

## Universal Telephone IC – All Functions Integrated

### Description

TEMIC's low-voltage telephone circuit U3762MB performs all the speech and line interface functions required in an electronic telephone set, the tone ringer, the

pulse and DTMF dialing with redial. Operation below 15 mA is possible with reduced performance (no dialing).

### Features

#### Speech Circuit

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

#### Tone Ringer

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

#### Dialer

- DTMF / pulse switchable
- Pulse dialing 66/33 or 60/40 or DTMF dialing selectable by pin
- Flashing time duration 98 ms
- Pause function
- Last number redial up to 32 digits
- Standard low-cost crystal 3.57 MHz or ceramic resonator
- Key tone

#### Benefits

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

### Ordering Information

| Type          | Package | Remarks          |
|---------------|---------|------------------|
| U3762MB-MFN   | SSO44   |                  |
| U3762MB-MFNG3 | SSO44   | Taped and reeled |

## Block Diagram / Applications

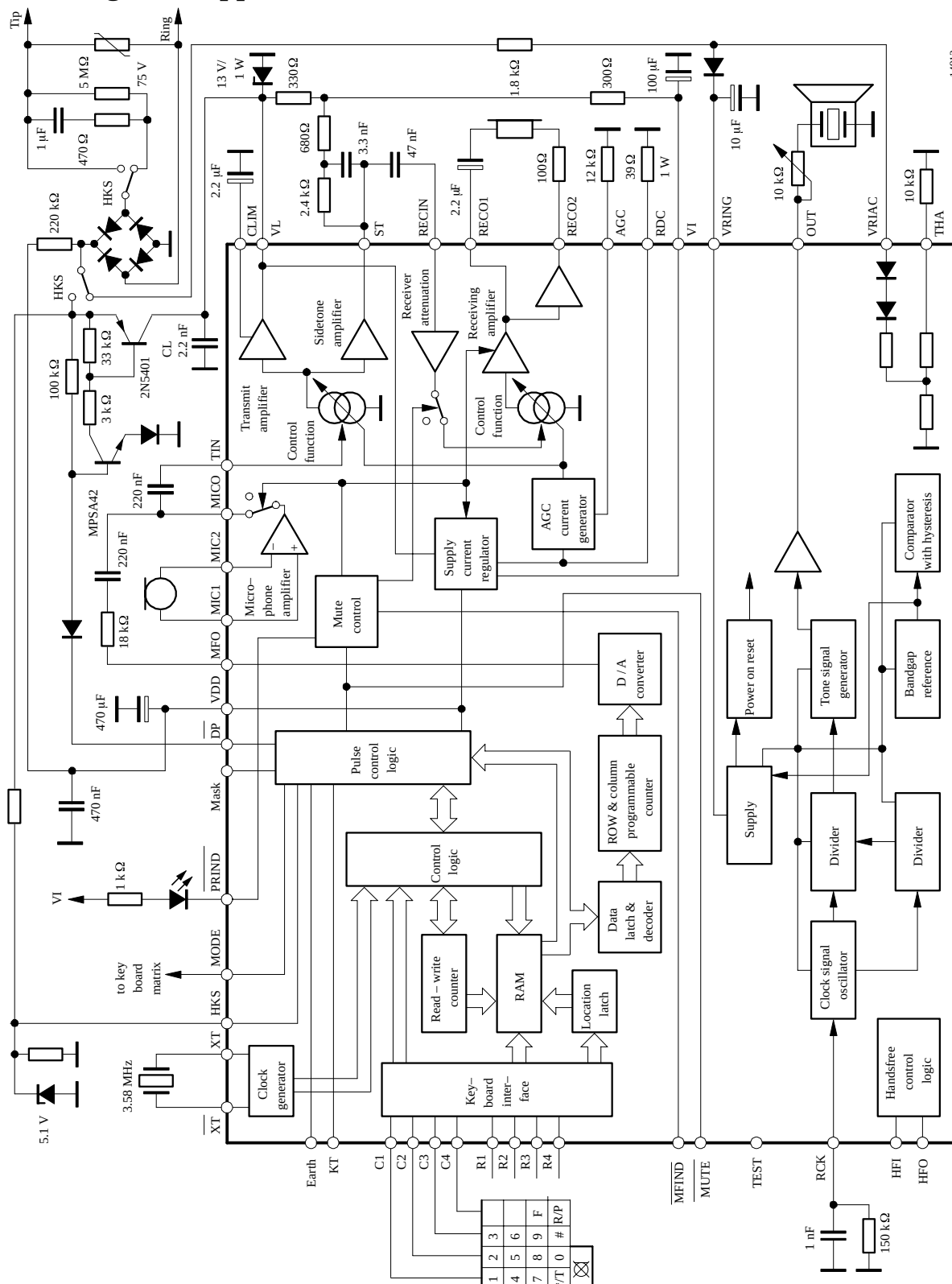
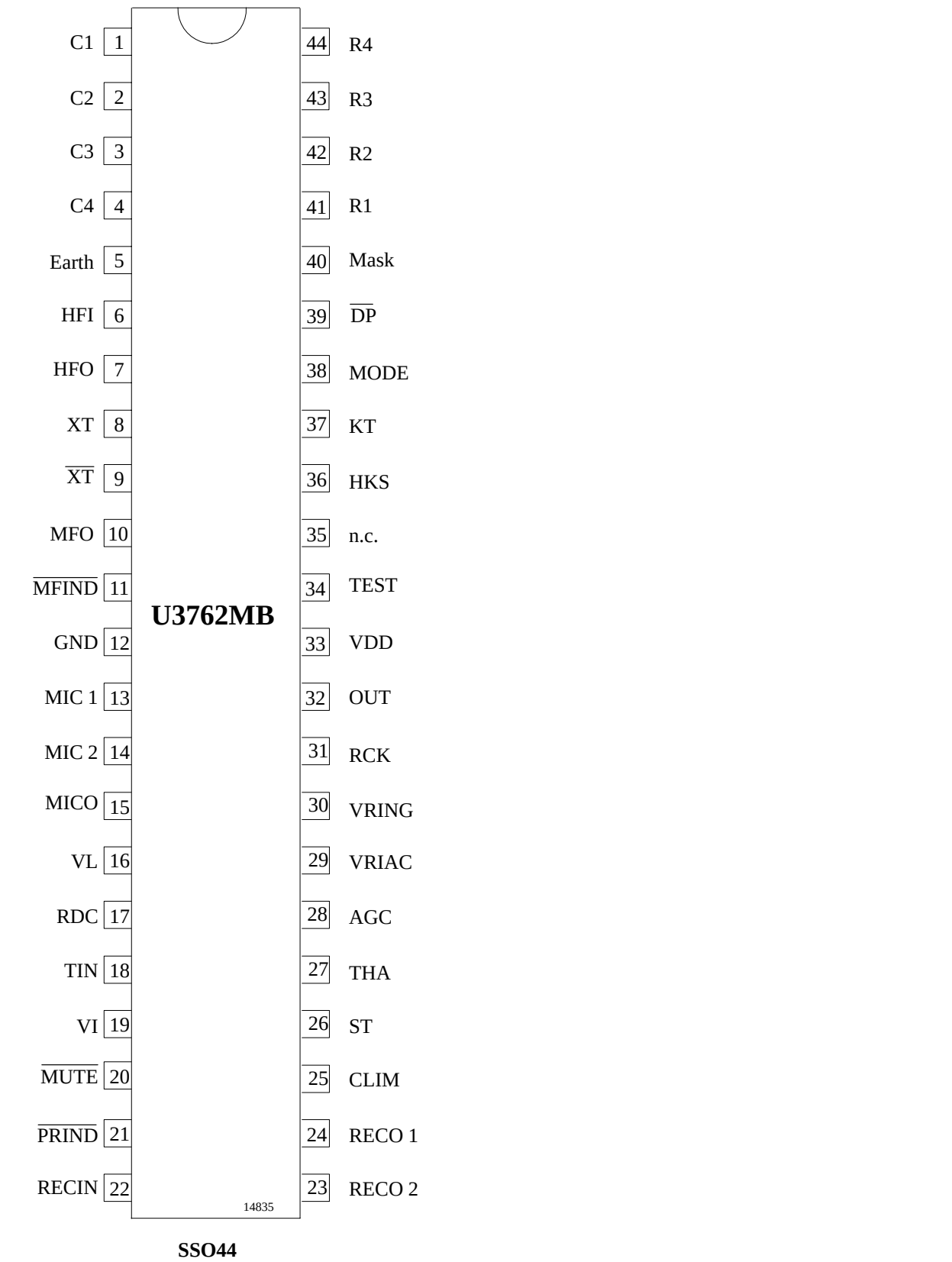


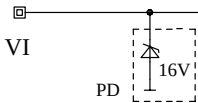
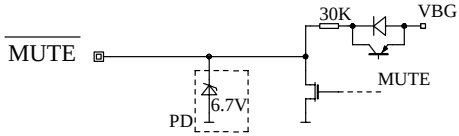
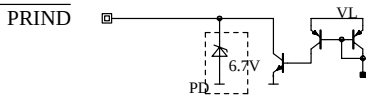
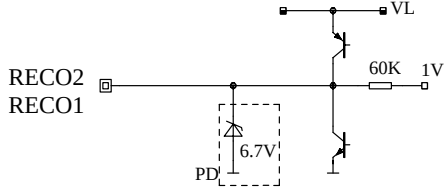
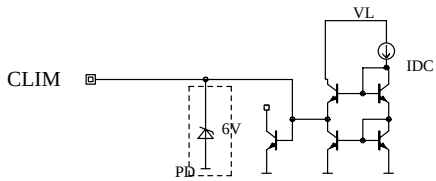
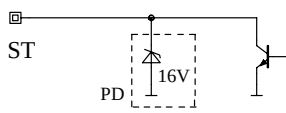
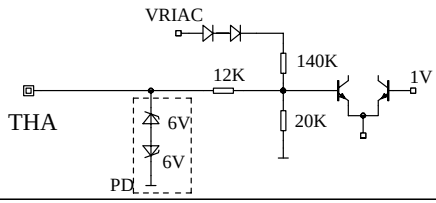
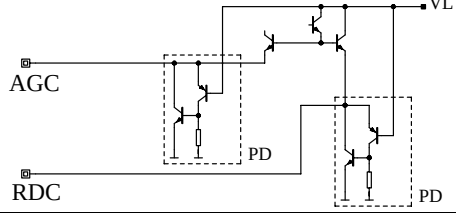
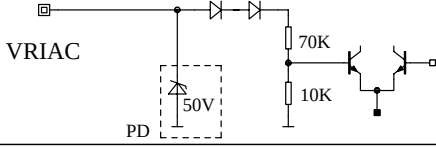
Figure 1.

