2.3.2 Connection Between CMT and Device Under Test

(see Figs. 2-11 and 2-12)

All connections between the CMT and the device under test are made via the connectors on the front panel (Fig. 2-8).

At least three connections are necessary:

Connection 1:

a) Bidirectional RF connection between antenna connector of the transceiver and connector RF IN/OUT 77 of the CMT

The CMT automatically switches to the transmitter test mode if an RF signal > 0.5 W is applied to this connector. The power, frequency, spectral purity (adjacent channel power measurement) and maximum modulation (positive, negative and average modulation peaks) of the applied signal can be examined.

Connection 3 must also be made to measure the transmitter modulation distortion (key DIST 26).

The CMT switches back to the receiver test mode if the RF power drops. The RF test signal is then applied to the receiver via this connection. All necessary receiver measurements are possible via connection 2 if the test generator has been correctly set to the receiver frequency of the transceiver.

Only this input/output must be used with duplex radio sets and the receiver test mode (also for reasons of RF power compatibility), in the case of transmitters with a lower power (e.g. radiotelephone) or coupling of the CMT to a transmitter via antenna (telemetry) it may be more favourable to use the more sensitive input (INPUT 2 79). RF power measurements are not possible in this case.

→ When the RF input INPUT 2 is used, the 20-dB attenuator at the CMT input can be switched on and off by means of
[20] [SPEC] / [21] [SPEC] .

When the input RF IN/OUT is used, this is done automatically according to the result of the RF power measurement.

The automatic 20-dB attenuation can be switched off by means of

[19] [SPEC] : automatic 20-dB attenuation off

The settings

[20] [SPEC] : 20-dB attenuation on

[21] [SPEC] : 20-dB attenuation off

can then be performed even when the input RF IN/OUT is used.

The automatic 20-dB attenuation can be switched on again by means of

[18] [SPEC] : automatic 20-dB attenuation on (default).

Connection 2:

b) AF output signal of transceiver to AF voltmeter (connector AF VOLTM 84) of the CMT

The level of any AF signal, even weighted by a CCITT filter, can be measured at this connector.

The receiver sensitivity (keys SINAD 33, S/N 34) and the receiver distortion (key DIST 33) can only be measured if connection 1 is present.

Connection 3:

c) Modulation signal of CMT (connector MOD GEN 83) to microphone input of transceiver

A defined modulation signal must be applied to the microphone input of the transceiver in order to measure the modulation sensitivity and the transmitter modulation distortion via this connection.

Connection 4:

d) Measurement of various RF levels in the device under test

RF levels from 1 mV to 100 V in the frequency range from 10 kHz to 2000 MHZ can be measured via various probes at connector RF PROBE 85 if the RF millivoltmeter option CM-B8 is fitted.

