TEMIC
Semiconductors

U3761MB

Low Voltage Standard Telephone Circuit with 13 Memories

Description

TEMIC's low voltage telephone circuit, U3761MB performs all the speech and line interface functions required in an electronic telephone set, the tone ringer, the pulse and DTMF dialing with redial, notice function, and 13 memories.

Features

Speech Circuit

- Adjustable DC characteristic
- Symmetrical input of microphone amplifier
- Receiving amplifier for dynamic or piezo-electric earpieces
- Automatic line loss compensation

Dialer

- DTMF / pulse switchable
- Pulse dialling 66/33 or 60/40 or DTMF dialling selectable by pin
- Selectable flashing duration by key pad
- Pause function

- Last number redial up to 32 digits
- Three by 32 digits direct (one touch) memory
- Ten by 16 digits indirect (two touch) memory
- Notice function up to 32 digits
- Standard low-cost crystal 3.57 MHz or ceramic resonator

Tone Ringer

- 2 Tone ringer
- Adjustable volume
- RC oscillator
- Adjustable threshold

Benefits

- Low number of external components
- High quality through one IC solution

Preliminary Information

U3761MB

TEMIC
Semiconductors

Block Diagram / Applications

Figure 1.

TELEFUNKEN Semiconductors
Rev. A2, 23-Apr-97

Preliminary Information

SDIP40

C1	1		40	R4
C2	2		39	R3
C3	3		38	R2
C4	4		37	R1
Earth	5		36	Mask
XT	6		35	$\overline{DP}$
$\overline{XT}$	7		34	MODE
MFO	8		33	BM
GND	9		32	$\overline{HKS}$
MIC 1	10		31	VDD
MIC 2	11		30	OUT
MICO	12	**U3761MB**	29	RCK
VL	13		28	VRING
RDC	14		27	VRIAC
NC	15		26	AGC
TIN	16		25	THA
VI	17		24	ST
$\overline{MUTE}$	18		23	PRIVACY
VBG	19		22	RECO 1
RECIN	20		21	RECO 2

12631

SSO44

C1	1		44	R4
C2	2		43	R3
C3	3		42	R2
C4	4		41	R1
Earth	5		40	Mask
NC	6		39	$\overline{DP}$
NC	7		38	MODE
XT	8		37	BM
$\overline{XT}$	9		36	$\overline{HKS}$
MFO	10		35	NC
NC	11		34	NC
GND	12	**U3761MB**	33	VDD
MIC 1	13		32	OUT
MIC 2	14		31	RCK
MICO	15		30	VRING
VL	16		29	VRIAC
RDC	17		28	AGC
TIN	18		27	THA
VI	19		26	ST
$\overline{MUTE}$	20		25	PRIVACY
VBG	21		24	RECO 1
RECIN	22		23	RECO 2

12632

Preliminary Information

Pin Description

SDIP40	SSO44	Symbol	Configuration	Function
1	1	C1		Keyboard input
2	2	C2		
3	3	C3		
4	4	C4		
5	5	Earth		Earth key
15	7, 6, 34, 35	NC		Not connected
6	8	XT		A built-in inverter provides oscillation with an inexpensive 3.579545 MHz crystal or ceramic resonator
7	9	$\overline{XT}$		
8	10	MFO		Output of DTMF
9	12	GND		Ground
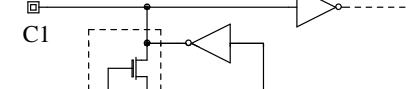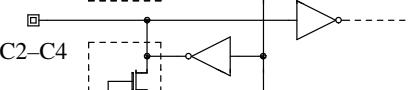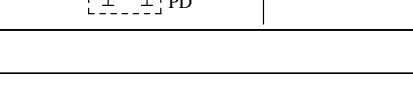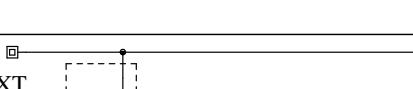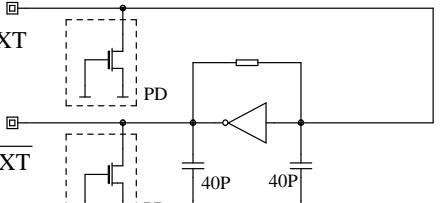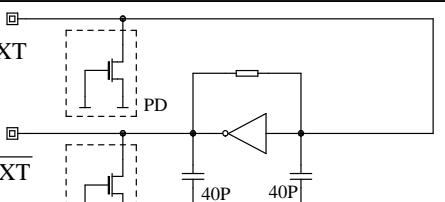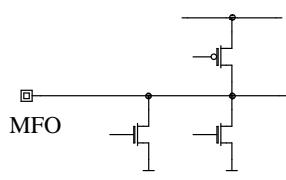
Configuration diagrams:

C1 / C2–C4 keyboard input circuit (PD)

XT / $\overline{XT}$ oscillator circuits with 40P capacitors (PD)

MFO output circuit

DTMF output frequency

	Specified (HZ)	Actual (Hz)	Error (%)
R1	697	699	+0.28
R2	770	766	−0.52
R3	852	848	−0.47
R4	941	948	+0.74
C1	1209	1216	+0.57
C2	1336	1332	−0.30
C3	1477	1472	−0.34

Preliminary Information

SDIP40	SSO44	Symbol	Configuration	Function
10	13	MIC 1		Inverting input of microphone amplifier
11	14	MIC 2		Non-inverting input of microphone amplifier
12	15	MICO		Transmit pre-amp output which is normally capacitively coupled to Pin TIN
13	16	VL		Positive supply voltage input to the device. The current through this pin is modulated by the transmit signal.
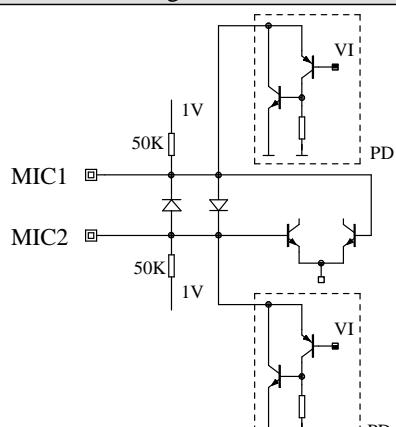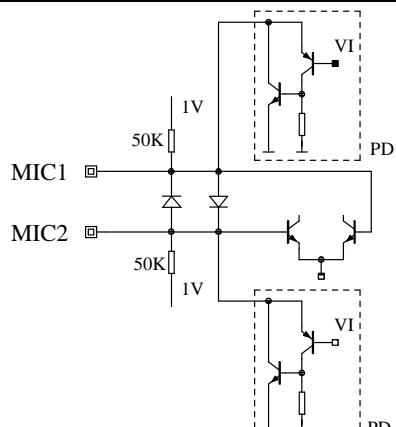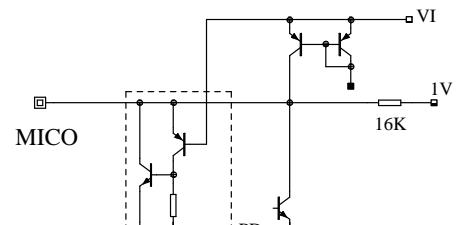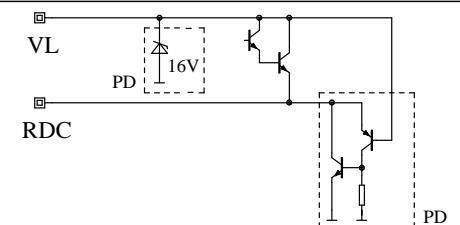
Preliminary Information