Pin Description



| Pin            | Symbol                 | Function                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Configuration |                |             |           |                |     |     |       |                |     |     |       |                |     |     |       |                |     |     |       |                |      |      |       |                |      |      |       |                |      |      |       |  |
|----------------|------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|----------------|-------------|-----------|----------------|-----|-----|-------|----------------|-----|-----|-------|----------------|-----|-----|-------|----------------|-----|-----|-------|----------------|------|------|-------|----------------|------|------|-------|----------------|------|------|-------|--|
| 1              | C1                     | Keyboard input                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |               |                |             |           |                |     |     |       |                |     |     |       |                |     |     |       |                |     |     |       |                |      |      |       |                |      |      |       |                |      |      |       |  |
| 2              | C2                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |               |                |             |           |                |     |     |       |                |     |     |       |                |     |     |       |                |     |     |       |                |      |      |       |                |      |      |       |                |      |      |       |  |
| 3              | C3                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |               |                |             |           |                |     |     |       |                |     |     |       |                |     |     |       |                |     |     |       |                |      |      |       |                |      |      |       |                |      |      |       |  |
| 4              | C4                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |               |                |             |           |                |     |     |       |                |     |     |       |                |     |     |       |                |     |     |       |                |      |      |       |                |      |      |       |                |      |      |       |  |
| 5              | Earth                  | Earth key ( 604 ms high pulse, 1 s pause)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |               |                |             |           |                |     |     |       |                |     |     |       |                |     |     |       |                |     |     |       |                |      |      |       |                |      |      |       |                |      |      |       |  |
| 6              | HFI                    | Input with 200 k $\Omega$ pull-down resistor. HFI triggers HFO with each LH edge.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |               |                |             |           |                |     |     |       |                |     |     |       |                |     |     |       |                |     |     |       |                |      |      |       |                |      |      |       |                |      |      |       |  |
| 7              | HFO                    | Output will be toggled by each LH edge at HFI.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |               |                |             |           |                |     |     |       |                |     |     |       |                |     |     |       |                |     |     |       |                |      |      |       |                |      |      |       |                |      |      |       |  |
| 8              | XT                     | A built-in inverter provides oscillation with an inexpensive 3.579545-MHz crystal or ceramic resonator                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |               |                |             |           |                |     |     |       |                |     |     |       |                |     |     |       |                |     |     |       |                |      |      |       |                |      |      |       |                |      |      |       |  |
| 9              | $\overline{\text{XT}}$ |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |               |                |             |           |                |     |     |       |                |     |     |       |                |     |     |       |                |     |     |       |                |      |      |       |                |      |      |       |                |      |      |       |  |
| 10             | MFO                    | Output of DTMF<br>DTMF output frequency<br><table> <thead> <tr> <th></th><th>Specified (Hz)</th><th>Actual (Hz)</th><th>Error (%)</th></tr> </thead> <tbody> <tr> <td>R<sub>1</sub></td><td>697</td><td>699</td><td>+0.28</td></tr> <tr> <td>R<sub>2</sub></td><td>770</td><td>766</td><td>-0.52</td></tr> <tr> <td>R<sub>3</sub></td><td>852</td><td>848</td><td>-0.47</td></tr> <tr> <td>R<sub>4</sub></td><td>941</td><td>940</td><td>-0.10</td></tr> <tr> <td>C<sub>1</sub></td><td>1209</td><td>1216</td><td>+0.57</td></tr> <tr> <td>C<sub>2</sub></td><td>1336</td><td>1332</td><td>-0.30</td></tr> <tr> <td>C<sub>3</sub></td><td>1477</td><td>1472</td><td>-0.34</td></tr> </tbody> </table> |               | Specified (Hz) | Actual (Hz) | Error (%) | R <sub>1</sub> | 697 | 699 | +0.28 | R <sub>2</sub> | 770 | 766 | -0.52 | R <sub>3</sub> | 852 | 848 | -0.47 | R <sub>4</sub> | 941 | 940 | -0.10 | C <sub>1</sub> | 1209 | 1216 | +0.57 | C <sub>2</sub> | 1336 | 1332 | -0.30 | C <sub>3</sub> | 1477 | 1472 | -0.34 |  |
|                | Specified (Hz)         | Actual (Hz)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Error (%)     |                |             |           |                |     |     |       |                |     |     |       |                |     |     |       |                |     |     |       |                |      |      |       |                |      |      |       |                |      |      |       |  |
| R <sub>1</sub> | 697                    | 699                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | +0.28         |                |             |           |                |     |     |       |                |     |     |       |                |     |     |       |                |     |     |       |                |      |      |       |                |      |      |       |                |      |      |       |  |
| R <sub>2</sub> | 770                    | 766                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | -0.52         |                |             |           |                |     |     |       |                |     |     |       |                |     |     |       |                |     |     |       |                |      |      |       |                |      |      |       |                |      |      |       |  |
| R <sub>3</sub> | 852                    | 848                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | -0.47         |                |             |           |                |     |     |       |                |     |     |       |                |     |     |       |                |     |     |       |                |      |      |       |                |      |      |       |                |      |      |       |  |
| R <sub>4</sub> | 941                    | 940                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | -0.10         |                |             |           |                |     |     |       |                |     |     |       |                |     |     |       |                |     |     |       |                |      |      |       |                |      |      |       |                |      |      |       |  |
| C <sub>1</sub> | 1209                   | 1216                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | +0.57         |                |             |           |                |     |     |       |                |     |     |       |                |     |     |       |                |     |     |       |                |      |      |       |                |      |      |       |                |      |      |       |  |
| C <sub>2</sub> | 1336                   | 1332                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | -0.30         |                |             |           |                |     |     |       |                |     |     |       |                |     |     |       |                |     |     |       |                |      |      |       |                |      |      |       |                |      |      |       |  |
| C <sub>3</sub> | 1477                   | 1472                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | -0.34         |                |             |           |                |     |     |       |                |     |     |       |                |     |     |       |                |     |     |       |                |      |      |       |                |      |      |       |                |      |      |       |  |

| Pin | Symbol                    | Function                                                                                                                                                                                                                                                                                                              | Configuration |
|-----|---------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| 11  | $\overline{\text{MFIND}}$ | Output switches to low being in temporary DTMF mode. Reset by on hook condition.                                                                                                                                                                                                                                      |               |
| 12  | GND                       | Ground                                                                                                                                                                                                                                                                                                                |               |
| 13  | MIC 1                     | Inverting input of microphone amplifier                                                                                                                                                                                                                                                                               |               |
| 14  | MIC 2                     | Non-inverting input of microphone amplifier                                                                                                                                                                                                                                                                           |               |
| 15  | MICO                      | Transmit pre-amp output which is normally capacitively coupled to Pin TIN                                                                                                                                                                                                                                             |               |
| 16  | VL                        | Positive supply voltage input to the device. The current through this pin is modulated by the transmit signal.                                                                                                                                                                                                        |               |
| 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 $\Omega$ for low-voltage operation. Values up to 100 $\Omega$ may be used to increase the available transmit output voltage swing at the expense of low-voltage operation. |               |
| 18  | TIN                       | Input to the line output driver amplifier. Transmit AGC applied to this stage.                                                                                                                                                                                                                                        |               |

| Pin | Symbol             | Function                                                                                                                                                                                                                                                      | Configuration                                                                         |
|-----|--------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| 19  | $V_I$              | This internal voltage bias line must be connected to VL via an external resistor which dominates the AC input impedance of the circuit and should be 680 $\Omega$ for an 600- $\Omega$ input impedance or 1.2 k $\Omega$ for a 900- $\Omega$ input impedance. |    |
| 20  | $\overline{MUTE}$  | Pin for testing                                                                                                                                                                                                                                               |     |
| 21  | $\overline{PRIND}$ | PRIVACY indication pin<br>Open collector with minimum 1 mA drive current to GND when PRIVACY = active                                                                                                                                                         |     |
| 22  | RECIN              | Receive amplifier input. The receiving amplification is regulated by an AGC.                                                                                                                                                                                  |     |
| 23  | RECO2              | Output of the receive amplifier. Dynamic transducers with a minimum impedance of 100 $\Omega$ can be directly driven by these outputs.                                                                                                                        |    |
| 24  | RECO1              |                                                                                                                                                                                                                                                               |                                                                                       |
| 25  | CLIM               | Time constant of anticlipping in transmit path.<br>$CLIM \geq 2.2 \mu F$<br>$CLIM = GND$ : anticlipping inactive                                                                                                                                              |   |
| 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.                                                                                                |  |
| 27  | THA                | Ringer threshold adjustment                                                                                                                                                                                                                                   |   |
| 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.                                                 |   |
| 29  | VRIAC              | Ringing supply                                                                                                                                                                                                                                                |   |