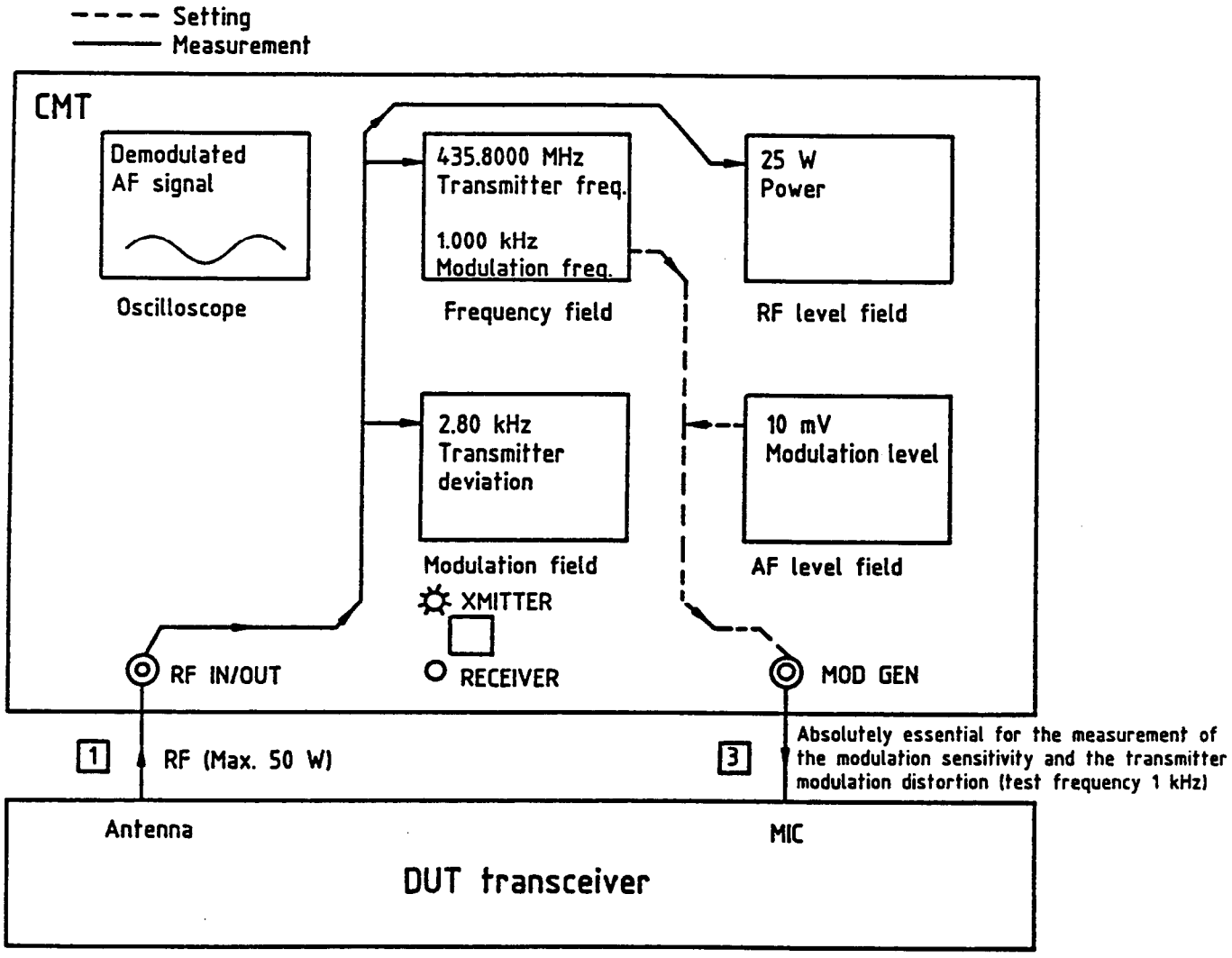


Fig. 2-11 Transmitter test

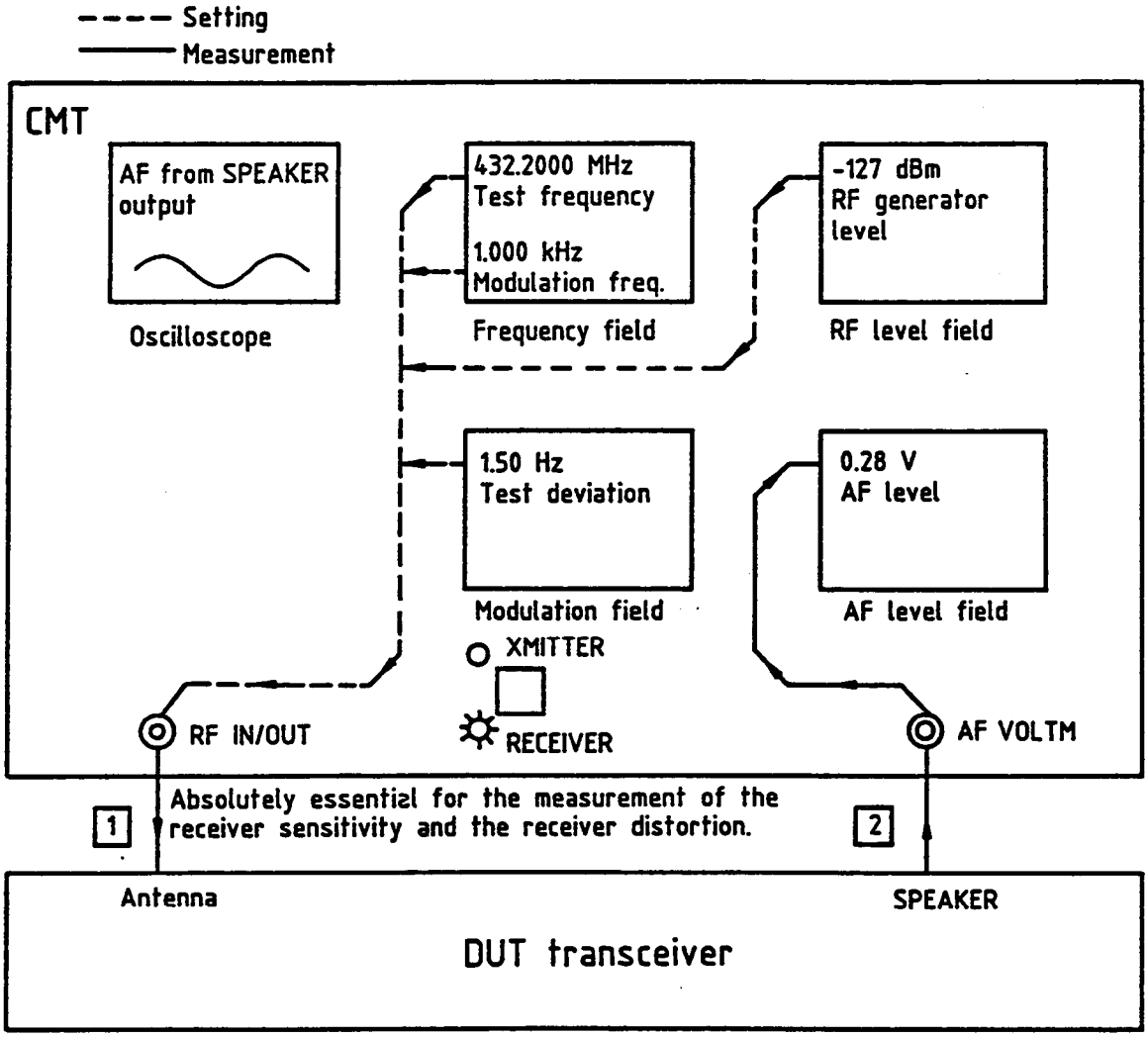


Fig. 2-12 Receiver test

2.3.3 Frequencies

All frequencies are input and output in the frequency field (Fig. 2-1).

2.3.3.1 RF Meter

The RF meter is switched on when the instrument is switched on for the first time or when the key COUNT f 5 is pressed. It processes input signals between 0.4 MHz and 1000 MHz if the level is high enough (min. 5 mV at RF INPUT 2 79 or 5 mW at connector RF IN/OUT 77) and outputs the result in frequency display 1 with a resolution of 10 Hz.

0.00000 MHz appears in the display if the level is too small or if no signal is present.

In addition to the frequency measurement, the meter correctly sets the operating frequency of the fully automatic modulation meter in the transmitter test mode. This operating frequency is therefore undefined with a meter value of 0.00000 MHz.

The gate time is 100 ms up to a frequency of 400 MHz and 400 ms at higher frequencies (4:1 prescaler). The controller carries out the switchover fully automatically.

The gate time can be increased to ten times this value using [C] [20] [SPEC] 55 in order to switch the resolution of the results from 10 Hz to 1 Hz.

BEAT and ACP measurements are not possible in this mode.

2.3.3.2 Operating Frequency in the Transmitter Test Mode

The operating frequency can also be entered directly if the level is too low to permit correct operation of the RF meter or if there are other reasons (e.g. telemetry) why automatic operation of the modulation meter is impossible.

Example:

[145.8] [MHz] [SET f TX]

This switches off the RF meter and the local oscillator is set according to the entered frequency; the oscillator frequency is calculated as follows:

Entered frequency	Modulation measurement	BEAT measurement
f_{in} < 3.65 MHz	$f_{osc} = f_{in} + 455$ kHz	$f_{osc} = f_{in}$
f_{in} > 3.65 MHz	$f_{osc} = f_{in} - 455$ kHz	$f_{osc} = f_{in}$

The IF offset of 455 kHz is automatically taken into account by the controller and the entered operating frequency is always displayed.

Example:

Frequency from the RF meter or set by hand:	438.95 MHz
Displayed frequency:	438.9500 MHz
Frequency of local oscillator:	438.4950 MHz

2.3.3.3 Operating Frequency in the Receiver Test Mode

The synthesizer output frequency must always be entered manually using the key SET f RX 5 since the receiver frequency of the transceiver cannot be automatically determined.

The displayed frequency then always corresponds to the frequency of the output signal.

Example:

[153.3] [MHz] [SET f RX].

The frequency of the test generator signal is 153.3 MHz.

Frequency transfer function:

This function permits to transfer the RF frequency measured or set in the transmitter test into the receiver test. The duplex spacing, if required, may be taken into account as well.

Each time the operating frequency of the transmitter test is set (SET f TX or COUNT), the new frequency is automatically stored. When switching from transmitter test to receiver test (manually or automatically), the value last stored is modified according to the duplex spacing entered ([C] [52] [SPEC]) and the resulting operating frequency of the receiver test is automatically set (SET f RX).

The duplex spacing between transmit and receive frequency is entered via [C] [52] [SPEC] <Dup.-Δf> [kHz] [SPEC] . Positive values result in a receive frequency of the transceiver that lies above the transmit frequency, negative values produce one that lies below. The values range from -99999.99 kHz to 0 to +99999.99 kHz.