SDIP40	SSO44	Symbol	Configuration	Function
14	17	RDC		An external resistor (1 W) is required from this pin to GND to control the DC input impedance of the circuit. It has a nominal value of 39 Ω for low-voltage operation. Values up to 100 Ω may be used to increase the available transmit output voltage swing at the expense of low-voltage operation.
16	18	TIN		Input to the line output driver amplifier. Transmit AGC applied to this stage.
17	19	V_I		This internal voltage bias line must be connected to VL via an external resistor, R_B, which dominates the AC input impedance of the circuit and should be 680 Ω for an 600 Ω input impedance or 1.2 kΩ for a 900 Ω input impedance.
18	20	$\overline{\text{MUTE}}$		Pin for testing
19	21	VBG		Pin for test mode
20	22	RECIN		Receive amplifier input. The receiving amplification is regulated by an AGC.
22	24	RECO1		Output of the receive amplifier. Dynamic transducers with a minimum impedance of 100 Ω can be directly driven by these outputs.
21	23	RECO2		

Preliminary Information

SDIP40	SSO44	Symbol	Configuration	Function
23	25	PRIVACY		Input for handset mute
24	26	ST		The output of the sidetone cancellation signal, which requires a balanced impedance of 8 to 10 times the subscribers line impedance to be connected to Pin VL.
25	27	THA		Ringer threshold adjustment
26	28	AGC		The range of transmit and receive gain variations between short and long loops may be adjusted by connecting a resistor R_{AGC} from this pin to (GND). This pin can be left open to set AGC out of action.
27	29	VRIAC		Ringing supply
28	30	VRING		DC supply voltage for the tone ringer is limited to 30 V with integrated Z-diode.
29	31	RCK		RC clock oscillator for ringer

Preliminary Information

SDIP40	SSO44	Symbol	Configuration	Function
30	32	OUT	VRING / OUT / PD 30V / 6.5K / 200 / PD 50V	Buzzer output
31	33	VDD	VDD / VL / 6V / PD 6V	Supply output for dialer part
32	36	$\overline{\text{HKS}}$	$\overline{\text{HKS}}$ / PD	Hook switch input. $\overline{\text{HKS}}$ = 1: On-hook state. Chip in sleep mode, no operation. $\overline{\text{HKS}}$ = 0: Off-hook state. Chip enable for normal operation with a pull-high resistor of about 4 MΩ.
33	37	BM	B/M / PD	If BM = floating pulse dialing with 3:2 B/M ratio. If BM is connected to ground pulse dialing with a B/M ratio of 2:1
34	38	MODE	MODE	Pulling mode pin to V_{DD} places the dialer in tone mode. Pulling mode pin to GND places the dialer in DTMF with 140 ms inter-tone pause. If the mode pin is left floating, the dialer is in pulse mode (10 ppS)
35	39	$\overline{\text{DP}}$	$\overline{\text{DP}}$ / DP	N-channel open drain pulse dialing output. Flash key will cause $\overline{\text{DP}}$ to be active in either DTMF mode or pulse mode.
36	40	Mask		Short mute during pulse dialing

Preliminary Information

SDIP40	SSO44	Symbol	Configuration	Function
37	41	R1		Keyboard input
38	42	R2		
39	43	R3		
40	44	R4		

Keyboard Operation

	C1	C2	C3	C4		
	1	2	3	S	M1	R1
	4	5	6		M2	R2
	7	8	9	A	M3	R3
	✳/T	0	#	R/P	N	R4
VDD ◄	F1	F2	F3	E	⊥	

- S: Store function key
- A: Indirect repertory dialing function key (LN 0 to 9)
- R/P: Redial and pause function key
- N: Notice function

- ✳/T: ✳ and pulse-to-tone key
- M1 to M3: One-touch memory
- F1, F2, F3: Flash keys

Normal Dialing

| OFF HOOK | , | D1 | , | D2 | , ..., | Dn |

1. D1, D2, ..., Dn will be dialed out.
2. Dialing length is unlimited, but redial is inhibited if length oversteps 32 digits.
3. If redialing length oversteps 32 digits, the redialing function will be inhibited.

Redialing

| OFF HOOK | , | D1 | , | D2 | , ..., | Dn | BUSY, Come | ON HOOK | , | OFF HOOK | , | R/P |

The | R/P | key can execute the redial function only as the first key-in after off-hook; otherwise, it executes the pause function.

Number Store

| OFF HOOK | , | D1 | , | D2 | , ..., | Dn | , | S | , | S | , | Mn | (or | Ln |)

1. If the sequence of the dialed digits D1, D2, ..., Dn has not finished | S | will be ignored.

2. D1, D2, ..., Dn will be stored in memory location and dialed out.

| OFF HOOK | , | S | , | D1 | , | D2 | , ..., | Dn | , | S | , | Mn | (or | Ln |)

3. D1, D2, ..., Dn will be stored in memory location but will not be dialed out.

4. | R/P | and | ✳/T | keys can be stored as a digit in memory.

In store mode, | R/P | is the pause function key; | ✳/T | is the pulse-to-tone function key.

5. The store mode is released after the store function is executed or when the state of the hook switch is changed.

Reportery Dialing

1. | OFF HOOK | , | Mn |

2. | OFF HOOK | , | A | , | Ln |

Notice (N)

| OFF HOOK | , | D1 | , | D2 | , ..., | Dn | , | N |

1. If the dialing of | D1 | to | Dn | is finished, pressing the | N | key will cause D1 to Dn to be copied to the N memory.