| Pin | Symbol | Function                                                                                                                                                                                  | Configuration |
|-----|--------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| 30  | VRING  | DC supply voltage for the tone ringer is limited to 30 V with integrated Z-diode.                                                                                                         |               |
| 31  | RCK    | RC clock oscillator for ringer                                                                                                                                                            |               |
| 32  | OUT    | Buzzer output                                                                                                                                                                             |               |
| 33  | VDD    | Supply output for dialer part                                                                                                                                                             |               |
| 34  | TEST   | TEST input with 6.25 kΩ pull-up resistor                                                                                                                                                  |               |
| 35  | n.c.   | Not connected                                                                                                                                                                             |               |
| 36  | HKS    | Hook switch input.<br>HKS = 0: On-hook state. Chip in sleep mode, no operation (with a pull-down resistor of about 400 kΩ).<br>HKS = 1: Off-hook state. Chip enable for normal operation. |               |
| 37  | KT     | Keytone output only sent out in pulse mode                                                                                                                                                |               |

| Pin | Symbol          | Function                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Configuration |
|-----|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| 38  | MODE            | Pulling MODE pin to:<br>C3 tone mode with 87 ms burst time and 140 ms pause<br>C4 tone mode with 87 ms DTMF burst and 87 ms pause<br>R1 pulse mode with 20 pps, Make/Break = 40/60<br>R2 pulse mode with 20 pps, Make/Break = 33/66<br>R3 pulse mode with 10 pps, Make/Break = 40/60<br>R4 pulse mode with 10 pps, Make/Break = 33/66<br>C1 pulse mode with 10 pps, Make/Break = 33/66 and temp. DTMF with 87 ms DTMF burst, 140 ms pause<br>MODE pin pulled to R4: with temporary DTMF, 87 ms DTMF burst and 87 ms pause |               |
| 39  | $\overline{DP}$ | Pulse dialing output. Flash key will cause $\overline{DP}$ to be active in either DTMF mode or pulse mode. In On-hook state is $\overline{DP} = VDD$ .                                                                                                                                                                                                                                                                                                                                                                    |               |
| 40  | Mask            | Short mute during pulse dialing, active high                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |               |
| 41  | R1              | Keyboard input                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |               |
| 42  | R2              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |               |
| 43  | R3              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |               |
| 44  | R4              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |               |



## Keyboard Operation

| C1    | C2 | C3 | C4  |    |
|-------|----|----|-----|----|
| 1     | 2  | 3  |     | R1 |
| 4     | 5  | 6  |     | R2 |
| 7     | 8  | 9  | F   | R3 |
| * / T | 0  | #  | R/P | R4 |
| ⊗     |    |    |     |    |

- R/P: Redial and pause function key
- F: Flash key
- \* / T: \* function;  
pulse-to-tone function
- ⊗ : hand set, MIC mute