This function is switched on via [C] [50] [SPEC]

and off via [C] [51] [SPEC]

2.3.3.4 Operation Without Duplex Modulation Meter (Option CM-B9)

The RF synthesizer is used as the local oscillator in the transmitter test as well as the RF test generator in the receiver test if the duplex modulation meter (option CM-B9) is not fitted.

The frequency is automatically switched over depending on SET f RX, SET f TX or COUNT f when a change is made from transmitter test to receiver test or vice versa.

The frequency of the RF synthesizer remains unchanged, however, if the mode of the frequency field is changed individually using the key DISPLAY CHANGE 65.

The message "Add-b9" appears in the frequency display with the functions SET f RX and SET f TX to indicate this special case.

SET f TX or SET f RX can still be used after switching over the frequency display and the oscillator frequency is correspondingly adjusted when these keys are pressed.

Examples:

Operating mode: Receiver test
Test generator frequency: 145.2 MHz

An operating frequency of 145.8 MHz was previously set in the transmitter test mode.

[DISPLAY CHANGE] [COUNT f] → frequency field in the transmitter test

COUNT f is switched on: The frequency of an RF signal is measured, the test generator frequency (145.2 MHz) remains unaffected.

SET f TX is switched on: The message "Add-b9" appears in the frequency display.

The test transmitter frequency is set to 145.8 MHz if the key SET f TX is now pressed.

Since the frequency may no longer agree with the received frequency, measurements associated with it (SINAD, S/N etc.) can no longer be made.

Operating mode: Transmitter test
Operating frequency: 145.8 MHz

A test transmitter frequency of 438.5 MHz was previously set in the receiver test mode.

[DISPLAY CHANGE] [SET f RX] → frequency field in the receiver test

The message "Add-b9" appears in the frequency display, the transmitter test frequency (145.8 MHz) remains unaffected, the modulation meter operates further at the set frequency.

The frequency is set to 438.5 MHz and displayed if the key SET f RX is pressed.

2.3.3.5 AF Meter

The meter operates according to the principle of period measurements (0.1 Hz resolution) in the range from 10 Hz to 4 kHz. It has therefore been possible to reduce the time per measuring cycle to a minimum (< 100 ms at 1 kHz) despite the high accuracy of 0.1 Hz.

It is possible to switch the meter to gate time frequency counting (measuring cycle 1 s, resolution 1 Hz) using [C] [10] [SPEC] in order to also achieve greater insensitivity to noise pulses in this frequency range. It is possible to return to period measurements using [C] [11] [SPEC] .

The principle of gate time frequency counting is always used for frequencies > 4 kHz.

The resolution of the gate time frequency measurement can be increased from 1 Hz (measuring cycle > 1 s) to 0.1 Hz (measuring cycle > 10 s) in the complete frequency range using [C] [12] [SPEC] .

The AF meter can be operated with three different sources:

DEMOD	Measurement of the demodulated AF signal
BEAT	Measurement of the difference between the set operating frequency and the RF input signal frequency
AF EXT	Measurement of the AF at connector AF VOLT

DEMOD measurements are only meaningful if the transmitter test operating frequency is correctly set which is usually the case when using COUNT f.

On the other hand, BEAT measurements can only be called if a transmitter test operating frequency has previously been set using SET f TX.

Independent of any other settings, the measurement AF EXT is always available for analysis of the signals applied to the connector AF VOLTM.

⚠ The oscilloscope and the test loudspeaker are automatically operated with the same source if the AF meter is switched on (identified in the status line).

The oscilloscope and the loudspeaker can only be operated as desired using the three available sources (selection using mode keys 92, 93) if the meter has been switched off by pressing AF INT 1, AF INT 2 or Δf.

2.3.3.6 AF Generator Settings

The basic configuration of the CMT possesses an AF generator whose frequency can be set in the range from 20 Hz to 30 kHz using the key AF INT 1 9.

Variation with the spin wheel takes place according to a standard tone sequence with 8 frequencies which can be defined as required:

Factory setting:

1st tone	0.3 kHz
2nd tone	0.6 kHz
3rd tone	1.0 kHz
4th tone	1.25 kHz
5th tone	2.7 kHz
6th tone	3.0 kHz
7th tone	6.0 kHz
8th tone	10.0 kHz

These frequencies can be reprogrammed as required at any time using the key SPEC 55 (see Section 2.3.8 "SPEC Function").

Furthermore, a continuous variation with any increments is possible using the key ΔVAR 53.

Example:

[1] [kHz] [AF INT 1]

→ The modulation generator is set to 1 kHz.
→ Variation using spin wheel in standard tone sequence.

[0] [ΔVAR] [AF INT 1]

→ Variation with smallest possible resolution (0.1, 1 or 10 Hz)

[ΔVAR] [CLEAR] [AF INT 1]

→ Variation in standard tone sequence

[ΔVAR] [AF INT 1]

→ Variation with smallest possible step value

[500] [Hz] [ΔVAR] [AF INT 1]

→ Variation now in 500 Hz steps

[ΔVAR] [CLEAR] [AF INT 1]

→ Variation in standard tone sequence again

The generated AF signal is available directly at connector MOD GEN 83 or internally for modulation of the RF test generator (INT 1).

The modulation generator can be switched off completely by entering [0] [AF INT 1] independent of the settings V_0 MOD GEN and INT 1.

Important with CODE:

Since the level settings by V_0 MOD GEN and INT 1 refer to the data telegram when using CODE, muting of the generator before and after transmission of a tone sequence can only be achieved using [0] [AF INT 1] .

The 2nd AF synthesizer (option CMT-B7), if fitted, can be operated using key AF INT 2.

The above-mentioned also applies in this case except that the signal of this AF generator is not usually available at connector MOD GEN but is primarily used to modulate the synthesizer.

The signal of the 2nd AF generator can be added to the signal of the first using [122] [SPEC] if a two-tone signal is required at this connector (see Section 2.3.6.1).

2.3.3.7 CODE/DECODE

In its basic configuration, the CMT can transmit and receive single-tone sequences to all common standards. The option CMT-B7, if fitted, additionally permits transmission, the option CM-B11 reception of special double-tone sequences.

The different tone sequence standards are selected using

[C] [110] [SPEC] CODE and DECODE (if possible)

[C] [111] [SPEC] only DECODE

where the different standard codes are represented by the following numbers:

Fixed single-tone sequences

Code number (No)	
00	ZVEI1 (default after master reset)
01	ZVEI2
02	CCIR
03	CCIR 70 ms
04	EEA
05	EIA
06	VDEW
07	EURO
08	CCITT
09	NATEL
10	reserved
11	reserved
12	only DECODE: socket D 11 on CM-B11
13	only DECODE: socket D 12 on CM-B11
14	only DECODE: socket D 13 on CM-B11

Fixed double-tone sequences
(only with option CMT-B7)

Code number (No)	
15	DTMF DECODE: only with option CM-B11
16	VDEW only DECODE, only with option CM-B11
17	reserved
18	reserved
19	reserved

Freely programmable tone sequences (single tones)

Code number (No)	
20	USER 0
21	USER 1

Freely programmable double-tone sequence
(only with option CMT-B7, only code transmission!)