| OFF HOOK | , | N |

2. D1 to Dn will be dialed out after the N key is pressed.

Cascaded Dialing

1. | Normal dialing | + | Repertory dialing | + | Normal dialing |

2. | Repertory dialing | + | Normal dialing | + | Normal dialing |

3. | Redialing | + | Normal dialing | + | Repertory dialing |

4. Redialing is valid as first key-in only.

Preliminary Information
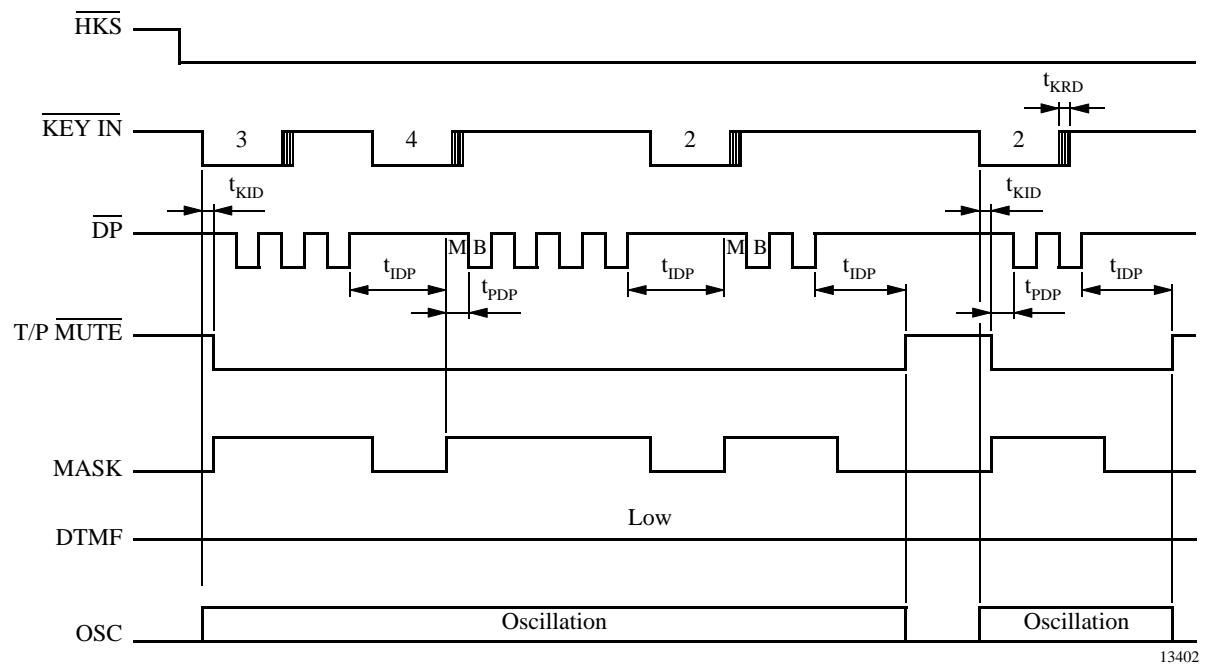
Figure 2. Pulse mode normal dialing
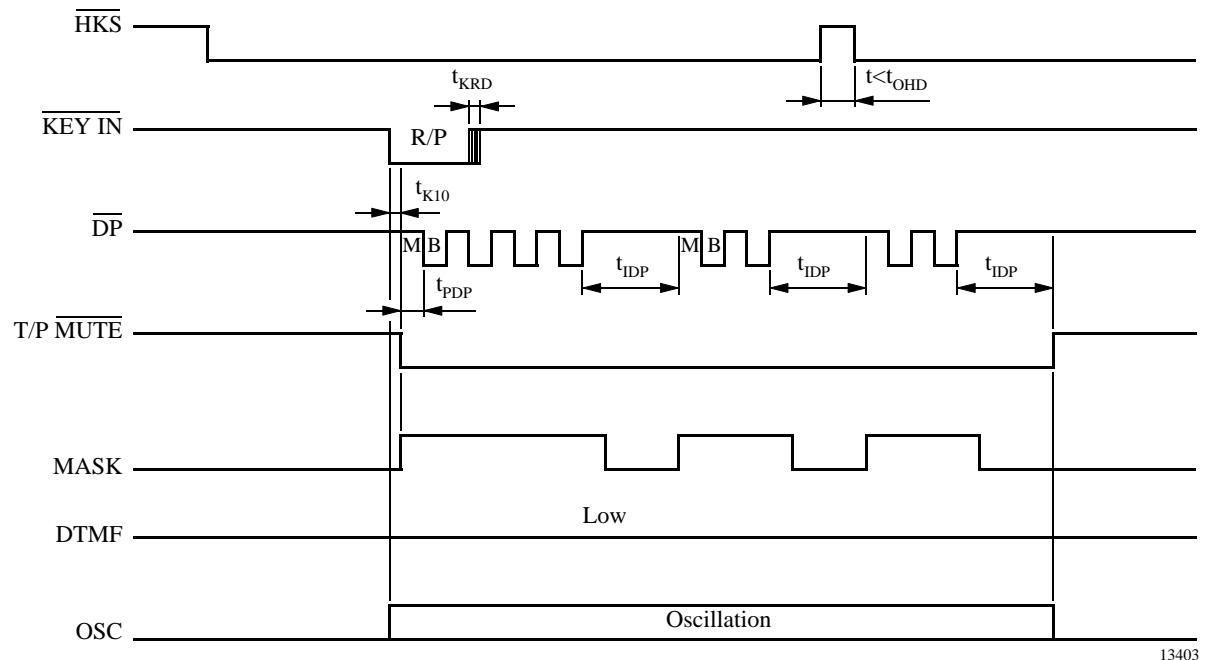
Figure 3. Pulse mode auto dialing

Preliminary Information
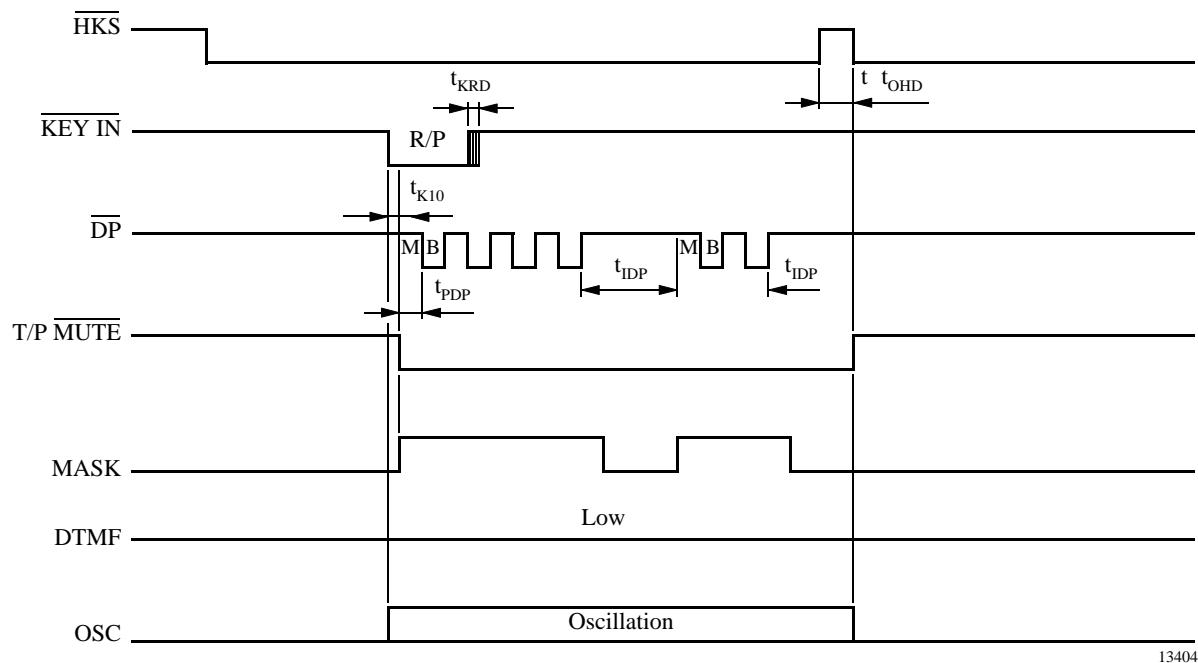
Figure 4. Pulse mode auto dialing
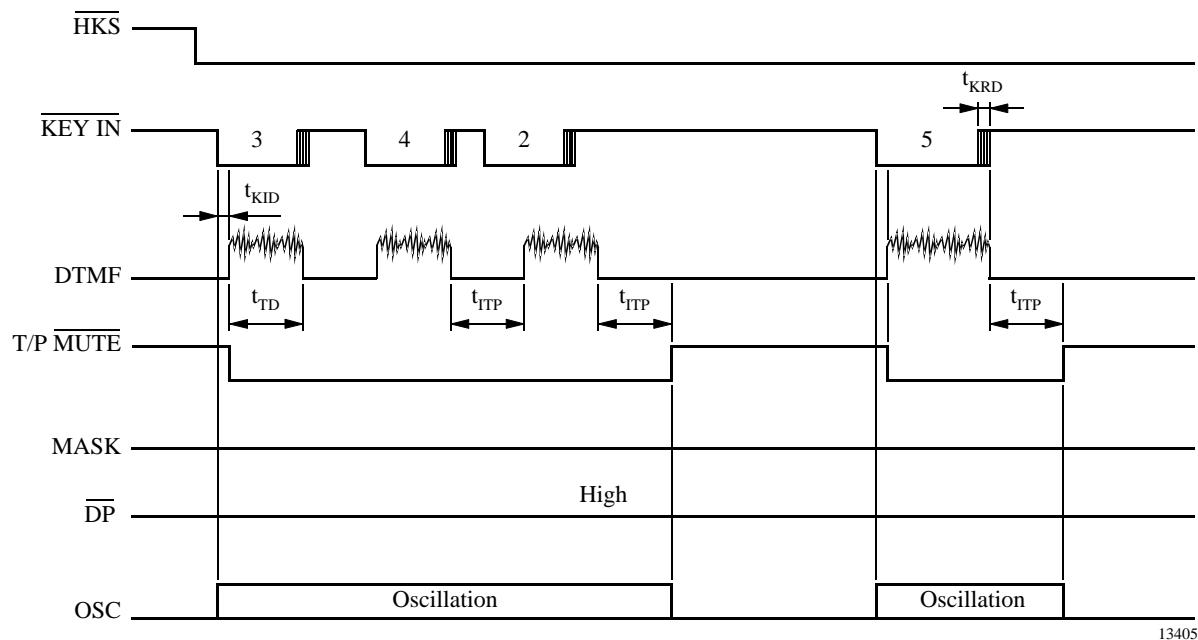