## 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 (3.6 s).  
Keys stored in redial memory: 0 to 9, \*, #, R/P, F

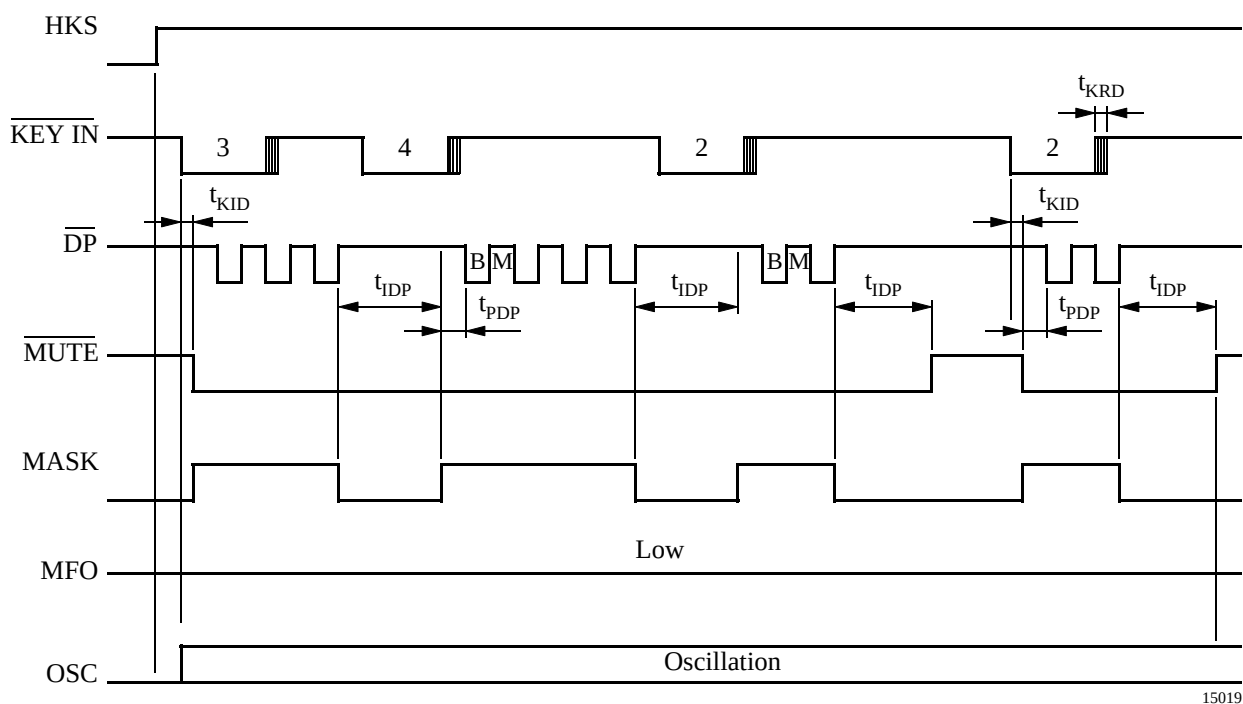


Figure 2. Pulse mode normal dialing

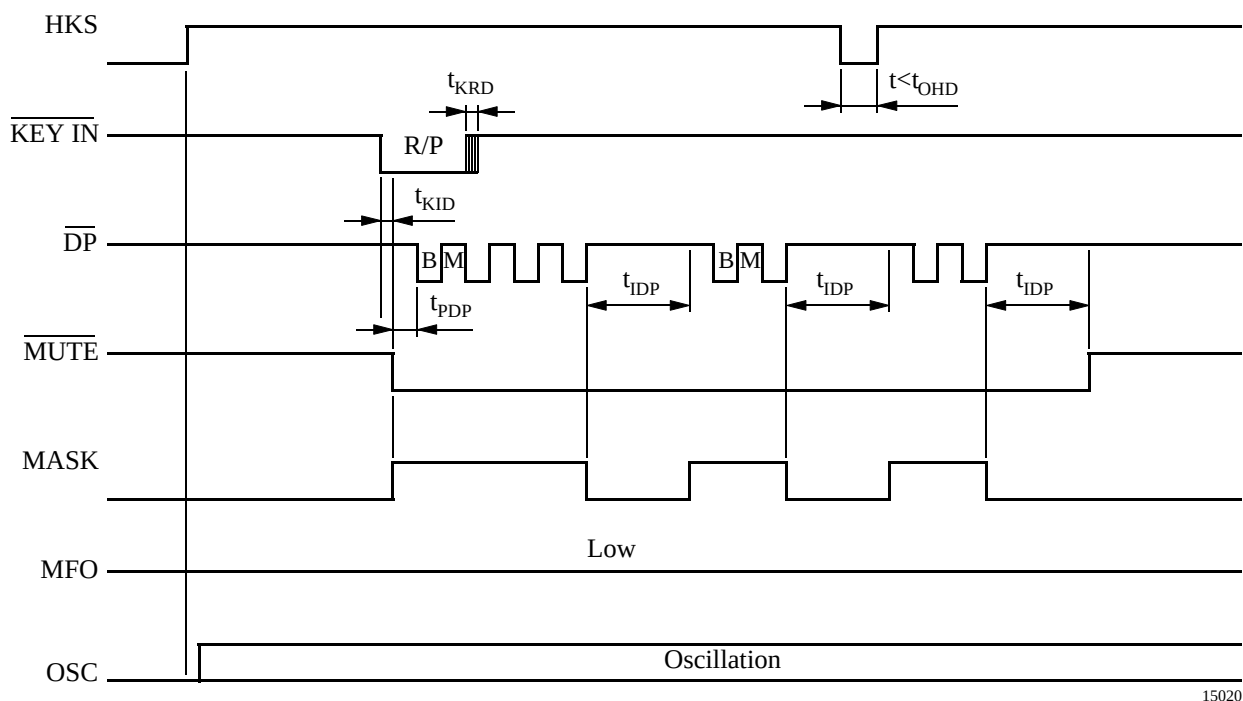


Figure 3. Pulse mode auto dialing

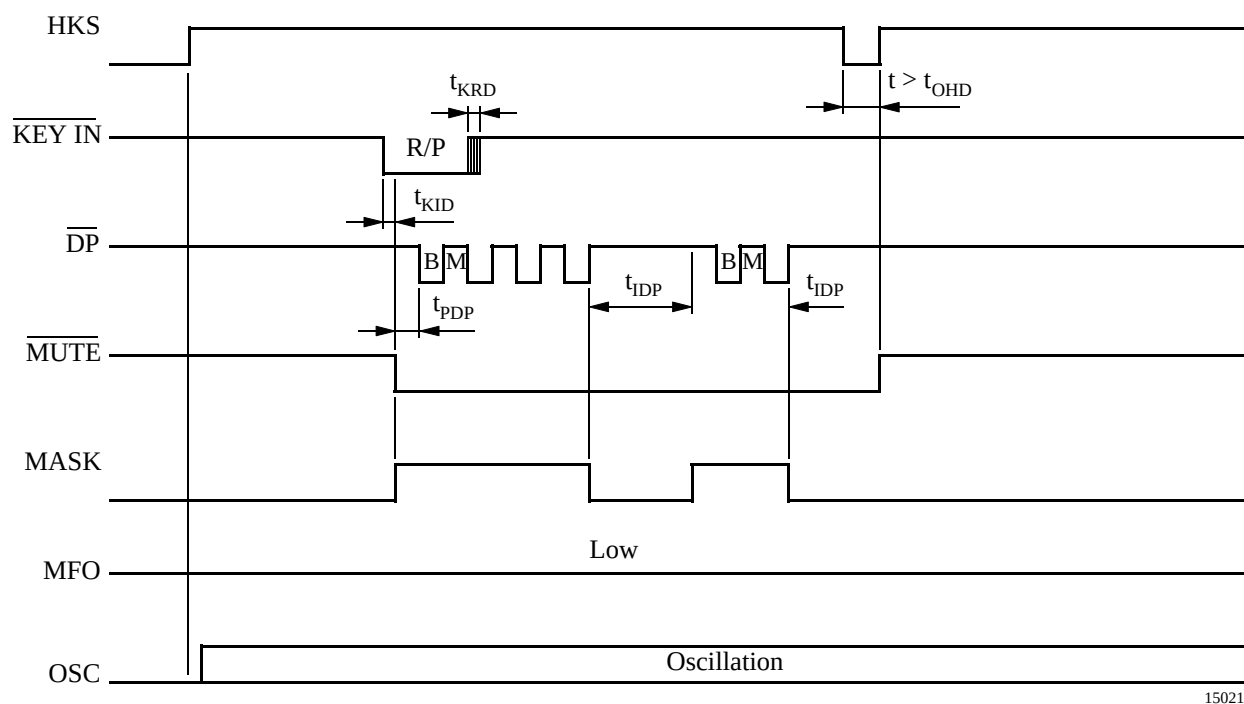


Figure 4. Pulse mode auto dialing

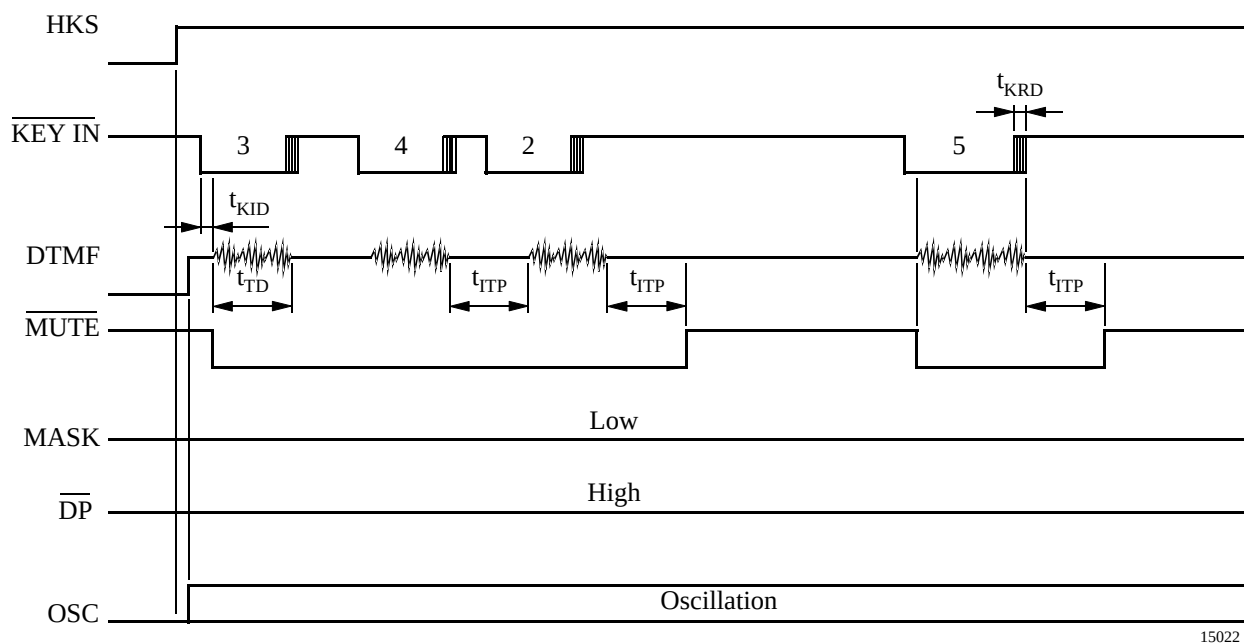


Figure 5. DTMF mode normal dialing

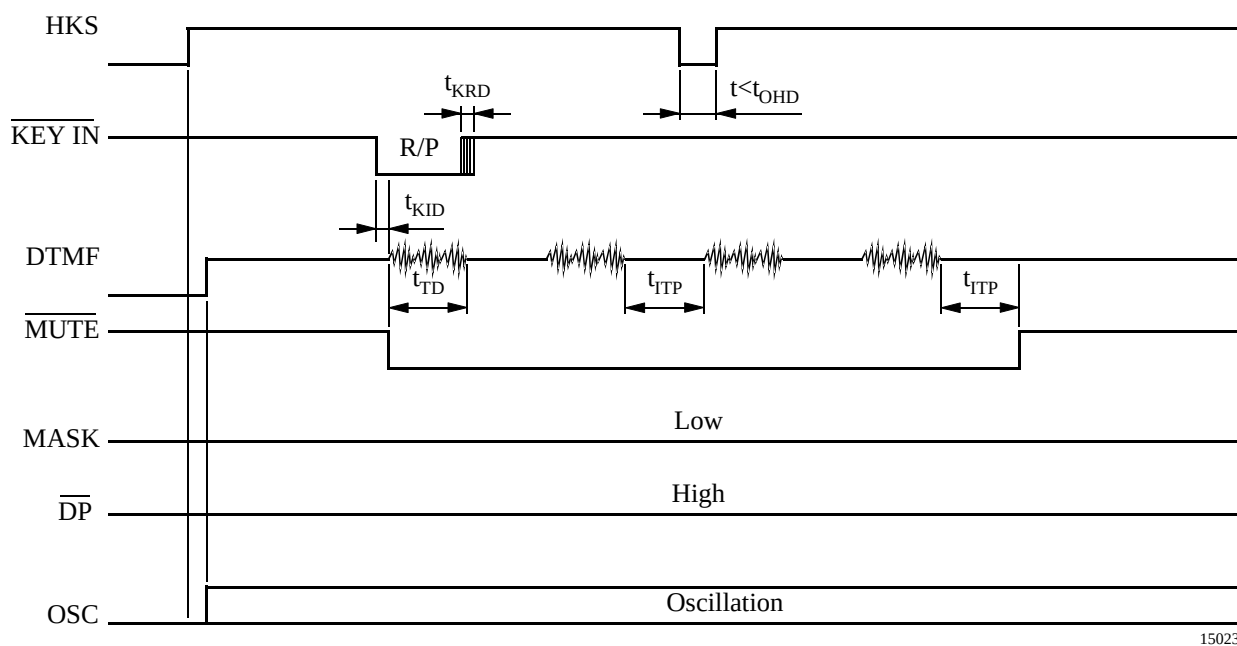


Figure 6. DTMF mode auto dialing ( $t < t_{OHD}$ )