Code number (No)	
22	USER 2

2.3.3.7.1 Selection of a Particular Code

It is possible to select a standard (Active Code) from the fixed codes and USER 0 to USER 2 using [C] [110] [SPEC] <No> [SPEC] (0 ≤No ≤22). In the case of single-tone sequences, this Active Code applies to both CODE and DECODE.

If CODE reception is not possible for the newly selected standard (option CM-B11 not fitted with DTMF), the previously set standard remains valid.

Example:

Set standard: No = 2 (CCIR)

Input: [C] [110] [SPEC] [5] [SPEC]

New standard for CODE/DECODE: No = 5 (EIA)

Input: [C] [110] [SPEC] [15] [SPEC]

New standard for CODE: No = 15 (DTMF)
(CMT-B7 fitted)

Standard for DECODE: No = 5 (EIA)
(CM-B11 not fitted)

Following selection of the CODE/DECODE tone-sequence standard

using [C] [110] [SPEC] <No> [SPEC]

another standard can be selected for CODE reception (DECODE) only

using [C] [111] [SPEC] <No> [SPEC] (0 <No <22)

The selected standard is retained for the tone sequencer. Using these two SPEC functions, the standards selected can also be displayed:

Input	α display	Remark
[C] [110] [SPEC]	C110 * 5	(5 = EIA)
[SPEC]	---	
[C] [111] [SPEC]	C111 * 4	(4 = EEA)
[SPEC]	---	

2.3.3.7.2 CODE Transmission

If Active Code is loaded with the desired code via [C] [110] [SPEC] <No> [SPEC], a selective call can be sent by entering the call number and pressing the CODE key. The call number is displayed in the α display and remains stored until the next input so that the call can be repeated as often as desired by pressing the CODE key.

If the tone sequence is to be sent as burst, the modulation generators 1 and 2 can be switched off using [0] [AF INT1] and [0] [AF INT2].

The modulation setting of the test generator is not internally checked. INT1 (with DTMF also INT2) should therefore be set to standard deviation before pressing the CODE key. The selective call is also sent at the connector MOD GEN with automatic switchover to double tone.

Example:

Input	α display	Remark
[345705509] [CODE]	345705509	This selective call is simultaneously sent.
[CODE]	345705509	(last entered call number) This call is simultaneously sent.

The sent tones can be varied with regard to frequency and tone duration using the following SPEC functions:

[C] [160] [SPEC] <T(ms)> [SPEC]	Duration of first tone in ms (10 ms <T <5000 ms)
[C] [161] [SPEC] <T(ms)> [SPEC]	Duration of following tones in ms (10 ms <T <5000 ms)
[C] [162] [SPEC] <T(ms)> [SPEC]	Pause duration in ms (T = 0 and 10 ms <T <5000 ms)
[C] [163] [SPEC] <f tol(%)> [SPEC]	Frequency deviation of the sent tones from the nominal frequency in % (-10 % to +10 %)

These SPEC functions always refer to the standard code selected using [C] [110] [SPEC] .

With each new call of [C] [110] [SPEC] , the parameters tone duration of 1st tone, tone duration of all following tones, pause duration and frequency deviation are cancelled again by the default values of the selected standard.

Example:

a) [C] [110] [SPEC] [2] [SPEC] CCIR standard is selected

The telegram 12345 is sent as follows:
Each tone is 100 ms long, no pauses, all tone frequencies correspond to the respective nominal frequencies.

b)

Input	α display	Remark
[C] [160] [SPEC]	C160* 100 ms	Duration of 1st tone 100 ms
[500] [SPEC]		now: 500 ms
[C] [161] [SPEC]	C161* 100 ms	Tone duration: 100 ms
[80] [SPEC]		now: 80 ms

The telegram 12345 is sent as follows:
Tone 1 is 500 ms long, tones 2, 3, 4, 5 are 80 ms each, no pauses, all tone frequencies correspond to the respective nominal frequencies.

c)

Input	α display	Remark
[C] [162] [SPEC]	C162* 0 ms	Pause duration: 0 ms
[50] [SPEC]		now: 50 ms
[C] [163] [SPEC]	C163* 0 PERC	Tone frequencies: ±0 %
[-] [4] [SPEC]		now: -4 %

The telegram 12345 is sent as follows:

```
1     500 ms long,    frequency 4 % below nominal frequency
P      50 ms pause

2      80 ms long,    frequency 4 % below nominal frequency
P      50 ms pause

3      80 ms long,    frequency 4 % below nominal frequency
P      50 ms pause

4      80 ms long,    frequency 4 % below nominal frequency
P      50 ms pause

5      80 ms long,    frequency 4 % below nominal frequency
```

[C] [110] [SPEC] [2] [SPEC] : CCIR standard is reloaded, the changes produced by

[C] [160] [SPEC]

to

[C] [163] [SPEC]

are cancelled.

2.3.3.7.3 CODE Reception

By pressing the DECODE key, the selective-call decoder is switched on and its readiness to receive signals indicated in the α display by the message "DECODE". Provided that the tone is applied constantly for more than 30 ms, the signal which is demodulated or applied to the connector AF VOLTM is assigned to a code number of the standard sequence defined by [C] [110] [SPEC] / [C] [111] [SPEC] and subsequently output using the code numbers 0 to 9 and A to F.

Pauses (50 ms <pause <100 ms) are marked in the display by means of "P", tones not in line with the standard are handled as errors and marked by an "X".

Since the decoding only starts when the first valid tone has arrived, faulty tones can only be marked within a tone sequence.

If automatic repeat is switched on (Section 2.3.3.7.4) E (repeat tone) is not displayed, but the previous code number is displayed twice instead.

Pauses longer than 100 ms cause the tone sequence evaluation to be aborted. The tones received until then are output in the α display.

Further pressing of the DECODE key clears the call number in the α display and reactivates the tone-sequence decoder.

Example:

[C] [111] [SPEC] [2] [SPEC]	Tone sequence to CCIR standard is selected
[DECODE]	Tone-sequence decoder waits for reception of a selective call (max. 1 min.). Output in the α display: *DECODE*

The transceiver sends 123E3 (pause) 567 (frequency outside the standard) 9ABC.