Figure 5. DTMF mode normal dialing

Preliminary Information
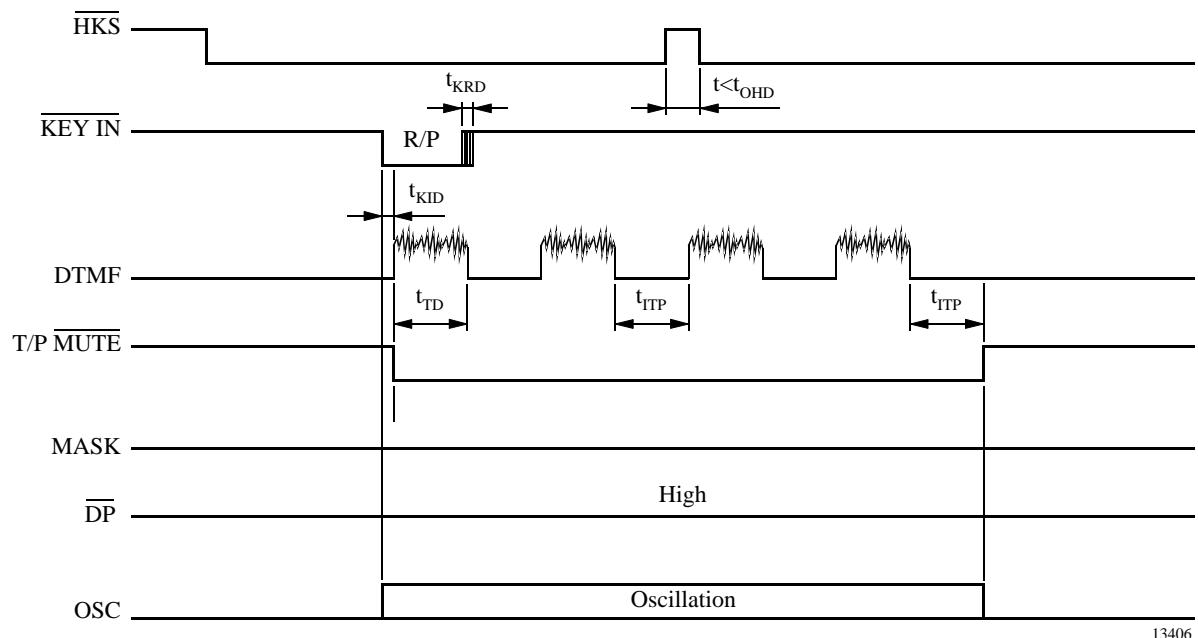
Figure 6. DTMF mode auto dialing
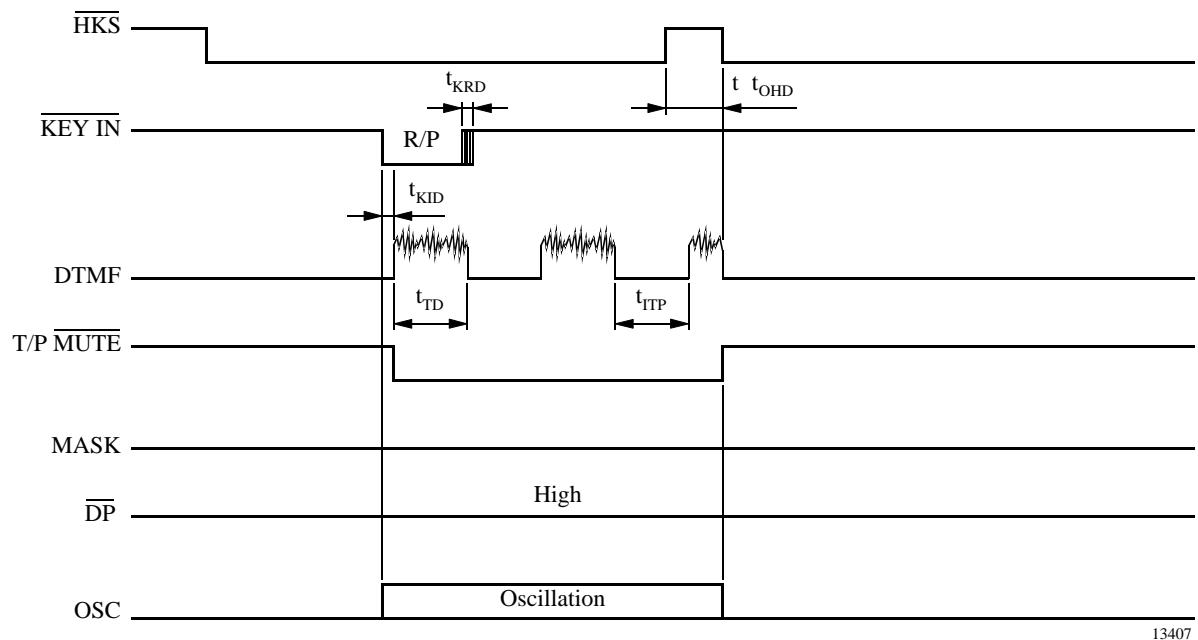
Figure 7. DTMF mode auto dialing

Preliminary Information

Access Pause

| OFF HOOK | , | D1 | , | D2 | , | R/P | , | D3 | , ..., | Dn' |

1. The pause function can be stored in memory.

2. The pause function is executed in normal dialing and redialing.
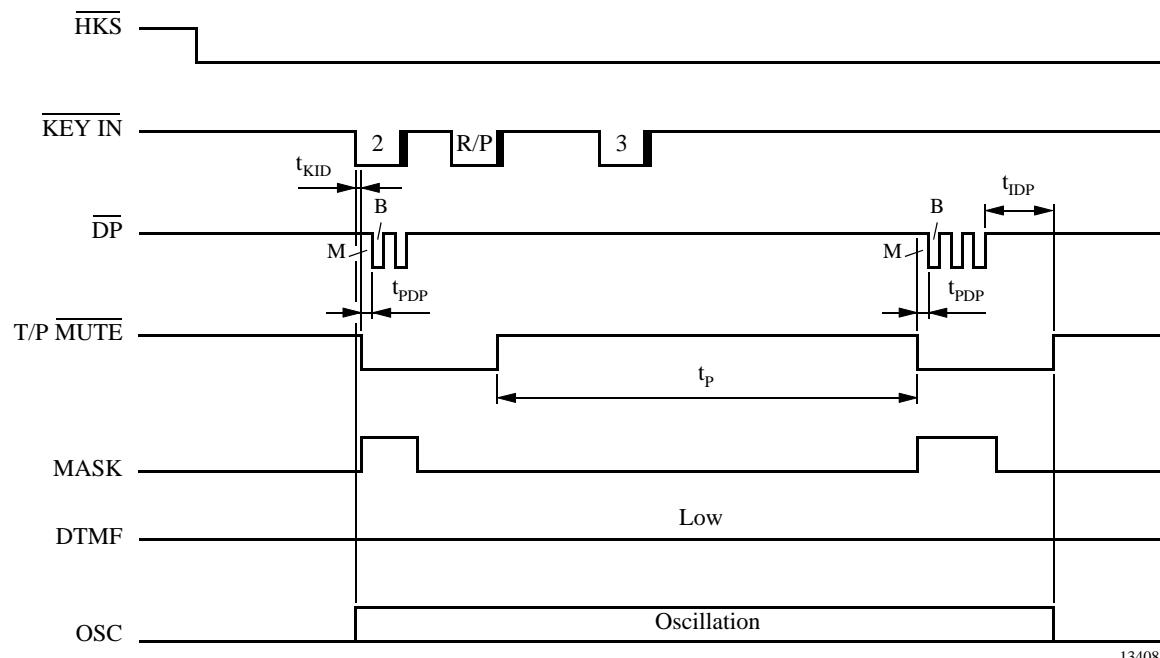
Figure 8. Pause function

