



T-75-07-07

UM91265

15 Memory Tone/Pulse Dialer

Features

- Tone/Pulse Switchable Dialer
- Stores ten 16-digit numbers for repertory dialing
- Additional four 16-digit numbers for emergency calls and long distance service company access code.
- One 31-digit Redial Memory
- Dialing length is unlimited, but if the normal dialing length of 31 digits is overstepped, then redial is inhibited
- Auto Pause Access for PBX and toll service operations; 3.1 seconds per pause
- Easy operation with Redial, Store, Auto and Pause keypads
- Key-tone output for valid keypad entry recognition
- Uses Form A keyboard or the standard 2-of-9 Matrix keyboard
- Electronic keypad input is available; low action
- Uses inexpensive 3.579545 MHz Television Color-burst crystal
- Pin selectable for make/break ratio
- Power-on reset is internally generated
- Memory Retention Current is less than 0.2μA at V_{DD} = 1.0V, on hook
- Wide operating voltage range: 2.0V to 5.5V
- Automatic switching from Pulse mode to Tone mode in long distance memory

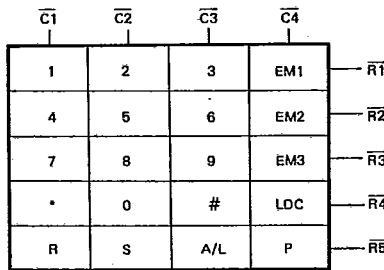
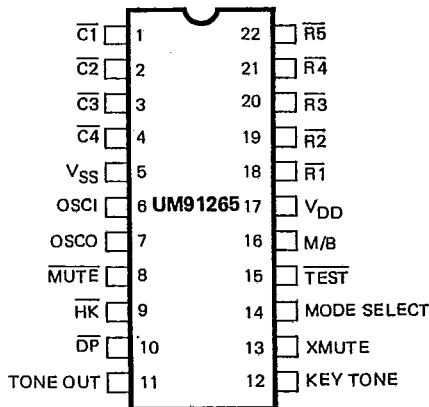
Tone/Pulse Dialer

General Description

The UM91265 is a monolithic integrated circuit which performs 15-memory tone/pulse switchable dialing functions for modern telephone set design. It is fabricated in CMOS technology and thus provides good performance in low voltage, low power operations. Four 16-digit direct dialing memories have been added for convenient em-

ergency calls (such as fire, police, doctor, etc.) and long distance service company access code operations (such as MCI and SPRINT). A wide operating voltage range and low memory retention current facilitate this chip's excellent battery-free, direct line-powered operation.

Pin Configuration & Keyboard Assignments



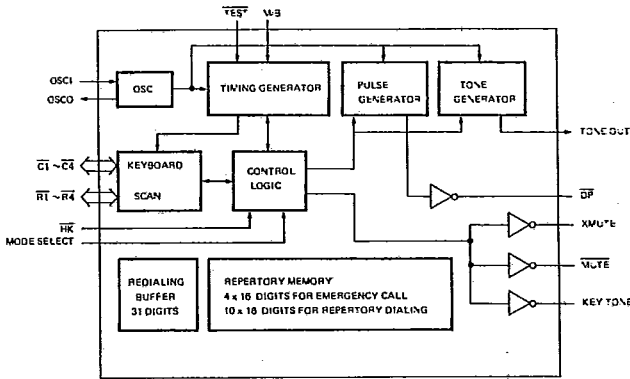
LDC : Long Distance Company
 R : Redial
 S : Store
 A/L : Auto-Dial/Location
 P : Pause



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Block Diagram



Absolute Maximum Ratings*

- DC Supply Voltage, V_{DD} 6.0V
- Input Voltage Range, V_I -0.3V to $V^+ - 0.3V$
- Power Dissipation Per Package, P_O (for $T_P = -25^\circ C$ to $60^\circ C$) 500mW
- Operating Temperature, T_P $-25^\circ C$ to $85^\circ C$
- Storage Temperature, T_{stg} $-65^\circ C$ to $+150^\circ C$

*Comments

Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only. Functional operation of this device at these or any other conditions above those indicated in the operational sections of this specification is not implied and exposure to absolute maximum rating conditions for extended periods may affect device reliability.

DC Characteristics ($V_{DD} = 3.5V, V_{SS} = 0V, F_{OSC} = 3.8 MHz, T_{OP} = 25^\circ C$ unless otherwise specified)