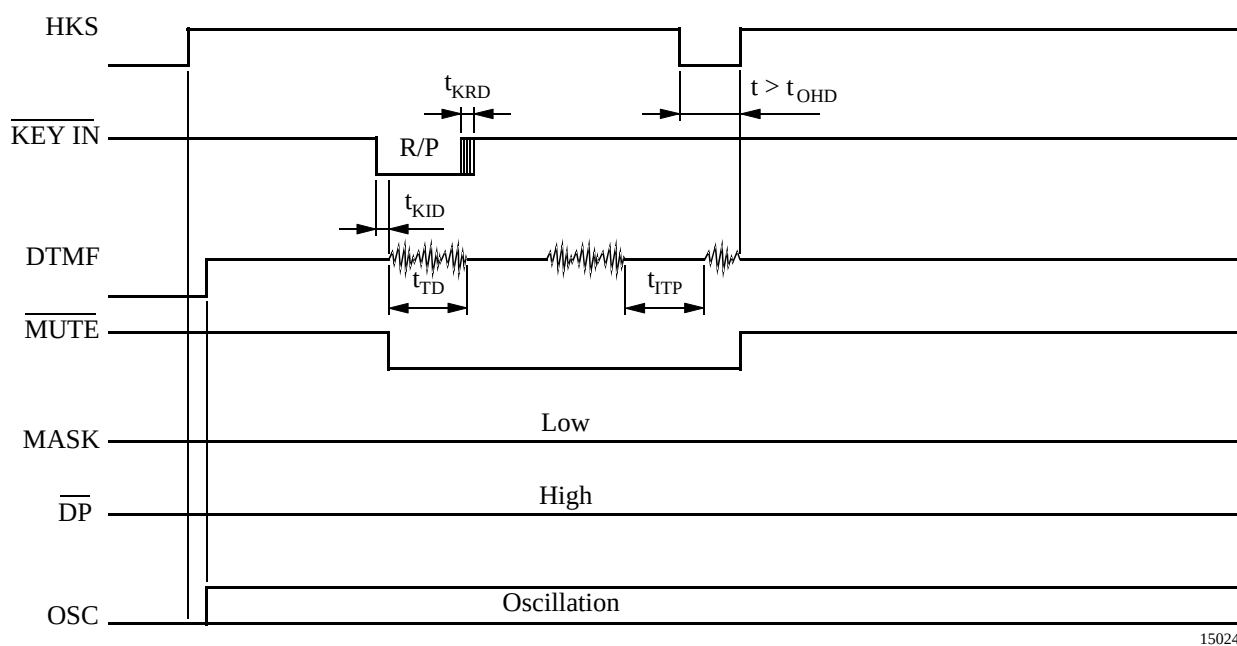
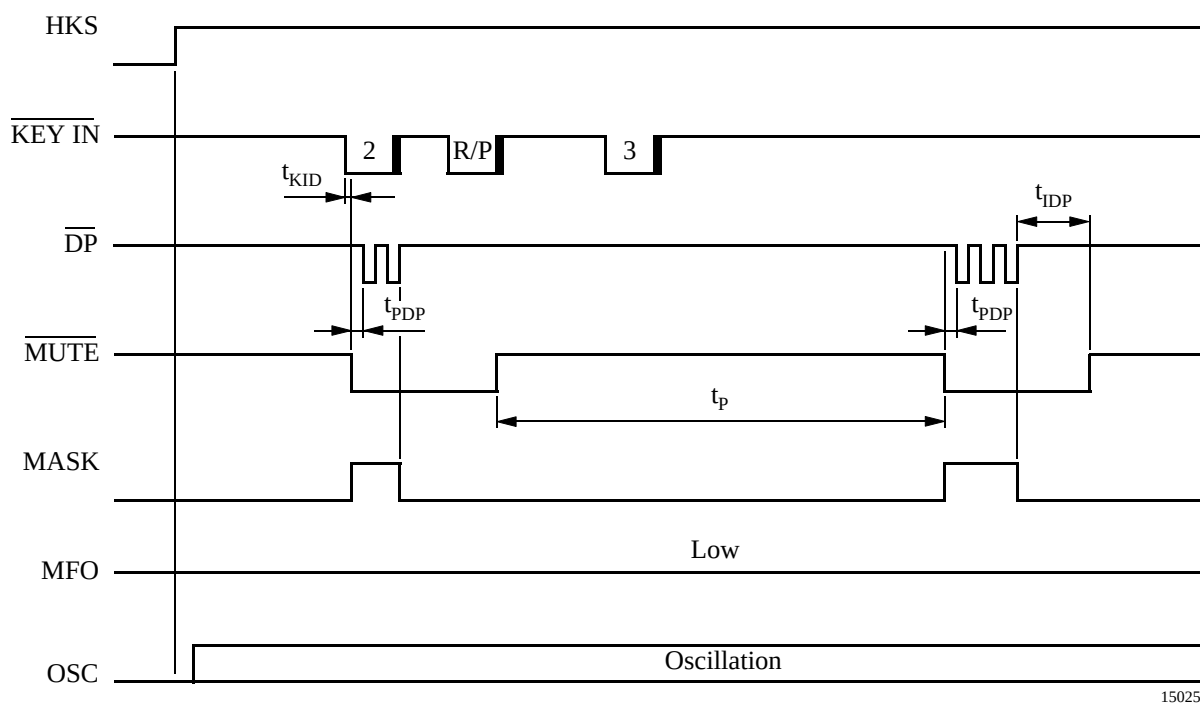


Figure 7. DTMF mode auto dialing ( $t > t_{OHD}$ )

## Access Pause

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

1. The pause function can be stored in the memory.
2. The pause function is executed in normal dialing and redialing.



15025

Figure 8. Pause function

## Pulse-to-Tone (\* /T)

OFF HOOK , D1 , D2 , ..., Dn , \* /T , D1' , D2' , ..., Dn'

1. a) 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)

1. b) (Pulse), (Tone), (Tone) if MODE pin = C2, \* is sent out as DTMF 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 by going on-hook only.

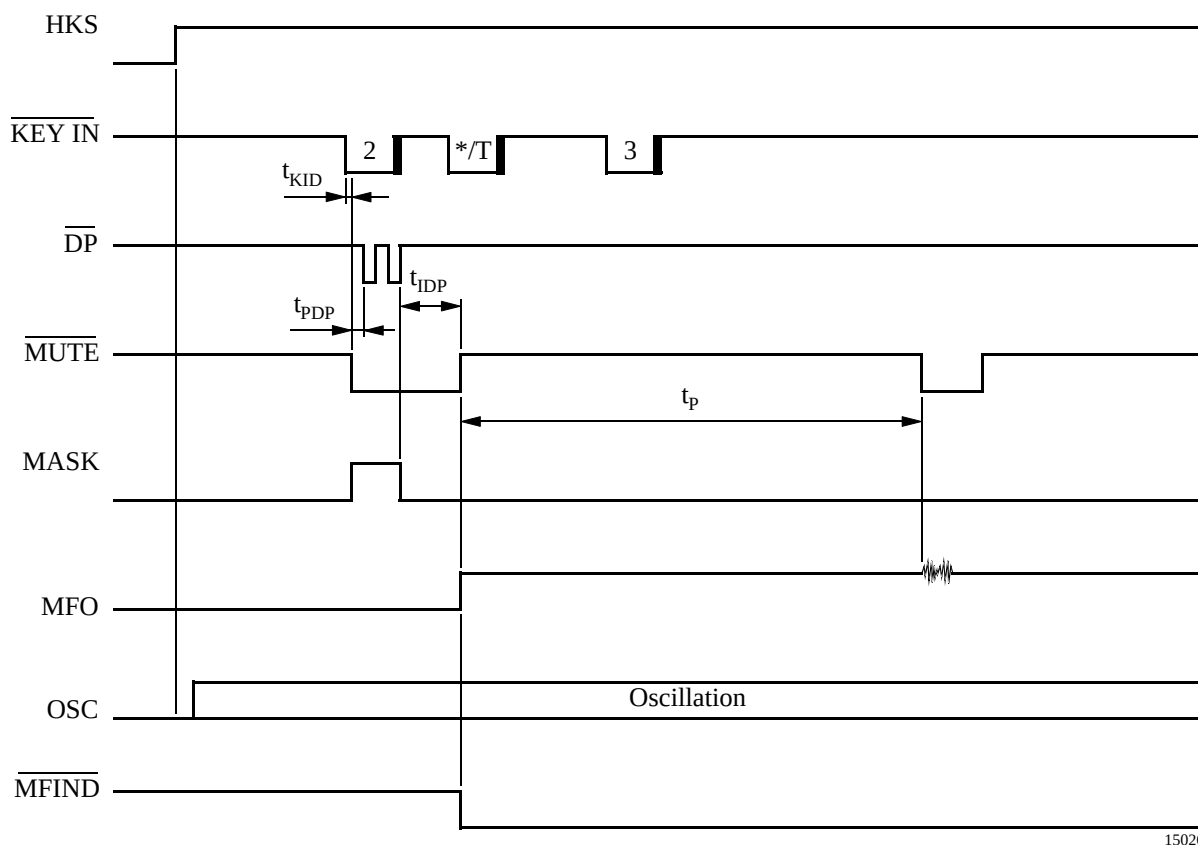


Figure 9. Pulse-to-tone operation

## Flash (F)

OFF HOOK

,

$F_n$

1. The dialer will execute flash break and the entire flash pause time will elapse before the next digits are dialed out.
2. The flash key can be stored as a digit in the memory. Only one flash, however, will be released to the users.
3. The system will return to the initial state after the flash pause time has elapsed.