Preliminary Information

Pulse-to-Tone (✳/T)

| OFF HOOK | , | D1 | , | D2 | , ..., | Dn | , | ✳/T | , | D1' | , | D2' | , ..., | Dn' |

1. If the mode switch is set to pulse mode, then the output signal will be:

   D1, D2, ..., Dn, Pause (3.6 s), D1', D2' ,..., Dn'

      (Pulse)   (Tone)

2. If the mode switch is set to tone mode, then the output signal will be:

   D1, D2, ..., Dn,   *   , D1', D2', ..., Dn'

   (Tone)   (Tone)   (Tone)

3. The dialer remains in tone mode when the digits have been dialed out and can be reset to pulse mode only by going on-hook.
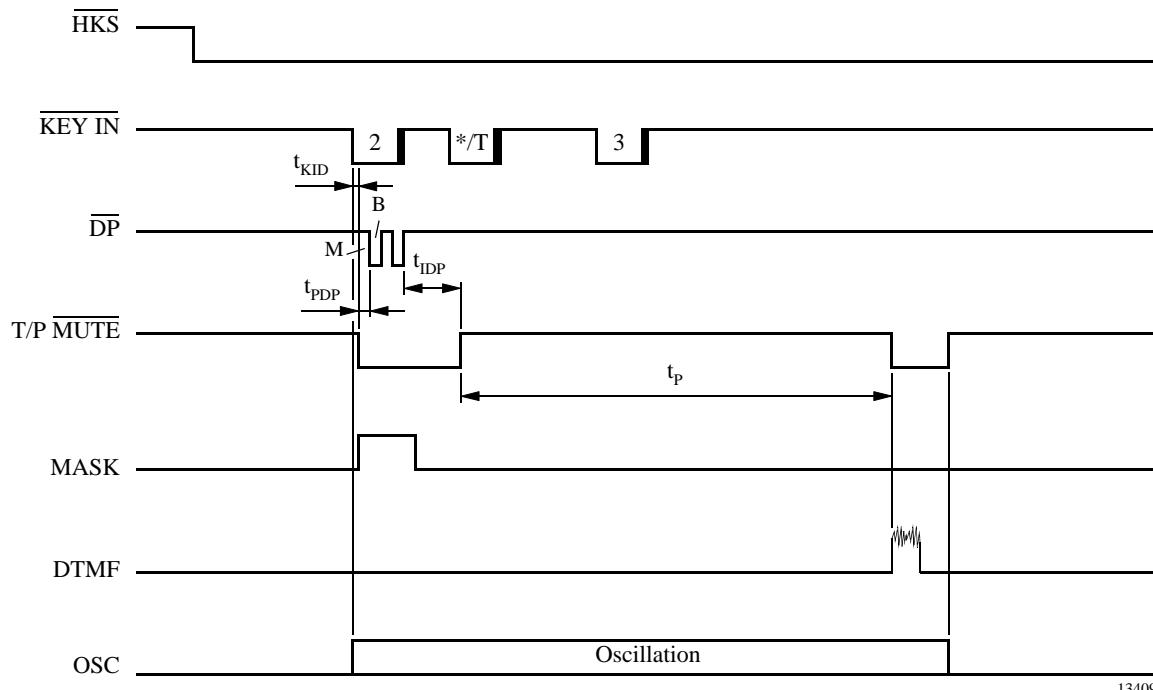
Figure 9. Pulse-to-tone operation

Earth

The Earth pin will go high 400 ms and the pause time of 1 s will be added when the Earth key is pressed. It can be stored as a digit in Memory and has not the first priority.

Preliminary Information

Flash (F1 or F2 or F3)

| OFF HOOK | , | F_n |

1. The dialer will execute flash break and all the flash pause time before the next digits is dialed out.

2. The flash key can be stored as a digit in memory, however, only one flash will be releases to users.

3. The system will return to the initial state after the flash pause time is finished.
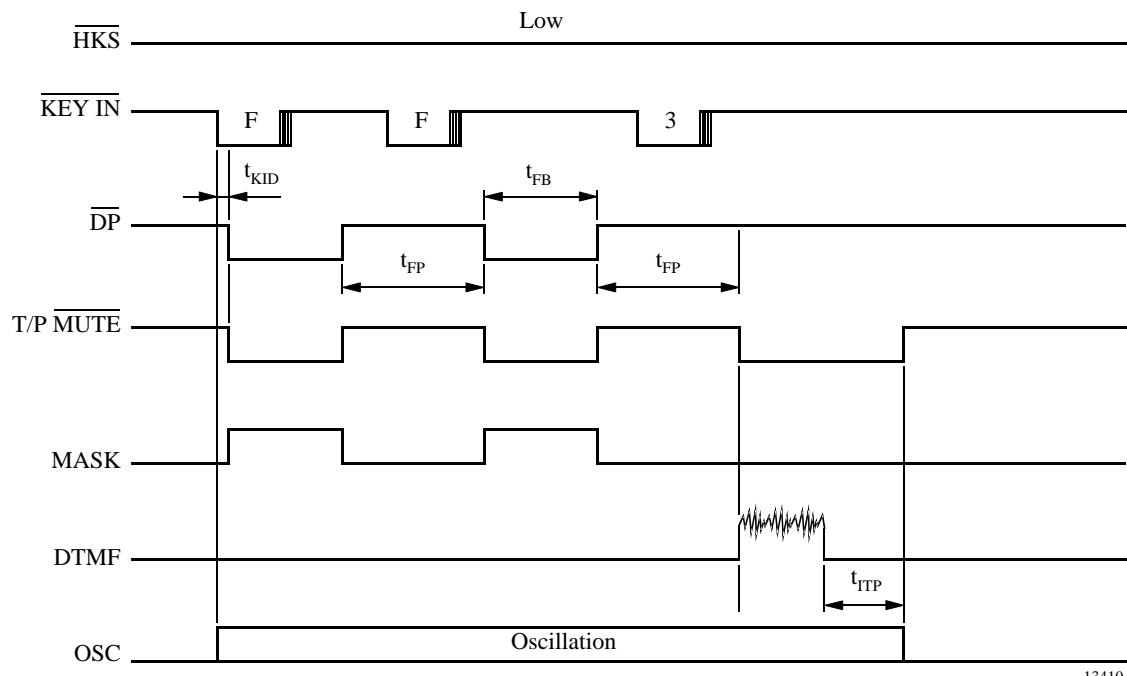

Figure 10. Flash operation

t_{KID} = key active in debounce
t_{KRD} = key release debounce
t_{PDP} = pre-digit pause
t_{IDP} = inter-digit pause
t_{TD} = DTMF output duration

t_{ITP} = intertone pause
t_{FB} = flash break time
t_{FP} = flash pause time
t_P = pause time