| Parameter | Symbol | Limit | | | Unit | Conditions | Test Ckt |
|-------------------------------------|------------|-------|------|------|-----------|--|----------|
| | | Min. | Typ. | Max. | | | |
| Operating Voltage | V_{DD} | 2.0 | — | 5.5 | V | Tone | |
| | | 2.0 | — | 5.5 | V | Pulse | |
| | | 1.0 | — | 5.5 | V | Memory | |
| Operating Current | I_{DD} | — | 0.6 | 2 | mA | Tone Notes 1, 4, 6 | 1 |
| | | — | 0.2 | 0.5 | mA | Pulse | |
| Memory Retention Current | I_R | — | 0.1 | 0.2 | μA | $\overline{HK} = 1, T_A = 45^\circ C, V^+ = 1.0V$ | 2 |
| Standby Current | I_S | — | 0.1 | 5 | μA | Notes 1, 2, 3, 5, 6 | 1 |
| Tone Output Voltage | V_{TO} | 130 | 150 | 170 | mVrms | Row Group, $R_L = 10 K\Omega$ | 3 |
| Pre-emphasis | | 1 | 2 | 3 | db | Column Group/Row Group $V_{DD} = 2.0$ to $5.5V$ | 4 |
| DTMF Distortion | T_{HD} | — | -30 | -23 | db | $R_L = 10 K\Omega$, Notes 7, 8 | 4 |
| Tone Output External Load Impedance | R_L | 10 | — | — | $K\Omega$ | $THD \leq -23db$ | |
| Tone Output DC Level | V_{DD} | 0.5 | — | 0.6 | V^+ | $V_{DD} = 2.5 - 5.5V$ | 4 |
| Tone Output Sink Current | I_{TL} | 0.2 | — | — | mA | $V_{TO} = 0.5V$ | 5 |
| Pulse Output Source Current | $ I_{PH} $ | 0.2 | — | — | mA | $V_{PO} = 2.0V$ | 5 |
| Sink Current | I_{PL} | 0.2 | — | — | | $V_{PO} = 0.5V$ | 6 |



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DC Characteristics (Continued)

| Parameter | Symbol | Limit | | | Unit | Conditions | Test Ckt |
|-----------------------------------|----------|-------|---------------|-----------|---------|---------------------|----------|
| | | Min. | Typ. | Max. | | | |
| Mute Output Source Current | I_{MH} | 0.2 | - | - | mA | $V_{MO} = 2.0V$ | 5 |
| Sink Current | I_{ML} | 2 | - | - | | $V_{MO} = 0.5V$ | |
| Key Tone Output Source Current | I_{KH} | 0.5 | - | - | mA | $V_{KO} = 2.0V$ | 8 |
| Sink Current | I_{KL} | 0.5 | - | - | | $V_{KO} = 0.5V$ | 5 |
| XMT Mute Source Current | I_{LH} | 0.2 | - | - | mA | $V_{LO} = 2.0V$ | 5 |
| Sink Current | I_{IL} | 0.2 | - | - | | $V_{LO} = 0.5V$ | |
| Input Voltage Low | V_{IL} | GND | - | 0.3 | V+ | Pins 1-4, 9, 14, 15 | |
| Input Voltage High | V_{IH} | 0.7 | - | - | | 16 & 18-22 | |
| Keypad Input Source Current | I_{KD} | 4 | 10 | 30 | μA | $V_I = 0V$ | 6 |
| Sink Current | I_{KS} | 200 | 400 | - | - | $V_I = 2.5V$ | 5, 7 |
| Control Pin Input Leakage Current | I_{IN} | - | $\pm 10^{-5}$ | ± 0.1 | μA | Pins 9, 14, 15, 16 | |

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- Note 1: $\overline{HK} = 0$
- Note 2: In DTMF Mode
- Note 3: In Pulse Mode
- Note 4: Keyboard Entry, Including Auto Dialing
- Note 5: No Keyboard Entry
- Note 6: All Outputs Unloaded
- Note 7: Dual Tone Multi-Frequency Distortion is measured in terms of total out-of-band power related to sum of row and column fundamental power.
- Note 8: Crystal parameters defined as $R_s \leq 100\Omega$, $L_m = 96mH$, $C_m = 0.25 pF$, $C_h = 5 pF$, $F = 3.579545 MHz$ and $C_L = 18 pF$ $\Delta F \leq \pm 200 PPM$

AC Characteristics

Crystal Parameter defined as $R_S \leq 100\Omega$, $L_m = 96mH$, $C_m = 0.25 pF$, $C_h = 5 pF$, $F = 3.579545 MHz$ and $C_L = 18 pF$ $\Delta F \leq \pm 200 PPM$.

| Parameter | Symbol | Conditions | Min. | Typ. | Max. | Unit |
|------------------|--------|---------------------------------------|----------|-------|------|------|
| Pulse | | | | | | |
| Make/Break Ratio | M/B | M/B = Terminal = V_{DD} | | 2/3 | | |
| | | M/B Terminal = V_{SS} | | 1/2 | | |
| Dial Pulse Rate | DR | \overline{TEST} Terminal = V_{DD} | | 10 | | pps |
| | | \overline{TEST} Terminal = V_{SS} | | 600 | | |
| Make Time | T_M | 10 pps | MB = 2/3 | 40 | | ms |
| | | | MB = 1/2 | 33.3 | | |
| | | 600 pps | MB = 2/3 | 0.667 | | |
| | | | MB = 1/2 | 0.556 | | |