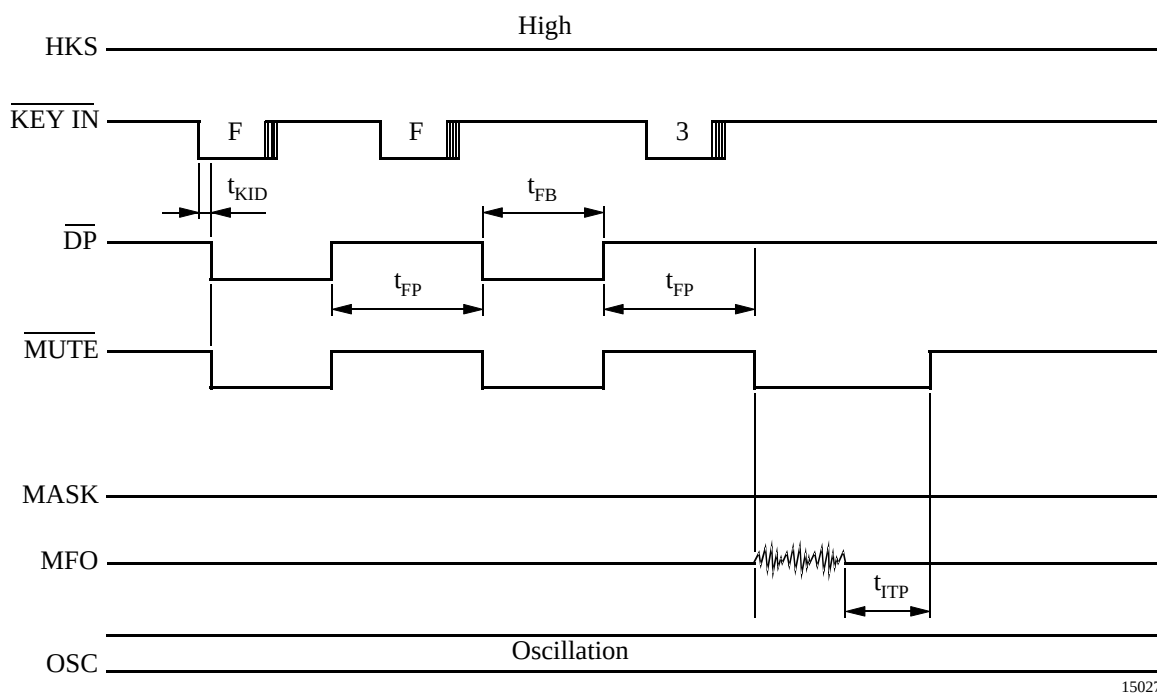


Figure 10. Flash operation

$t_{KID}$  = 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

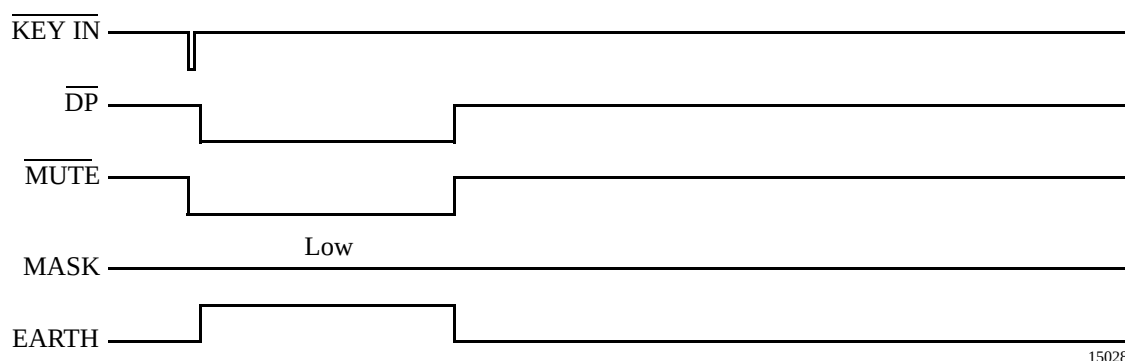


Figure 11. Symbolic timing diagram: Earth function

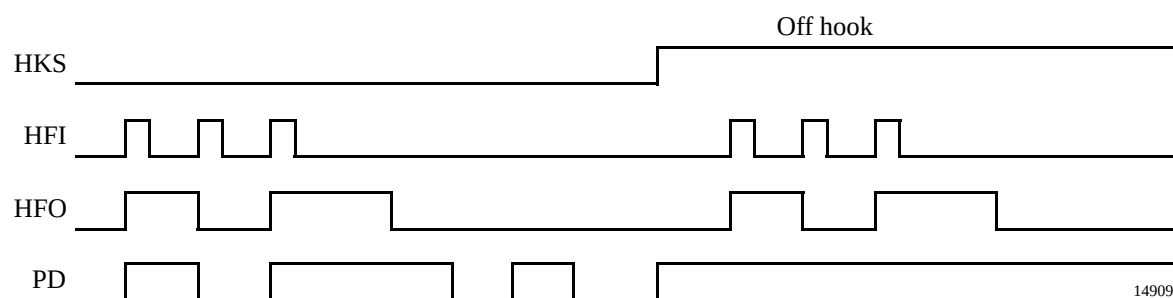


Figure 12. Symbolic timing diagram: HFI, HFO function

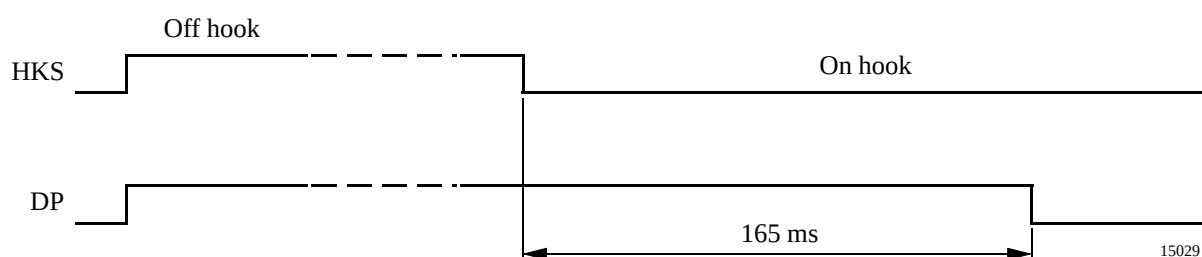


Figure 13. Symbolic timing diagram: on hook debounce time

## 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, $T_{amb} = 60^{\circ}\text{C}$ SSO44 | $P_{tot}$  | 0.9         | W    |
| Junction ambient SSO44                                        | $R_{thJA}$ | 70          | K/W  |

ESD withstand voltage 1 kV according to MIL standard 883d method 3015.7 (HBM)



## Electrical Characteristics Speech Circuit

Reference point Pin GND,  $f = 1000 \text{ Hz}$ ,  $0 \text{ dBm} = 775 \text{ mV}_{\text{rms}}$ ,  $R_{\text{DC}} = 39 \Omega / 1 \text{ W}$ ,  $T_{\text{amb}} = 25^\circ\text{C}$ , unless otherwise specified, refer to “Basic Test Circuit”.

| Parameters                                                     | Test Conditions / Pin                                                                                          | Symbol             | Min. | Typ.  | Max. | Unit             |
|----------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|--------------------|------|-------|------|------------------|
| Line voltage                                                   | $I_L = 8 \text{ mA}$                                                                                           | $V_L$              |      | 1.4   |      | V                |
|                                                                | $I_L = 20 \text{ mA}$                                                                                          |                    | 3.6  | 3.85  | 4.1  | V                |
|                                                                | $I_L = 73 \text{ mA}$                                                                                          |                    | 5.9  | 6.55  | 7.2  | V                |
|                                                                | $I_L = 100 \text{ mA}$                                                                                         |                    | 6.9  |       | 8.2  | V                |
| <b>Transmit and sidetone</b>                                   |                                                                                                                |                    |      |       |      |                  |
| Input resistance                                               | $R_i$                                                                                                          | $R_i$              | 45   | 80    | 120  | k $\Omega$       |
| Gain                                                           | $I_L = 20 \text{ mA}$ , S5 = open                                                                              | $G_s$              | 46.8 | 47.8  | 48.8 | dB               |
| Gain change with current                                       | $I_L = 20 \text{ to } 60 \text{ mA}$<br>$R_{\text{AGC}} = \text{infinite}$                                     | $\Delta G_s$       | -0.5 |       | 0.5  | dB               |
| Gain deviation                                                 | $T_{\text{amb}} = -10 \text{ to } +60^\circ\text{C}$<br>$I_L = 20 \text{ mA}$                                  | $\Delta G_s$       | -0.5 |       | 0.5  | dB               |
| Line-loss compensation                                         | $R_{\text{AGC}} = 12 \text{ k}\Omega$ , $I_L = 73 \text{ mA}$                                                  | $\Delta G_s$       | -4.8 | -6    | -7   | dB               |
| Max. output voltage at line                                    | $I_L = 20 \text{ mA}$ , $V_{\text{mic}} = 10 \text{ mV}$ ,<br>$\text{CLIM} = 2.2 \mu\text{F}$ , S1 = open      | $V_{L\text{max}}$  |      | 1.2   |      | dBm              |
| Noise at line weighted<br>psophometrically                     | $I_L > 20 \text{ mA}$ , $G_s = 48\text{dB}$                                                                    | $n_o$              |      |       | -72  | dBmp             |
| Sidetone reduction                                             | $I_L \geq 20 \text{ mA}$                                                                                       | $G_{\text{STA}}$   | 10   | 15    | 20   | dB               |
| <b>DTMF amplifier</b>                                          |                                                                                                                |                    |      |       |      |                  |
| Volume range $d < 5\%$                                         | Single tone, $I_L \geq 20 \text{ mA}$                                                                          | $V_L$              | 1.3  |       |      | dBm              |
| DTMF output level low<br>frequency group                       | $I_L = 20 \text{ mA}$ , S5 = closed                                                                            | $V_L$              | -8   |       | -4   | dBm              |
| Pre-emphasis between<br>high- and low-level<br>frequency group | $P_{\text{PRE}} = P_{\text{HLG}} - P_{\text{LLG}}$ ,<br>S5 = closed                                            | $P_{\text{PRE}}$   | 1    |       | 3    | dB               |
| <b>Receiving amplifier</b>                                     |                                                                                                                |                    |      |       |      |                  |
| Gain                                                           | $I_L \geq 20 \text{ mA}$                                                                                       | $G_R$              | 3    |       | 5    | dB               |
| Gain change with current                                       | $I_L = 20 \text{ to } 60 \text{ mA}$<br>$R_{\text{AGC}} = \text{infinite}$                                     | $\Delta G_R$       | -0.5 |       | 0.5  | dB               |
| Gain deviation                                                 | $T_{\text{amb}} = -10 \text{ to } +60^\circ\text{C}$<br>$I_L = 20 \text{ mA}$                                  | $\Delta G_R$       | -0.3 |       | 0.7  | dB               |
| Line-loss compensation                                         | $I_L = 73 \text{ mA}$                                                                                          | $\Delta G_R$       | -4.7 | -6    | -7   | dB               |
| Receiving noise at<br>earphone weighted<br>psophometrically    | $I_L = 73 \text{ mA}$                                                                                          | $n_i$              |      | -77.5 | -71  | dBm              |
| Gain change when muted                                         | $I_L \geq 20 \text{ mA}$                                                                                       | $G_{\text{RM}}$    | 24   | 29    | 34   | dB               |
| Output voltage push-pull                                       | $I_L \geq 20 \text{ mA}$ , $Z_{\text{ear}} = 68 \text{ nF}$ ,<br>$100 \Omega$ in series, $d \leq 2\%$          | $V_{\text{RECO}}$  | 0.8  | 0.9   |      | $V_{\text{rms}}$ |
| Ear protection differential                                    | $I_L = 40 \text{ mA}$ , $V_{\text{gen}} = 4 V_{\text{rms}}$ ,<br>$Z_{\text{ear}} = 68 \text{ nF} + 100 \Omega$ | $V_{\text{ear}}$   | 1.3  | 1.6   | 2.5  | $V_{\text{rms}}$ |
| <b>Supply voltage (for internal use only)</b>                  |                                                                                                                |                    |      |       |      |                  |
| Output voltage *                                               | $I_L \geq 20 \text{ mA}$ dialing mode                                                                          | $V_{\text{DD}}$    | 2.0  |       | 6.3  | V                |
| Available current for<br>peripherals                           | $I_L \geq 20 \text{ mA}$ dialing mode                                                                          | $I_{\text{DD}}$    | 150  |       |      | $\mu\text{A}$    |
| Distortion at line<br>$V_L = 0.775 V_{\text{rms}}$             | $I_L = 20 \text{ mA}$ , S5 = open                                                                              | $d_t$              |      |       | 2    | %                |
| Maximum output voltage<br>swing at line                        | $I_L = 20 \text{ mA}$ ,<br>$V_{\text{MIC}} = 50 \text{ mV}_{\text{rms}}$                                       | $V_{L\text{max}}$  |      | 3.4   | 4    | Vpp              |
| Mute suppression transmit<br>with privacy function             | $I_L = 20 \text{ mA}$                                                                                          | $G_{\text{SPRIV}}$ | 60   |       |      | dB               |