Absolute Maximum Ratings

Parameters		Symbol	Value	Unit
Line current		I_L	140	mA
DC line voltage		V_L	14	V
Junction temperature		T_j	125	°C
Ambient temperature		T_{amb}	−25 to +75	°C
Storage temperature		T_{stg}	−55 to +150	°C
Total power dissipation, $T_{amb} = 60°C$	SSO44	P_{tot}	0.9	W
	SDIP40	P_{tot}	1.3	W
Junction ambient	SSO44	R_{thJA}	70	K/W
	SDIP40	R_{thJA}	50	K/W

Preliminary Information

Electrical Characteristics Speech Circuit

Reference point Pin GND, f = 1000 Hz, 0 dBm = 775 mV$_{rms}$, R$_{DC}$ = 39 Ω / 1 W, T$_{amb}$ = 25°C, unless otherwise specified

Parameters	Test Conditions / Pin	Symbol	Min.	Typ.	Max.	Unit
Line voltage	I$_L$ = 5 mA	V$_L$	1.2		1.5	V
	I$_L$ = 20 mA			4.0		V
	I$_L$ = 30 mA			4.5		V
	I$_L$ = 73 mA			6.4		V
Transmit and sidetone						
Input resistance	R$_i$	R$_i$	45	80	120	kΩ
Gain	I$_L$ = 20 mA, S5 = open	G$_s$	46.8	47.8	48.8	dB
Gain change with current	I$_L$ = 20 to 60 mA R$_{AGC}$ = infinite	ΔG$_S$	–0.5		0.5	dB
Gain deviation	T$_{amb}$ = –10 to +60°C I$_L$ = 20 mA	ΔG$_S$	–0.5		0.5	dB
Line-loss compensation	R$_{AGC}$ = 12 kΩ, I$_L$ = 73 mA	ΔG$_s$	–4.8	–6	–7	dB
Noise at line weighted psophometrically	I$_L$ > 20 mA, G$_S$ = 48dB	n$_o$			– 72	dBmp
Sidetone reduction	I$_L$ ≧ 20 mA	G$_{STA}$	10	15	20	dB
DTMF amplifier						
Volume range d < 5%	Single tone, I$_L$ ≥ 20 mA	V$_L$	1.3			dBm
DTMF output level low frequency group	I$_L$ = 20 mA, S5 = closed	V$_L$	–8		–4	dBm
Pre-emphasis between high and low level frequency group	P$_{PRE}$ = P$_{HLG}$ – P$_{LLG}$, S5 = closed	P$_{PRE}$	1		3	dB
Receiving amplifier						
Gain	IL ≥ 20 mA	G$_R$	3		5	dB
Gain change with current	I$_L$ = 20 to 60 mA R$_{AGC}$ = infinite	ΔG$_R$	–0.5		0.5	dB
Gain deviation	T$_{amb}$ = –10 to +60°C I$_L$ = 20 mA	ΔG$_R$	–0.3		0.7	dB
Line-loss compensation	I$_L$ = 73 mA	ΔG$_R$	–4.7	–6	–7	dB
Receiving noise at earphone weighted psophometrially	I$_L$ = 73 mA	n$_i$		–77.5	–71	dBm
Gain change when muted	I$_L$ ≧ 20 mA	G$_{RM}$	24	29	34	dB
Output voltage push-pull	I$_L$ ≧ 20 mA, Z$_{ear}$ = 68 nF, 100 Ω in series	V$_{RECO}$	0.8	0.9		V$_{RMS}$
Ear protection differential	I$_L$ = 40 mA, V$_{gen}$ = 4 V$_{rms}$, Z$_{ear}$ = 68 nF + 100 Ω	V$_{ear}$	1.3	1.6	2.5	V$_{rms}$
Supply voltage (for internal use only)						
Output voltage	I$_L$ ≧ 20 mA dialing mode	V$_{DD}$	2.3		6.3	V
Distortion at line VL = 0.775 Vrms	IL = 20 mA, S5 = open	d$_t$			2	%
Maximum output voltage swing at line	IL = 20 mA, Vmic = 50 mVoff	V$_{L\,max}$		3.4	4	Vpp
Mute suppression transmit with privacy function	IL = 20 mA	G$_{SPRIV}$	60			dB

Preliminary Information

DC Characteristics Dialer

V_{DD2} = 2.7 V, f_{OSC} = 3.58 MHz, all outputs unloaded, S9b

Parameters	Test Conditions / Pins	Symbol	Min.	Typ.	Max.	Unit
Memory rentention current	$\overline{HKS}$ = 1, V_{DD2} = 1.0 V	I_{MR}			0.2	µA
Pre-emphases	Column/Row		1	2	3	dB
DTMF distortion	R_L = 5 kΩ	d		−30	−23	dB
DP output sink current	V_{PO} = 0.5 V	I_{PL}	0.5			mA
Keyboard input drive current	V_I = 0 V	I_{KD}	30			µA
Keyboard input sink current	V_I = 2.7 V	I_{KS}	200	400		µA
Keyboard resistance					5	kΩ
F1, F2, F3, E board resistance					300	Ω
Mask sink / drive current		I_M H/L	0.5			mA
Earth sink / drive current		I_e H/L	0.5			mA

AC Characteristics Dialer

Parameters	Test Conditions / Pins	Symbol	Min.	Typ.	Max.	Unit
Keypad active in de-bounce		t_{KID}		20		ms
Key release debounce		t_{KRD}		20		ms
Pre-digit pause	B/M pin = floating 10 ppS B/M pin = low	t_{PDP} t_{PDP}		40 33.3		ms ms
Inter-digit pause (auto dialing)	10 ppS	t_{IDP}		800		ms
Make/break ratio	B/M pin = floating B/M pin = low	M/B		40:60 33:67		% %
DTMF output duration	Auto dialing, MODE = V_{DD} MODE = GND	t_{TD}		87 70		ms
Inter-tone pause	Auto dialing, MODE = V_{DD} MODE = GND	t_{ITP}		87 140		ms
Flash break time F1 F2 F3	C_1 connected to V_{DD} C_2 connected to V_{DD} C_3 connected to V_{DD}	t_{FB}		98 250 600		ms ms ms
Flash pause time	F1 F2 F3	t_{FP}		1		s
Pause time		t_P		3.6		s
On Hook debounce time		t_{ohd}		150		ms
Earth time	C_4 connected to V_{DD}	t_{et}		400		ms
Earth pause time		t_{pt}		1		s

Preliminary Information

Electrical Characteristics Tone Ringer

f_{RCK} = 4 kHz, V_{RING} = 20 V, T_{amb} = 25 °C, reference point GND, unless otherwise specified