100 ms after reception of the last tone, the call number can be read on the α display as follows:

1 2 3 3 3 P 5 6 7 X 9 A B C

If a continuous tone remains applied after the last call number, decoding is only aborted after 250 measurements. The associated wait time is about

$$Tw = 1300 \times (1/f)$$

Tw = wait time until decoding is aborted (s)
f = frequency of continuous tone (Hz)

e.g.: f continuous tone = 310 Hz → Tw = approx. 4.2 s
f continuous tone = 4 kHz → Tw = approx. 330 ms

Reducing the decoding time:

Enter: [C] [180] [SPEC] <t> [SPEC]

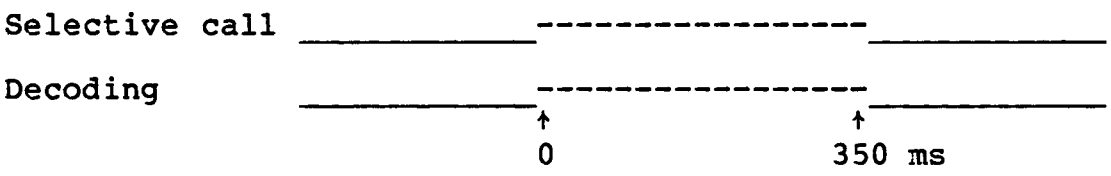
This special function can be used to reduce the decoding time following the arrival of the first valid tone to t (10 ms < t < 10000 ms).
Thus the call is evaluated and displayed after max. t ms.

For t = 10000 ms (e.g. after [99] [SPEC] or master reset), this function is switched off.

Example:

A five-digit telegram (each tone 70 ms) is expected.

When [C] [180] [SPEC] [350] [SPEC] is entered (= 350 ms total duration), the end of decoding coincides exactly with the end of the last tone.



Advantage of this operating mode:

After the selective call has been started, the CMT will again be able to execute autorun control commands (or IEC-bus commands) at a defined point in time and is thus able to respond faster (useful in the case of NATEL).

Accuracy:

±10 ms after detection of the first tone.

The detection of the first tone may be delayed by up to 12 periods (AF frequency/1st tone).

Extension of permissible pauses between two tones or telegrams (selective-call decoder)

The detection of the end of telegram is delayed in order to bridge possible pauses between the tones. After switching on the instrument, the maximum permissible pause is set to approx. 100 ms (no AF signal during the pause).

The delay time can be adjusted in three stages:

[C] [173] [SPEC] : Decoding aborted approx. 100 ms after last tone (default after switching on)

[C] [174] [SPEC] : Decoding aborted approx. 400 ms after last tone

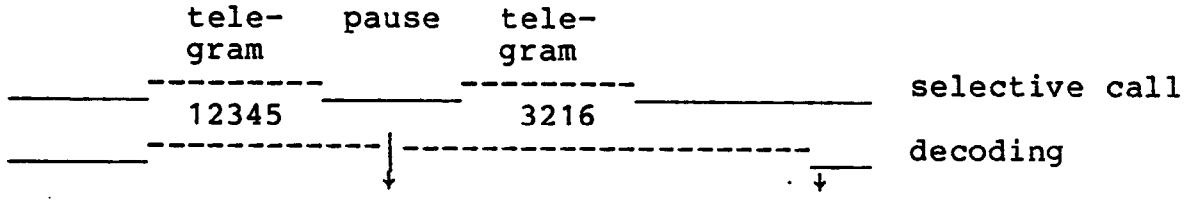
[C] [181] [SPEC] : Decoding aborted approx. 2 s after last tone

It is thus possible to simultaneously display several telegrams arriving in quick succession (pause <400 ms/2s).

Example:

[C] [174] [SPEC] : pause <400 ms

[C] [181] [SPEC] : pause < 2 s



The call is only aborted if the pause is longer than 400 ms/2s.

Decoding is aborted, earliest display after 400 ms/2s.

Readout on the alphanumeric display: 1 2 3 4 5 P 3 2 1 6

Extension of the maximum permissible pauses can also be employed in combination with limitation of the decoding time ([C] [180] [SPEC] <t> [SPEC]).

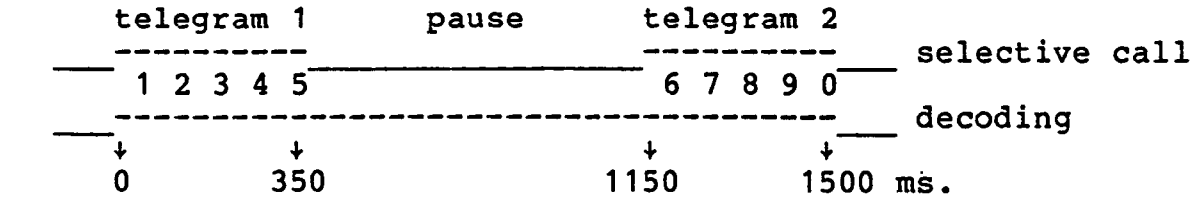
Example:

Two five-tone sequences with a pause of 800 ms are to be decoded. At the end of the last tone, the CMT (autorun control, IEC bus) is to respond immediately. The duration of a tone is 70 ms.

Total decoding time = (2 x 5 x 70 ms) + 800 ms = 1500 ms

Enter: [C] [180] [SPEC] [1500] [SPEC]

[C] [181] [SPEC] : pause >400 ms



Readout on alphanumeric display: 1 2 3 4 5 P 6 7 8 9 0

Source selection of the decoder:

Although, in general, the demodulated signal is fed to the tone-sequence decoder, switchover to the signal applied to the connector AF VOLTM is also possible for testing.

[C] [171] [SPEC]	Signal at the connector AF VOLTM is evaluated.
[C] [170] [SPEC]	DEMOD signal is evaluated (default following switch-on).

⚠ Switching between the signal sources has also effect on the display of the oscilloscope in internal mode, i.e., with the decoder switched on, the oscilloscope can only display the internal signal which is also fed to the decoder; the arrow above the symbol AUTO in the status line of the oscilloscope appears.

Frequency tolerances:

The single tone decoder (code numbers 0 to 9 and 20, 21) detects only the tones whose frequency falls within the tolerance window of the nominal value. This tolerance is ±2 % after switching on and master reset, but can be easily changed using the command [C] [172] [SPEC] <f tol. (%)> [SPEC] (0.5 % <f tol. <10 %).