\* Output must be limited externally to max. 5.5 V

## DC Characteristics Dialer

$V_{DD} = 2.7\text{ V}$ ,  $f_{OSC} = 3.58\text{ MHz}$ , all outputs unloaded, S9 closed; HKS = 0

| Parameters                          | Test Conditions / Pins           | Symbol           | Min. | Typ. | Max. | Unit             |
|-------------------------------------|----------------------------------|------------------|------|------|------|------------------|
| Memory retention current            | HKS = 1, $V_{DD} = 1.0\text{ V}$ | $I_{MR}$         |      |      | 0.1  | $\mu\text{A}$    |
| Pre-emphasis                        | Column/Row                       |                  | 1    | 2    | 3    | dB               |
| DTMF distortion                     | $R_L = 5\text{ k}\Omega$         | d                |      | -30  | -23  | dB               |
| DP output sink current              | $V_{PO} = 0.5\text{ V}$          | $I_{PL}$         | 0.5  |      |      | mA               |
| Keyboard input drive current        | $V_I = 0\text{ V}$               | $I_{KD}$         |      | 20   |      | $\mu\text{A}$    |
| Keyboard input sink current         | $V_I = 2.7\text{ V}$             | $I_{KS}$         |      | 500  |      | $\mu\text{A}$    |
| Key on resistance<br>all other keys |                                  | $R_{KON}$        |      |      | 5    | $\text{k}\Omega$ |
| Key off resistance                  |                                  | $R_{KOFF}$       |      | 100  |      | $\text{k}\Omega$ |
| Mask sink / drive current           |                                  | $I_M\text{ H/L}$ | 0.5  |      |      | mA               |
| Earth sink / drive current          |                                  | $I_e\text{ H/L}$ | 0.5  |      |      | mA               |

## AC Characteristics Dialer

| Parameters                          | Test Conditions / Pins                 | Symbol    | Min.      | Typ.  | Max.      | Unit |
|-------------------------------------|----------------------------------------|-----------|-----------|-------|-----------|------|
| Keypad active in<br>debounce mode   |                                        | $t_{KID}$ | 15        | 20    | 25        | ms   |
| Key release debounce                |                                        | $t_{KRD}$ | 15        | 20    | 25        | ms   |
| Pre-digit pause                     | MODE pin = R3 (10 pps)                 | $t_{PDP}$ | 37        | 40    | 41        | ms   |
|                                     | MODE pin = C1, C2, C4 (10 pps)         | $t_{PDP}$ | 31        | 33.3  | 33.5      | ms   |
|                                     | MODE pin = R1 (20 pps)                 | $t_{PDP}$ |           | 20    |           | ms   |
|                                     | MODE pin = R2                          | $t_{PDP}$ |           | 16.65 |           | ms   |
| Inter-digit pause<br>(auto dialing) | 10 pps, $t_{IP} = t_{IDP} + t_{PDP}$   | $t_{IP}$  | 810       | 836   | 860       | ms   |
|                                     | 20 pps                                 | $t_{IP}$  |           | 512   |           | ms   |
| Make/break ratio                    | MODE pin = R1 (20 pps), R3<br>(10 pps) | M/B       | 40.8:60.2 | 40:60 | 39.2:60.8 | %    |
|                                     | MODE pin = C1, C2, R4 (10 pps)         |           | 35.6:64.4 | 33:67 | 31.2:68.8 | %    |
|                                     | R2 (20 pps)                            |           |           |       |           |      |
| DTMF output duration                | Auto dialing, MODE = C4                | $t_{TD}$  | 84        | 87    | 90        | ms   |
|                                     | MODE = C3                              |           | 84        | 87    | 90        | ms   |
| Inter-tone pause                    | Auto dialing, MODE = C4                | $t_{ITP}$ | 84        | 87    | 90        | ms   |
|                                     | MODE = C3                              |           | 135       | 140   | 147       | ms   |
| Flash break time, F                 | C4 connected to R3                     | $t_{FB}$  | 95        | 98    | 101       | ms   |
| Flash pause time                    | F                                      | $t_{FP}$  | 0.9       | 1     | 1.1       | s    |
| Pause time                          |                                        | $t_p$     | 3.5       | 3.6   | 3.7       | s    |
| On-hook debounce<br>time            |                                        | $t_{ohd}$ |           | 220   |           | ms   |

| Parameters            | Test Conditions / Pins     | Symbol | Min. | Typ.  | Max. | Unit |
|-----------------------|----------------------------|--------|------|-------|------|------|
| Break duration        | MODE pin = R3              | $t_B$  | 57.6 | 60    | 62.4 | ms   |
|                       | MODE pin = C1, C2, R4      |        | 63   | 66.7  | 69   | ms   |
|                       | MODE pin = R1 (20 pps)     | $t_B$  |      | 30    |      | ms   |
|                       | MODE pin = R2              |        |      | 33.35 |      | ms   |
| Make duration         | MODE pin = R3              | $t_M$  | 38   | 40    | 41   | ms   |
|                       | MODE pin = C1, C2, R4      |        | 31   | 33.3  | 35   | ms   |
|                       | MODE pin = R1 (20 pps)     | $t_M$  |      | 20    |      | ms   |
|                       | MODE pin = R2              |        |      | 16.65 |      | ms   |
| Break + make duration | MODE pin = C1, C2, R3, R4  | $t_p$  | 95   | 100   | 105  | ms   |
|                       | MODE pin = R1, R2 (20 pps) | $t_p$  |      | 50    |      | ms   |

## Electrical Characteristics Tone Ringer

$f_{RCK} = 4 \text{ kHz}$ ,  $V_{RING} = 20 \text{ V}$ ,  $T_{amb} = 25^\circ\text{C}$ , reference point GND, unless otherwise specified

| Parameters                   | Test Conditions / Pins                                                 | Symbol     | Min. | Typ. | Max. | Unit     |
|------------------------------|------------------------------------------------------------------------|------------|------|------|------|----------|
| Supply current, outputs open | $V_{RIAC} = 20 \text{ V}$                                              | $I_{RING}$ | 2.1  |      | 3.8  | mA       |
| Switch-on threshold          | $V_{RIAC}$ , $THA = \text{open}$                                       | $V_{RON}$  | 8    | 9    | 10   | V        |
| Switch-off threshold         | $V_{RIAC}$                                                             | $V_{ROFF}$ | 5.0  | 5.6  | 6.5  | V        |
| Ringing frequency            | $R = 150 \text{ k}\Omega$ , $C = 1 \text{ nF}$<br>$V_{RIAC} > V_{RON}$ | $f_{1H}$   | 937  | 1010 | 1083 | Hz       |
|                              |                                                                        | $f_{1L}$   | 752  | 808  | 868  | Hz       |
| Audio sequence frequency     |                                                                        | $f_2$      | 11.5 | 12.5 | 14.0 | Hz       |
| Output voltage swing         | $V_{Ring} = 25 \text{ V}$ , $C_{out} = 68 \text{ nF}$                  | $V_{out}$  | 21   | 23   |      | $V_{pp}$ |
| Turn-off delay               | See figure 11                                                          | $t_{off}$  |      | 65   | 100  | ms       |