Parameters	Test Conditions / Pins	Symbol	Min.	Typ.	Max.	Unit
Supply current, outputs open	V_{RIAC} = 20 V	I_{RING}	2.1		3.8	mA
Switch-on threshold	V_{RIAC}	V_{RON}		23.5		V
Switch-off threshold	V_{RIAC}	V_{ROFF}		5.6		V
Ringing frequency	R = 150 kΩ, C = 1 nF V_{RIAC} > V_{RON}	f_{1H} f_{1L}	937 752	1010 808	1083 868	Hz
Audio sequence frequency		f_2	11.5	12.5	14.0	Hz
Output voltage swing	V_{Ring} = 25 V, C_{out} = 68 nF	V_{out}	21	23		V_{pp}
Turn-off delay	See figure 11	t_{off}		65		ms
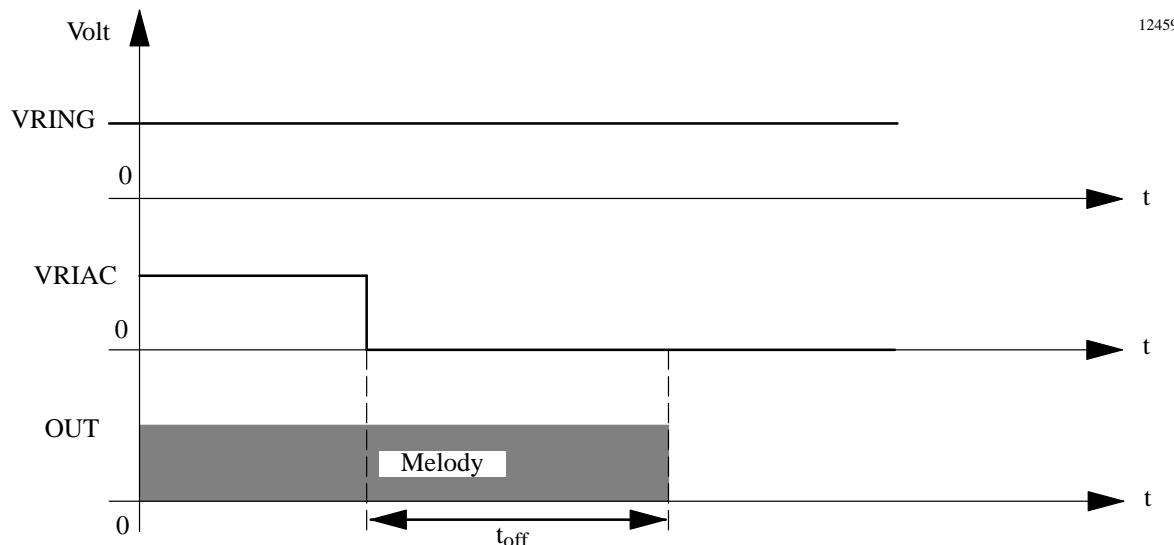
Figure 11. Turn off delay time

Ordering Information

Type	Package
U3761MB-ASD	SDIP40
U3761MB-AFN	SSO44
U3761MB-AFNG3	SSO44 tape and reel

U3761MB

Basic Test Circuit

Preliminary Information
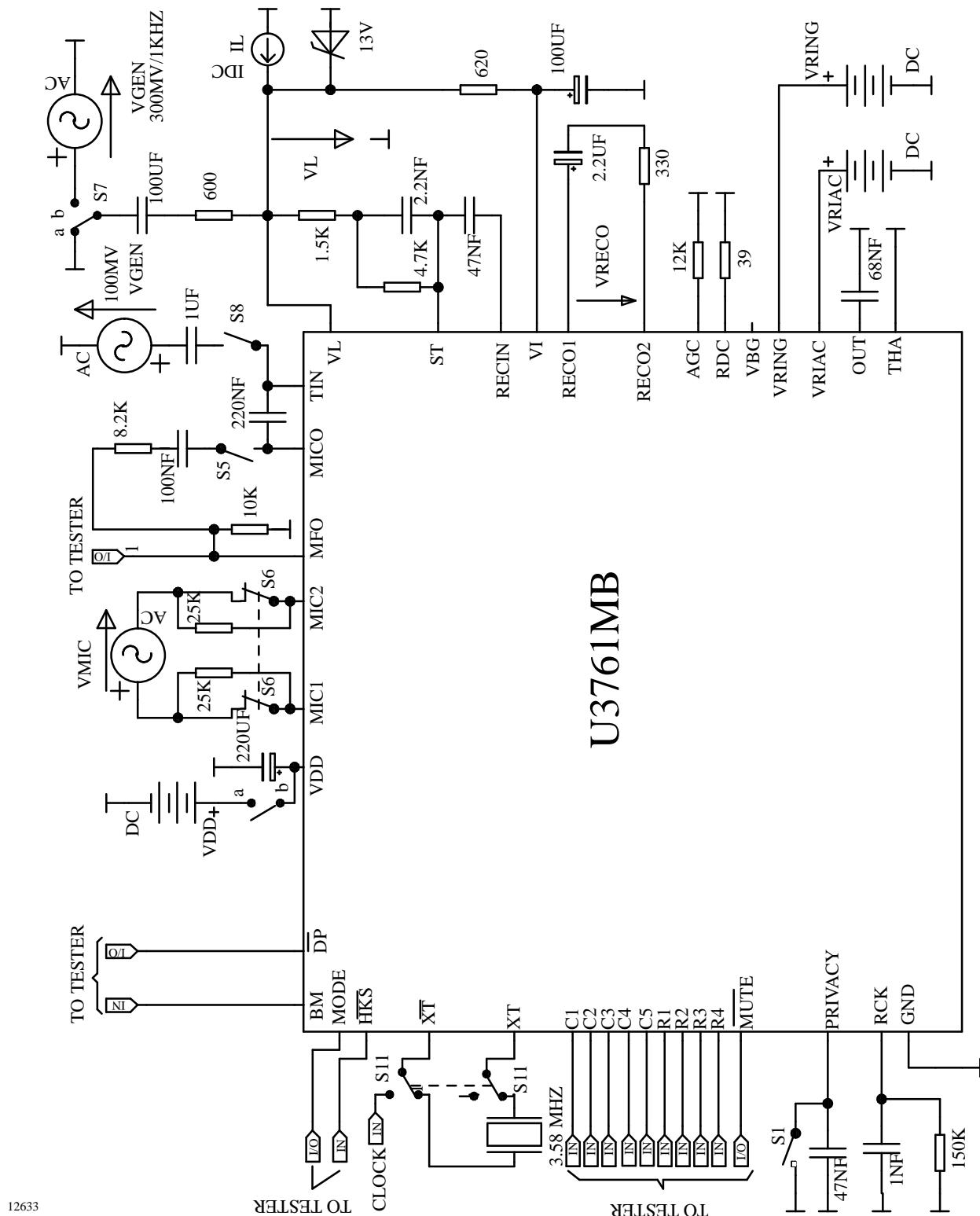
Formulas for Parameters of Elecrtrical Characteristics of Speech Circuit

Formulas referred to the basic test circuit. If not otherwise specified switches in basic test circuit are inactive.

Transmit gain

$$GS = 20 \times \log \left(\frac{VL}{VMIC} \right)$$

VMIC = 3 mV/1 kHz, S5 = open

Receiving gain

$$GR = 20 \times \log \left(\frac{VRECO}{VL} \right)$$

RX-mode: VGEN = 300 mV/1 kHz, S7b

Line loss compensation transmit

$\Delta GS = GS(\text{at IL} = 73 \text{ mA}) - GS(\text{at IL} = 20 \text{ mA})$

TX-mode: VMIC = 3 mV/1 kHz, S5 = open

Sidetone reduction

$$GSTA = 20 \times \log \left(\frac{VL}{VRECO} \right) (\text{in TX–mode}) + GR$$

TX-mode: VMIC = 3 mV/1 kHz, S5 = open

Line loss compensation receive

$\Delta GR = GR(\text{at IL} = 73 \text{ mA}) - GR(\text{at IL} = 20 \text{ mA})$

RX-mode: VGEN = 300 mV/1 kHz, S7b

Gain change when muted

$$GRM = 20 \times \log \frac{VRECO}{VL} (\text{Mute} = \text{inactive}) - 20 \times \log \frac{VRECO}{VL} (\text{Mute} = \text{active})$$

VGEN = 100 mV/1 kHz, S5 = open, S8 = open

Input impedance of microphone amplifier

$$Ri = \frac{50 \text{ k}}{\left(\frac{VL_{(s6 = closed)}}{VL_{(S6 = open)}} - 1 \right)}$$