The option CM-B11 enables decoding of DTMF signals. With double tones, the dynamic range ensuring correct evaluation is smaller than with single tones. Therefore, depending on the selected source and the type of modulation, preamplification of the signal is matched to the current conditions. In the event that this default setting does not lead to satisfactory results for some reason or other, a different gain setting can be selected using the following SPEC functions:

[C] [176] [SPEC]	-6-dB gain
[C] [177] [SPEC]	0-dB gain
[C] [178] [SPEC]	+6-dB gain
[C] [175] [SPEC]	Automatic gain setting (default)

VDEW direct dialling:

(5-tone sequence to ZVEI1, then DTMF signalling)

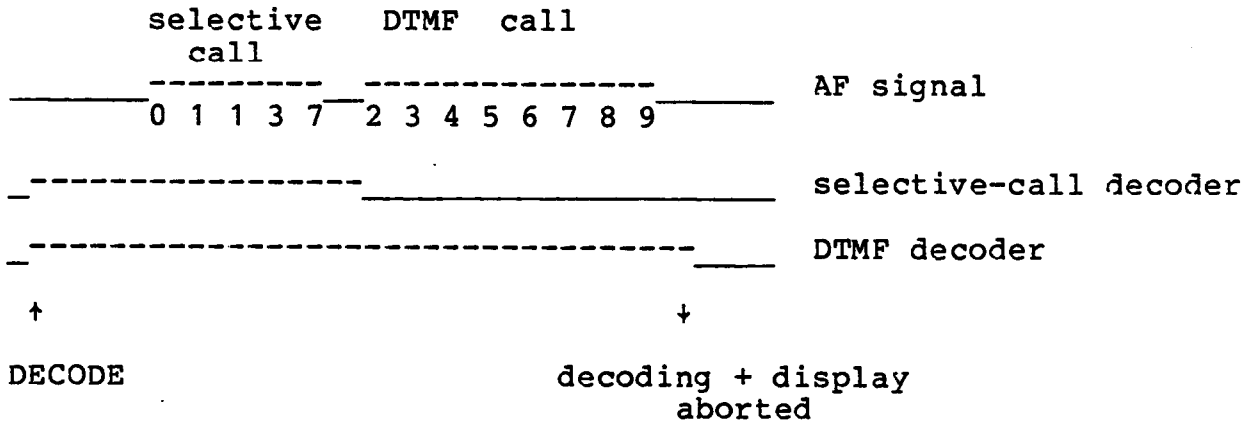
Code number 16 is provided for the signalling of VDEW direct dialling:

[C] [111] [SPEC] [16] [SPEC] (16 = VDEW decoding)

Selective-call decoder and DTMF decoder are simultaneously started when pressing the DECODE key (selective call standard = ZVEI1).

The selective-call decoder is immediately switched off by the first incoming DTMF tone. After the last DTMF tone, the results of the selective-call decoder and the DTMF decoder are combined (a hyphen is used as separator) and indicated on the alphanumeric display.

Example:



Readout on the alphanumeric display: 01137-23456789
(and test report or IEC bus)

The tone combination 697Hz/1633Hz (= 'A' in the CMT) is used as separator in the VDEW direct dialling system. Therefore, the facility to suppress the display of separators is provided.

[C] [190] [SPEC] : The separators are also displayed.

[C] [191] [SPEC] : The display of separators is suppressed. (Default, only with VDEW signalling, code number 16 effective!)

2.3.3.7.4 Automatic Repeat

If the repeat tone (E) is to be used automatically for CODE transmission of two identical successive tones, the automatic repeat facility must be switched on. Otherwise, a single tone with overlength (possibly with short pauses in between) would be transmitted instead of a sequence of several call numbers.

For testing, this automatic repeat facility can be switched off using [C] [151] [SPEC] .

To switch it on again, [C] [150] [SPEC] is entered.

Example:

Selective call:	111233
Automatic repeat on:	1E123E is sent
Automatic repeat off:	1 (triple tone duration) 2 3 (double tone duration)

During DECODE, with automatic repeat switched off, the repeat tone (E) is directly displayed; otherwise, the last sent tone is doubled.

Example:

Received telegram:	1E2E345E5E	
Automatic repeat on:	1122345555	displayed
Automatic repeat off:	1E2E345E5E	displayed

2.3.3.7.5 Frequency Tables of the Fixed Tone-sequence Standards

All frequencies are given in Hz.

Code Tone dur. Pause	ZVEI1 70 ms 0 ms	ZVEI2 70 ms 0 ms	CCIR 100 ms 0 ms	CCIR 70 ms 0 ms	EEA 40 ms 0 ms	EIA 33 ms 0 ms	YDEN 100 ms 0 ms	EURO 100 ms 0 ms	CCITT 100 ms 0 ms	NATEL 70 ms 0 ms
Tone no.										
0	2400.0	2200.0	1981.0	1981.0	1981.0	600.0	2280.0	979.8	400.0	1633.0
1	1060.0	970.0	1124.0	1124.0	1124.0	741.0	370.0	903.1	697.0	631.0
2	1160.0	1060.0	1197.0	1197.0	1197.0	882.0	450.0	832.5	770.0	697.0
3	1270.0	1160.0	1275.0	1275.0	1275.0	1023.0	550.0	767.4	852.0	770.0
4	1400.0	1270.0	1358.0	1358.0	1358.0	1164.0	675.0	707.4	941.0	852.0
5	1530.0	1400.0	1446.0	1446.0	1446.0	1305.0	825.0	652.0	1209.0	941.0
6	1670.0	1530.0	1540.0	1540.0	1540.0	1446.0	1010.0	601.0	1335.0	1040.0
7	1830.0	1670.0	1640.0	1640.0	1640.0	1587.0	1240.0	554.0	1477.0	1209.0
8	2000.0	1830.0	1747.0	1747.0	1747.0	1728.0	1520.0	510.7	1633.0	1336.0
9	2200.0	2000.0	1860.0	1860.0	1860.0	1869.0	1860.0	470.8	1800.0	1477.0
10 (A)	2799.9	2599.9	2400.0	2400.0	1055.0	2151.0	2000.0	433.9	1900.0	1633.0
11 (B)	810.0	2799.9	930.0	930.0	930.0	2432.9	2100.0	400.0	2000.0	600.0
12 (C)	970.0	810.0	2246.9	2246.9	2246.9	2010.1	2200.0	368.7	2100.0	1995.0
13 (D)	886.0	886.0	991.0	991.0	991.0	2292.0	2300.0	1153.1	2200.0	2205.0
14 (E)	2599.9	2400.0	2110.0	2110.0	2110.0	459.0	2400.0	1062.9	2300.0	1805.0
15 (F)	0	0	0	0	0	0	0	339.9	0	0

Code Tone dur. Pause	DTMF 70 ms 0 ms	
Tone no.	Tone 1	Tone 2
0	941.0	1336.0
1	697.0	1209.0
2	697.0	1336.0
3	697.0	1477.0
4	770.0	1209.0
5	770.0	1336.0
6	770.0	1477.0
7	852.0	1209.0
8	852.0	1336.0
9	852.0	1477.0
10 (A)	697.0	1633.0
11 (B)	770.0	1633.0
12 (C)	852.0	1633.0
13 (D)	941.0	1633.0
14 (*)	941.0	1209.0
15 (#)	941.0	1477.0

2.3.3.7.6 Programming the User Codes USER 0 to USER 2

Following master reset, the standard tone sequences USER 0 and USER 1 are loaded according to ZVEI1, USER 2 is loaded according to DTMF. There are two ways of programming special tone sequences:

a) Setting all tone sequence parameters individually

Each user code has the following individual parameters:

