



ROHDE & SCHWARZ

SERVICE INSTRUCTIONS

DTMF Decoder Option CM-B11

803.4610.02

Printed in West Germany

5	<u>Service Manual for DTMF Decoder Option CM-B11</u>	... 5.1
5.1	Function Description	5.1
5.2	Testing and Adjustment	5.2
5.2.1	Recording Status	5.2
5.2.1.1	Programming the Tone Sequence Length	5.2
5.2.1.2	Input Amplifier	5.2
5.2.1.3	Decoder Selection	5.2
5.2.1.4	Decoder	5.3
5.2.1.4.1	Oscillator Frequency	5.3
5.2.1.4.2	Output Code	5.3
5.2.1.5	Data Change	5.3
5.2.1.6	Sequence Control Signals	5.4
5.2.2	Read Status	5.4

Component lists
Circuit diagrams
Component layout diagrams

5.1 Function Description

This option processes double-tone sequences to DTMF. The received sequences are already decoded as they enter and the result is stored until called for processing by the microprocessor. The following criteria must first be entered:

- a) - EST mode (early steering):
 fast decoding without tone duration check
- STD mode (steering delayed):
 normal decoding with suppression of too short tones
- b) Number of tones in the expected sequence

A tone sequence can then enter the decoder via the input amplifier D1 ($G = 0.5, 1, 2$) where it is immediately decoded into a 4-bit wide word per tone. The decoder generates a data change pulse each time a word appears. This pulse acts on the clock input of shift register D20 (4 bit wide, 80 bit long) via switches D3, D30 and pulse shaper D25. Thus the word which has just been decoded is transferred to the shift register with each data change pulse.

Each data change pulse also increments the counter D23 which is blocked via switch D24 when the programmed length of the sequence has been reached. The flags TFOK and SCINT are then set to inform the microprocessor that the entered tone sequence has reached the expected length (interrupt possibility). Further information is available to the microprocessor by interrogating D22:

- a) "Tone sequence running" is signalled at D22/5 by monoflop D25 by a Low level. The time constant has been selected such that it is retriggered by each data change in a valid sequence but drops out following an (invalid) pause of 700 ms.
- b) If a further tone does not occur within 700 ms of the last tone, a High level at D22/5 and 6 signals that the tone sequence is finished.

The tone data are now present at the first locations of shift register D20. They must be completely shifted through by the microprocessor before they can be read. This is carried out with the decoder deactivated (D6 and D7 High, only High levels are shifted). With each shift pulse, the word present at the output of D20 is transferred in parallel to register D22 for serial output and the next word from D20 is shifted following the elapse of the time constant of D25 (1 μ s). Thus 4 tone data and 3 sequence data are present with each serial output from D22 to the microprocessor.

5.2 Testing and Adjustment

The module cannot be adjusted. The following tests can be carried out.

5.2.1 Recording Status

D9/14 = H
D10/13 = L
D10/12 = L

5.2.1.1 Programming the Tone Sequence Length

D9/ 5	6	7	Number of double tones
L	L	L	3
H	L	L	4
L	H	L	5
H	H	L	6
L	L	H	7
H	L	H	8
L	H	H	9
H	H	H	10

5.2.1.2 Input Amplifier

At P3: input signal (tone sequence) amplified by factor G

D9/4	D10/11	G
L	L	0.5
L	H	1
H	L	2

5.2.1.3 Decoder Selection

D9/12	D9/13	Signal
H	H	Double-tone sequence at P9

5.2.1.4 Decoder

5.2.1.4.1 Oscillator Frequency

At D5/8: sinewave signal, $f = 3.57 \text{ MHz}$

5.2.1.4.2 Output Code

At $\left\{ \begin{array}{l} \text{P11 (LSB)} \\ \text{P12} \\ \text{P13} \\ \text{P14 (MSB)} \end{array} \right.$

Bit pattern associated with each tone in a sequence, H and L depending on standard.

DTMF code

f_{Low} [Hz]	f_{High} [Hz]	Character	Output code			
			Q4 14	Q3 13	Q2 12	Q1 11 Pin
6 9 7	1 2 0 9	1	0	0	0	1
6 9 7	1 3 3 6	2	0	0	1	0
6 9 7	1 4 7 7	3	0	0	1	1
7 7 0	1 2 0 9	4	0	1	0	0
7 7 0	1 3 3 6	5	0	1	0	1
7 7 0	1 4 7 7	6	0	1	1	0
8 5 2	1 2 0 9	7	0	1	1	1
8 5 2	1 3 3 6	8	1	0	0	0
8 5 2	1 4 7 7	9	1	0	0	1
9 4 1	1 3 3 6	0	1	0	1	0
9 4 1	1 2 0 9	*	1	0	1	1
9 4 1	1 4 7 7	#	1	1	0	0
6 9 7	1 6 3 3	A	1	1	0	1
7 7 0	1 6 3 3	B	1	1	1	0
8 5 2	1 6 3 3	C	1	1	1	1
9 4 1	1 6 3 3	D	0	0	0	0

5.2.1.5 Data Change

At P10: One TTL pulse per tone

D10/4 = H (EST mode): data change **before** appearance of associated 4-bit code at P11 to P14

D10/4 = L (STD mode): data change **after** appearance of associated 4-bit code at P11 to P14

At D25/10: as at P10 but pulses of equal duration, $\tau = 1 \mu\text{s} \pm 50\%$

5.2.1.6 Sequence Control Signals

	TFOK (X1.A4)	SCINT (X1.A22)	D22/5	D22/6
Standby	L	L	H	L
Tone sequence running	L	L	L	L
Programmed sequence length has been reached	H	H	L	L
Tone sequence finished	L	H	H	H

TFOK: H As soon as the programmed number of data changes has been reached
L 700 ms after start of last data change pulse

SCINT: H As soon as the programmed number of data change pulses has been reached
L With strobe for D8, D9, D10

D22/5: H 700 ms after start of last data change pulse
L As soon as a data change arrives and retriggering of D25 takes place with further data change

D22/6: H 700 ms after start of last data change pulse if the programmed number of data changes has been reached
L With strobe for D8, D9, D10

5.2.2 Read Status

D9/14 = L
D10/13 = H
D10/12 = H

At X1.B4 (DATIN):

Sequentially read tone data

With each $P/\bar{S}$ from microprocessor to X1.B8:

4 tone data (MSB first),
3 sequence data ("SCINT", "Counter Reset" and "Tone sequence finished").