TX-mode: VMIC = 3 mV/1 kHz, S5 = open

Preliminary Information

TEMIC
Semiconductors

Packaging Information

Package SDIP40

Dimensions in mm

37.4
36.9

4.9
4.3

0.7

3.3

0.53
0.48

1.778

33.782

15.34
15.14

13.9
13.7

0.38
0.20

17.2
16.0

technical drawings
according to DIN
specifications

1

13027
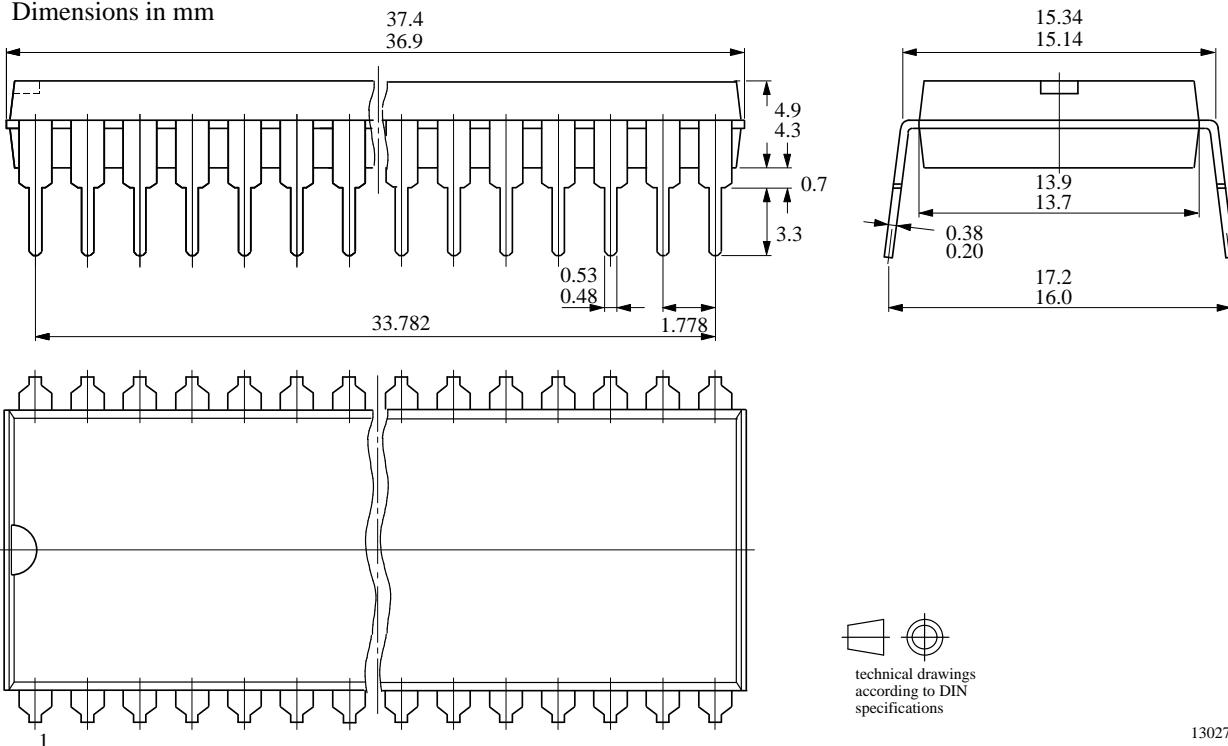
Package SSO44

Dimensions in mm

18.05
17.80

2.35

0.3

0.8

0.25
0.10

16.8

9.15
8.65

7.50
7.30

10.50
10.20

0.25

44

23

technical drawings
according to DIN
specifications

1

22

13040

TELEFUNKEN Semiconductors
Rev. A2, 23-Apr-97

Preliminary Information
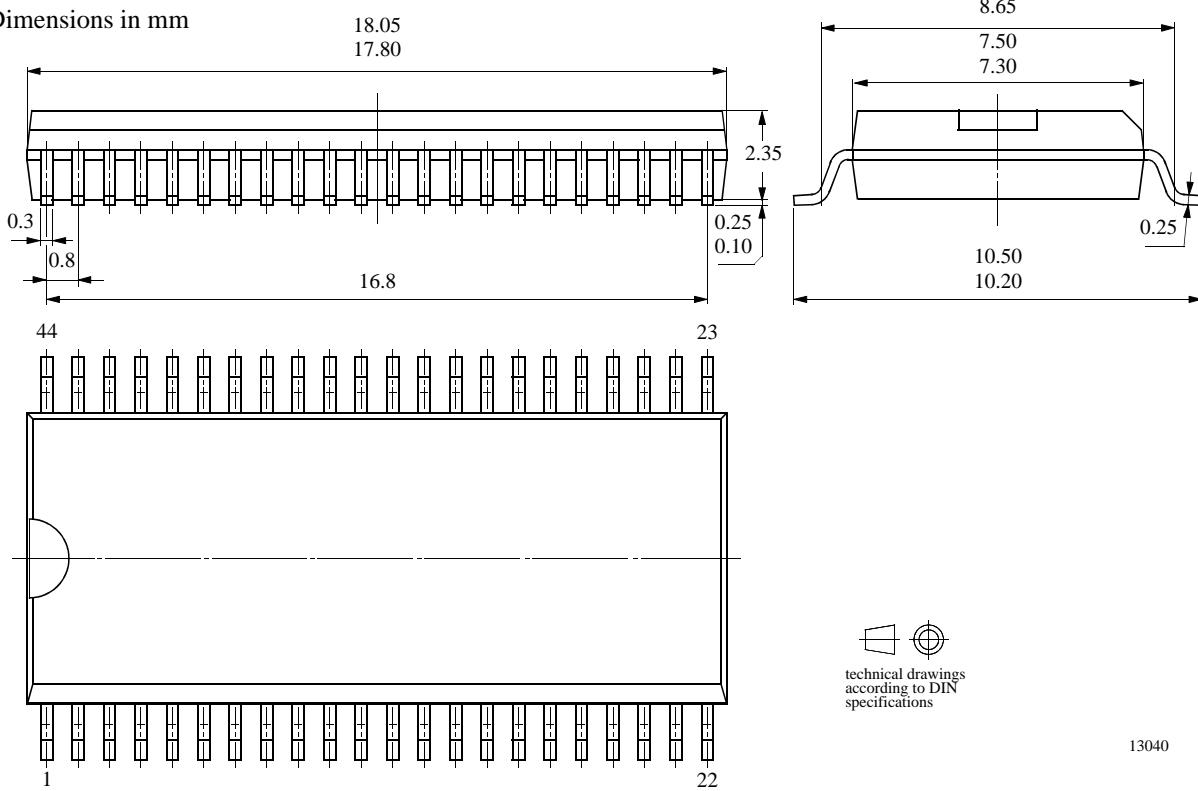
Ozone Depleting Substances Policy Statement

It is the policy of **TEMIC TELEFUNKEN microelectronic GmbH** to

1. Meet all present and future national and international statutory requirements.

2. Regularly and continuously improve the performance of our products, processes, distribution and operating systems with respect to their impact on the health and safety of our employees and the public, as well as their impact on the environment.

It is particular concern to control or eliminate releases of those substances into the atmosphere which are known as ozone depleting substances (ODSs).

The Montreal Protocol (1987) and its London Amendments (1990) intend to severely restrict the use of ODSs and forbid their use within the next ten years. Various national and international initiatives are pressing for an earlier ban on these substances.

TEMIC TELEFUNKEN microelectronic GmbH semiconductor division has been able to use its policy of continuous improvements to eliminate the use of ODSs listed in the following documents.

1. Annex A, B and list of transitional substances of the Montreal Protocol and the London Amendments respectively

2. Class I and II ozone depleting substances in the Clean Air Act Amendments of 1990 by the Environmental Protection Agency (EPA) in the USA

3. Council Decision 88/540/EEC and 91/690/EEC Annex A, B and C (transitional substances) respectively.

TEMIC can certify that our semiconductors are not manufactured with ozone depleting substances and do not contain such substances.