16 x tone frequency (tones 0 to F)
16 x 2nd tone frequency (only with two-tone sequences, USER 2)
1 x tone duration of the first sent tone
1 x tone duration of the following tones
1 x pause duration

For USER 0 to USER 2, these parameters can be varied at any time by means of the following SPEC functions:

[C] [500] [SPEC] to [C] [599] [SPEC] for USER 0

[C] [600] [SPEC] to [C] [699] [SPEC] for USER 1

[C] [700] [SPEC] to [C] [799] [SPEC] for USER 2

Each of the 16 different tones can be assigned a frequency in the range from 310 Hz to 4 kHz in any sequence desired using

[C] [5xx] [SPEC] <f (Hz)> [SPEC] (USER 0)

[C] [6xx] [SPEC] <f (Hz)> [SPEC] (USER 1)

[C] [7xx] [SPEC] <f (Hz)> [SPEC] (USER 2)

(310 Hz <f <4 kHz and f = 0 kHz). xx corresponds to one of the tones as shown in the following table:

xx	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Tone	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F

Example:

USER 0 is to be loaded (first digit: 5)

Tone	Input	Call No.	Frequency
0	[C] [500] [SPEC] [3150] [SPEC]	0	≙ 3.15 kHz
1	[C] [501] [SPEC] [1200] [SPEC]	1	≙ 1.2 kHz
5	[C] [505] [SPEC] [800] [SPEC]	5	≙ 800 Hz
B	[C] [511] [SPEC] [960] [SPEC]	B	≙ 960 Hz
F	[C] [515] [SPEC] [3400] [SPEC]	F	≙ 3.4 kHz

In the case of USER 2, it is additionally required to enter the frequency of the second tone generator (double tone!) using [C] [720] to [C] [735] [SPEC] <f (Hz)> [SPEC] for the different tones (see table).

xx	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
Tone	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F

Example:

Key 0 is to be assigned two frequencies:

[C] [700] [SPEC] [340] [SPEC]	Frequency of generator 1: 340 Hz
[C] [720] [SPEC] [2300] [SPEC]	Frequency of generator 2: 2.3 kHz

The other parameters of USER 0 to USER 2 can be checked and set using similar SPEC functions.

Tone duration of the first sent tone:

[C] [560] [SPEC] <T (ms)> [SPEC]	for USER 0
[C] [660] [SPEC] <T (ms)> [SPEC]	for USER 1
[C] [760] [SPEC] <T (ms)> [SPEC]	for USER 2

(10 ms <T <5000 ms)

Tone duration of all following tones:

[C] [561] [SPEC] <T (ms)> [SPEC]	for USER 0
[C] [661] [SPEC] <T (ms)> [SPEC]	for USER 1
[C] [761] [SPEC] <T (ms)> [SPEC]	for USER 2

(10 ms <T <5000 ms)

Pause duration:

[C] [562] [SPEC] <T (ms)> [SPEC]	for USER 0
[C] [662] [SPEC] <T (ms)> [SPEC]	for USER 1
[C] [762] [SPEC] <T (ms)> [SPEC]	for USER 2

(10 ms <T <5000 ms and T = 0 ms)

b) **Setting all parameters according to a standard tone sequence**

If the special code differs from a fixed standard tone sequence in a few parameters only, the latter can be loaded into USER 0 to USER 2 (two-tone sequences only into USER 2). All that remains to be entered then are the variations as indicated under a).

The parameters frequency, tone duration of 1st tone, tone duration of the following tones and pause duration are defined as required using the following SPEC functions:

[C] [100] [SPEC] <No> [SPEC] (No = 0 to 14) for USER 0

[C] [101] [SPEC] <No> [SPEC] (No = 0 to 14) for USER 1

[C] [102] [SPEC] <No> [SPEC] (No = 15 to 19) for USER 2

Variation of these tone sequences has an effect only when the code is loaded into Active Code using [C] [110] / [111] [SPEC] <No> [SPEC] .

Example:

Loading USER 0

Definition of frequency:

[C] [500] [SPEC] <f> [SPEC] to

[C] [515] [SPEC] <f> [SPEC]

Tone duration:

[C] [560] [SPEC] [500] [SPEC] Tone duration of 1st tone: 500 ms

[C] [561] [SPEC] [100] [SPEC] Tone duration of the following tones: 100 ms

[C] [562] [SPEC] [0] [SPEC] No pauses.

This standard tone sequence determined by the user is available at any time until a further variation is made, but does not act directly on the current setting, even if USER 0 is loaded in Active Code. Only following [C] [110] [SPEC] [21] [SPEC] do the changed parameters take effect. These relationships are shown in detail in Fig. 2-13.

