resolution 0.1 Hz) and then at 5 kHz, 50 kHz and 500 kHz (resolution 1 Hz). The error is ±1 x the resolution since the reference frequencies are combined.

Determine the sensitivity of the counter at frequencies of 20 Hz, 30 kHz and 500 kHz. It must be < 3 mV up to 30 kHz and < 30 mV above 30 kHz. An AF signal with a high signal-to-noise ratio is required to test the sensitivity of the counter.