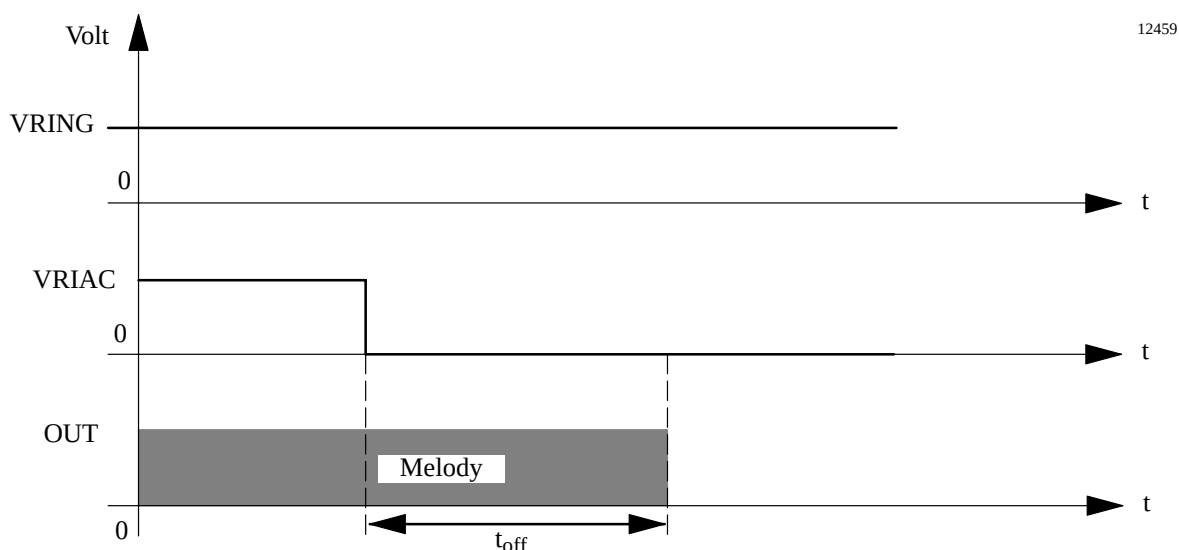


Figure 14. Turn-off delay time

## Basic Test Circuit

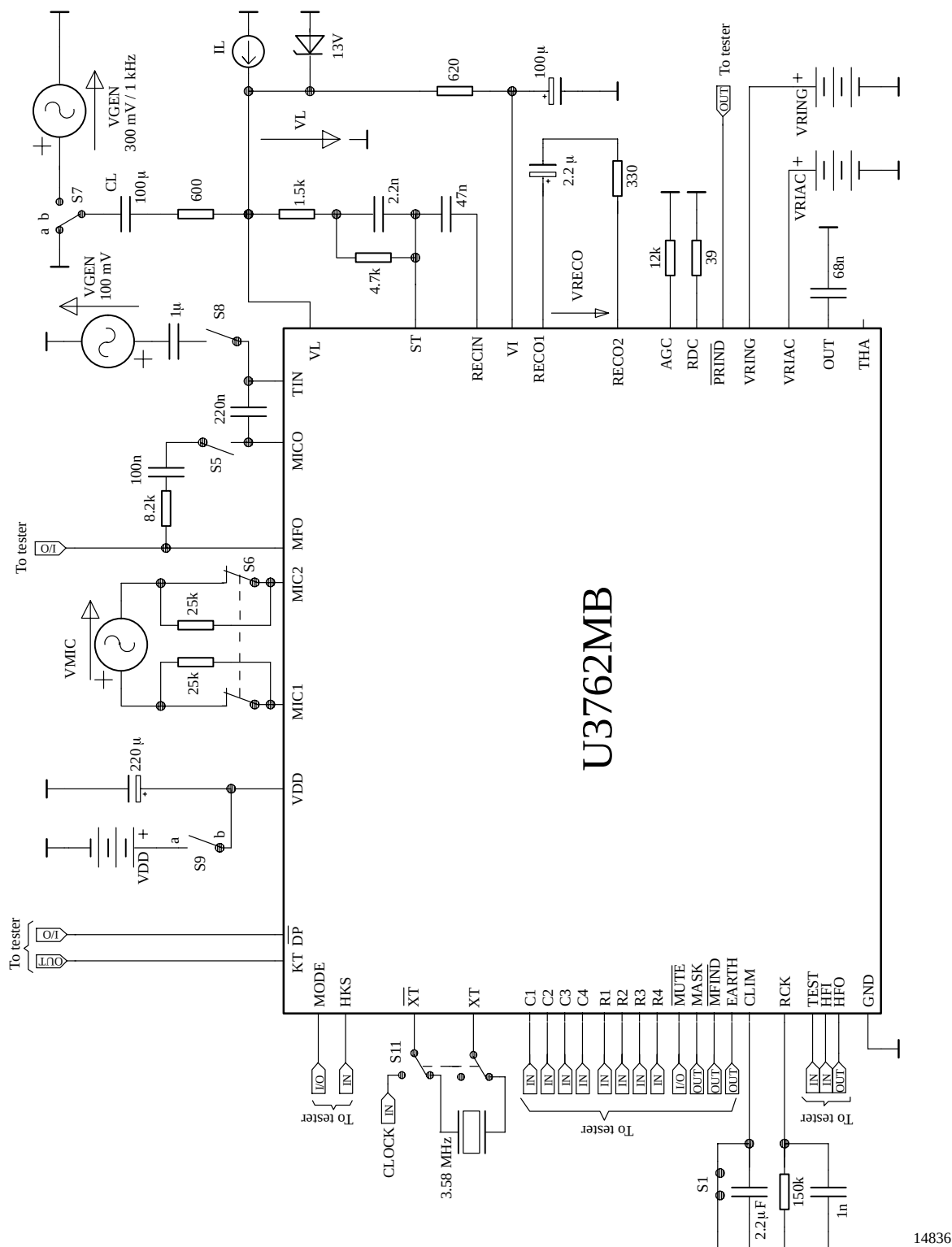


Figure 15. Basic test circuit

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## Equations for Electrical Characteristic Parameters of the Speech Circuit

The equations refer to the basic test circuit. If not otherwise specified, the switches in the basic test circuit are inactive.

### Transmit gain

$$GS = 20 \times \log \left( \frac{V_L}{V_{MIC}} \right)$$

$V_{MIC} = 3 \text{ mV/1 kHz}$ , S5 = open

### Receiving gain

$$GR = 20 \times \log \left( \frac{V_{RECO}}{V_L} \right)$$

RX-mode:  $V_{gen} = 300 \text{ mV/1 kHz}$ , S7b

### Line-loss compensation transmit

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

TX-mode:  $V_{MIC} = 3 \text{ mV/1 kHz}$ , S5 = open

### Sidetone reduction

$$GSTA = 20 \times \log \left( \frac{V_L}{V_{RECO}} \right) (\text{in TX-mode}) + GR$$

TX-mode:  $V_{MIC} = 3 \text{ mV/1 kHz}$ , S5 = open

### Line-loss compensation receive

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

RX-mode:  $V_{gen} = 300 \text{ mV/1 kHz}$ , S7b

### Gain change when muted

$$GRM = 20 \times \log \frac{V_{RECO}}{V_L} (\text{Mute} = \text{inactive}) - 20 \times \log \frac{V_{RECO}}{V_L} (\text{Mute} = \text{active})$$

$V_{gen} = 100 \text{ mV/1 kHz}$ , S5 = open, S8 = open

### Input impedance of microphone amplifier

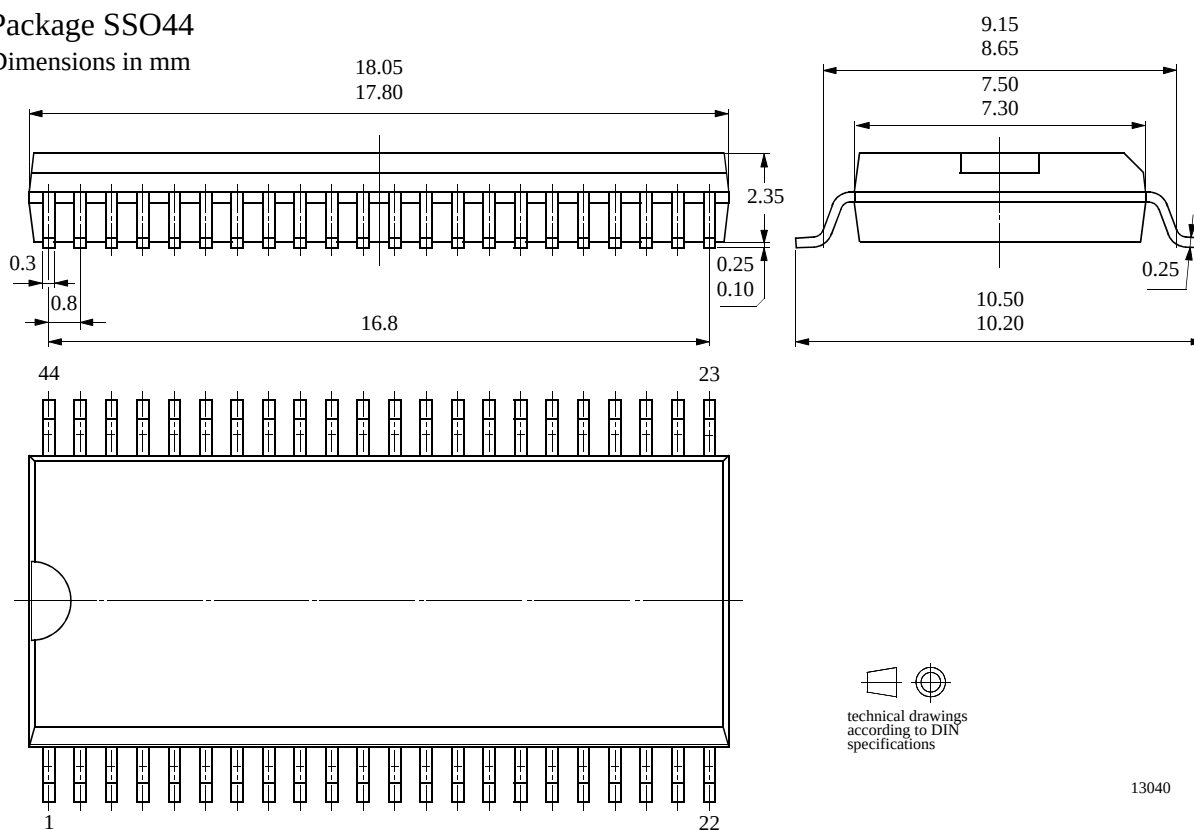
$$R_i = \frac{50 \text{ k}}{\left( \frac{V_{L(S6 = \text{closed})}}{V_{L(S6 = \text{open})}} - 1 \right)}$$

TX-mode:  $V_{MIC} = 3 \text{ mV/1 kHz}$ , S5 = open

## Packaging Information

### Package SSO44

Dimensions in mm



technical drawings  
according to DIN  
specifications

13040

## Ozone Depleting Substances Policy Statement

It is the policy of **TEMIC Semiconductor 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 (ODS).

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 Semiconductor GmbH** 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.

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