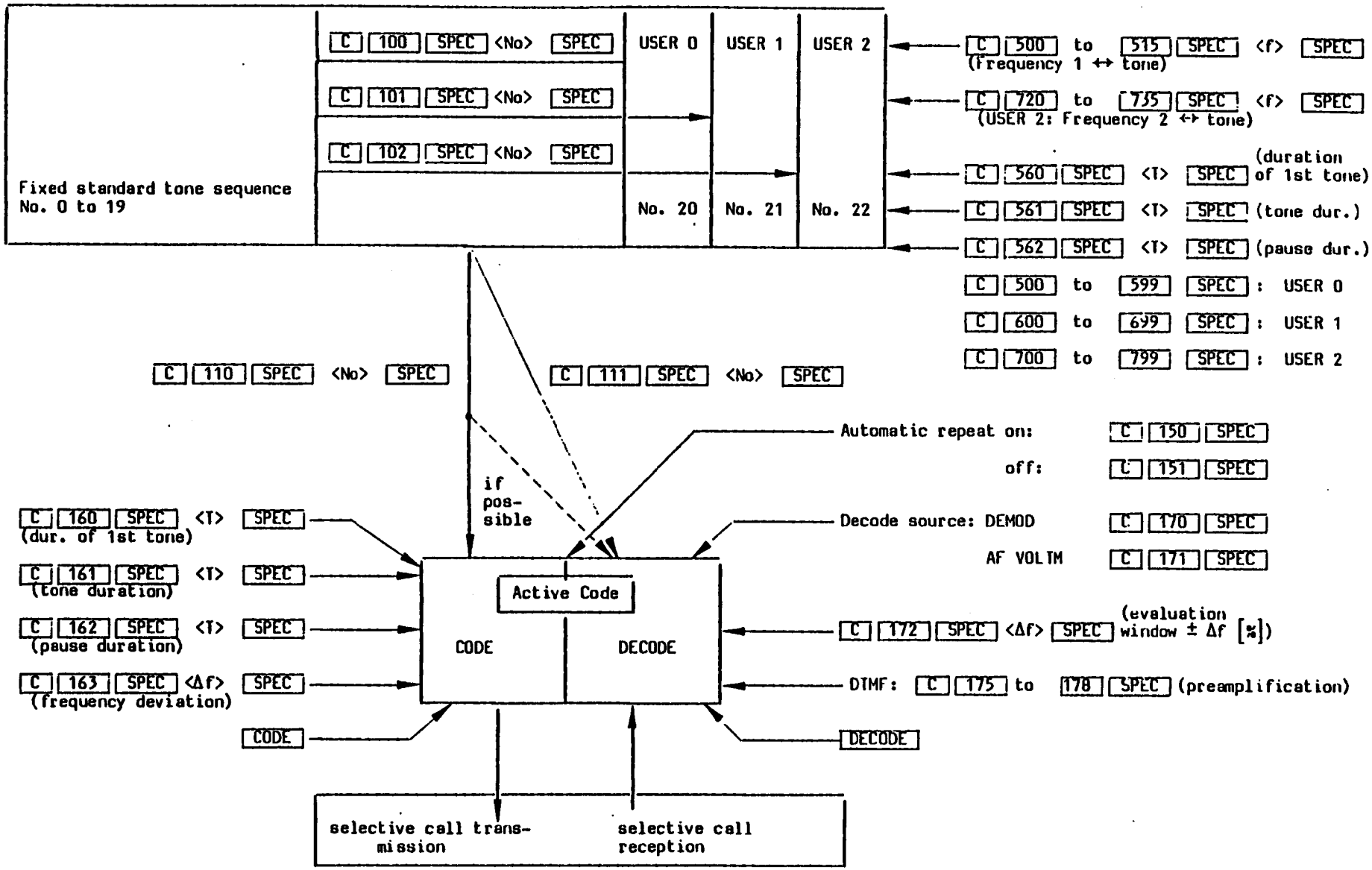


Bild 2-13 Relationships and control of CODE/DECODE

2.3.3.7.7 Measurements on Transceivers with Acknowledgement Call

The acknowledgement call test is carried out as follows:

a) Set the expected transmit frequency of the transceiver in the transmitter test, e.g.:

[148.33] [MHz] [SET f TX]

b) Switch over to receiver test and switch on the acknowledgement call test function (ACK TEST)

[TXRX]

[ACK TEST] (ACK TEST LED lights up)

c) Call the transceiver by sending the selective call, e.g.:

[12345] [CODE]

After sending the last tone (5), the CMT automatically switches over from receiver to transmitter test if ACK TEST is activated. Furthermore, the following preparations for reception of the transceiver reply are made:

- Set the transmitter test operating frequency (SET f TX) to be able to demodulate as fast as possible.
- Switch on the PK HOLD function to store the maximum deviation or modulation depth of the transmission.
- Switch on the tone sequence evaluation (DECODE).
- Switch on the LOCK function to prevent the CMT from switching back to the receiver test mode if the RF power decreases after reception of the transceiver reply.

2.3.4 RF Power / RF Level

All RF level measurements and settings are made in the RF level field (Fig. 2-2).

2.3.4.1 RF Power Measurements

RF power measurements are called when the instrument is switched on or when the key POWER 14 is pressed. All levels in the range from 1 mW to 50 W (0 to 47 dBm) are measured at high accuracy and simultaneously output in digital and analog form in the displays 12 and 13.

A linear or logarithmic representation according to the following relationship can be selected using the commands [W] [POWER] and [dBm] [POWER] :

$$P\ dBm = 10\ log\ (P\ [mW]/1[mW])$$

Since the power display 0.00 W corresponds to a level of $-\infty$ dBm, the display "Negative overflow" appears if the input signal is missing with the logarithmic scale (-1 in the digital display 12 and full analog bar in display 13).

The test diode of the power meter can be removed from the circuit using [28] [SPEC] in order to prevent RF distortions at the connector RF -30 dB 111. Power measurements are then no longer possible (identified in three dashes in the digital display). The function is switched on again using [29] [SPEC] (see Section 2.3.8).

An attenuating element of 0 to 40 dB connected to connector RF IN/OUT 77 can be taken into account during power measurements. The attenuation value is entered using the SPEC function [30] [SPEC] [Attenuation value (dB)] [SPEC] .

The basic status is selected again by entering [30] [SPEC] [0] [SPEC] .

If required, temperature influences on small RF levels can be largely compensated using an offset adjustment.

The connector RF IN/OUT 77 must be terminated with 50 Ω in this case (an RF power must not be present) and the key sequence [1] [D] [SPEC] entered. The offset voltage of the equipment measured in this manner is stored and taken into account during the following power measurements.

The power meter can only be used for RF signals at connector RF IN/OUT 77.

If the RF input is thermally overloaded, the messages "OVERHEAT" and "REMOVE RF-POWER" are alternately output on the alphanumeric display. In this case, immediately switch off the RF power source and make sure that sufficient ventilation is provided (slots on the rear of the instrument!). When the message "OK,TEMP NORMAL" appears, the measurement can be continued where interrupted.

2.3.4.2 RF Synthesizer Output Level

The built-in RF synthesizer provides signals of 0.032 µV (-137 dBm, -30 dBµV) and 1 V (+13 dBm, +120 dBµV), but the maximum level is limited to 0.5 V (+7 dBm) in AM mode.

The RF synthesizer level is reduced to a maximum of 1 mV (-47 dBm) by switching from receiver test to transmitter test or applying an RF signal > 0.5 W.

The synthesizer level is doubled (= + 6.02 dB) by pressing the key V_0 SYNTH. + 6 dB and the acknowledgement appears above this key.

Adjustments and variations can still be carried out as usual and the current synthesizer level is always halved by pressing the key V_0 SYNTH. + 6 dB again and the acknowledgement is switched off. The maximum possible level is set if the limit is exceeded by pressing this key; subsequent pressing results in half of this voltage.

The key V_0 OFF 16 can be used to switch the synthesizer level off and on again (toggle key) in both transmitter and receiver tests. The minimum possible level is 0.032 µV (-137 dBm, -30 dBµV).

The mechanical attenuation set is activated if the synthesizer output level is changed using the keys V_0 SYNTH., V_0 SYNTH. + 6 dB and V_0 OFF and short interruptions in the output level are possible at the switchover points.

The function [30] [SPEC] <Att.> [SPEC] also produces an effect on the synthesizer output level, i.e. the actually set level is increased by the value of the attenuator connected ahead and the maximum level is reduced correspondingly.

If negative attenuation values (0 to -40 dB) are entered (corresponds to preamplification), the actually set synthesizer level is reduced by this value. This can be used e.g. for representing the RF level in EMF.

Example: [30] [SPEC] [-6.02] [SPEC] (gain 6 dB)

[1] [µV] [V_0 SYNTH]

→ RF level set: 0.5 µV rms = 1 µV EMF
Readout: 1 µV