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AC Characteristics (Continued)

| Parameter | Symbol | Conditions | Min. | Typ. | Max. | Unit |
|--------------------------------|------------|----------------------------|-----------|------|-------|------|
| Break Time | T_B | 10 pps | MB = 2/3 | | 60 | mS |
| | | | MB = 1/2 | | 66.6 | |
| | | 600 pps | MB = 2/3 | | 1 | |
| | | | MB = 1/2 | | 1.111 | |
| Inter-Digit Pause Time | T_{IDP} | 10 pps | MB = 2/3 | | 800 | mS |
| | | | MB = 1/2 | | 800 | |
| | | 600 pps | MB = 2/3 | | 13.3 | |
| | | | MB = 1/2 | | 13.3 | |
| Pre-Digit Pause | T_{PDP} | 10 pps | MB = 2/3 | | 40 | mS |
| | | | MB = 1/2 | | 33.3 | |
| | | 600 pps | MB = 2/3 | | | |
| | | | MB = 1/2 | | | |
| MUTE Delay | T_{MDP} | 10 pps | MB = 2/3 | | 40 | mS |
| | | | MB = 1/2 | | 33.3 | |
| | | 600 pps | MB = 2/3 | | | |
| | | | MB = 1/2 | | | |
| TONE | | | | | | |
| Minimum Tone Duration | T_{MFD} | | | 100 | | mS |
| Minimum Tone Inter-Digit Pause | T_{TIDP} | | | 105 | | mS |
| Key-In | | | | | | |
| Key-In Debounce Time | T_{KD} | $\overline{TEST} = V_{DD}$ | | 20 | | mS |
| Key-Release Debounce Time | T_{KR} | | | 20 | | mS |
| Key Tone | | | | | | |
| Key-Tone Frequency | F_{KS} | C1 ~ C4, R1 ~ R5 | | 1.2 | | KHz |
| Row, Column Frequency | | | | | | |
| R/C | Spec. | Actual | Error (%) | | | Unit |
| R1 | 697 | 699 | +0.29 | | | Hz |
| R2 | 770 | 766 | -0.78 | | | Hz |
| R3 | 852 | 848 | -0.47 | | | Hz |
| R4 | 941 | 948 | +0.74 | | | Hz |
| C1 | 1209 | 1216 | +0.58 | | | Hz |
| C2 | 1336 | 1332 | -0.30 | | | Hz |
| C3 | 1477 | 1472 | -0.34 | | | Hz |



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Pin Description

| Pin No. | Symbol | I/O | Description |
|--------------|--|-----|---|
| 1-4 18-22 | $\overline{C1} \sim \overline{C4}$ $\overline{R1} \sim \overline{R5}$ | I/O | The keypad input is compatible with the standard 2-of-9 keyboard, the inexpensive single-contact (Form A) keyboard, and electronic inputs. Figure 1 shows how to connect the two keyboard types and Figure 2 shows wave forms for electronic inputs. In normal operation, any single button is pushed to produce a dual tone, pulses or a function. Activation of two or more buttons will result in no response, except for a single tone. Table 1 illustrates the address keypad function, in detail. |
| 6 7 | OSCI OSCO | | A built-in inverter provides oscillation with an inexpensive 3.579545 MHz television color-burst crystal. The oscillator ceases when a keypad input is not sensed. An on-board counter is used to decrease the frequency of the oscillator and creates crystal debounce, mute delay, predigit pause, pulse rate, interdigit pause, Make/Break ratio, intertone pause, tone duration, row group and column group frequency, and key tone frequency oscillation. Any crystal frequency deviation from 3.579545 MHz will be reflected in the time parameter above. Most crystals do not vary more than ± 0.02 percent. |
| 8 | MUTE | O | The mute is a conventional CMOS inverter that pulls to positive voltage with no keyboard input and pulls to ground when an address keypad entry is sensed (excluding the * and # keypads in pulse mode), that is, when any keypad in row 5 and column 4 is pushed, then mute out remains at high level. The mute output is used to cut out the current biased in type-2500 telephone circuit that is required to actuate upon address keypad input. |
| 9 | HK | I | The HK (Hook Switch) input is used to sense the state of the handset as On-hook or Off-hook. In the On-hook state, HK = 1, the keyboard input is disabled. There is no operation for any keyboard entry. This avoids energy loss to the capacitor. In the Off-hook state, HK = 0, all of the functions work. |
| 10 | DP | O | In the DTMF mode, the pulse out remains high regardless of keyboard entry. In the pulse mode, this output sends a chain of pulses to the corresponding keypad input address, but remains high for * and # entries. Figure 3 shows the timing diagram in pulse mode. Under normal conditions, the pulse rate and interdigit pause are fixed, Pin 15 = 1, and will be 10 pps and 800 ms respectively. The Make/Break ratio is pin selectable and depends on the state of the M/B pin. It is 60:40 for M/B = 1 and 66.6:33.3 for M/B = 0. |
| 11 | TONE OUT | O | This pin is used to send out the DTMF address code. During pulse dialing, it always remains in a low state, regardless of keypad input. In the tone mode, it will put out a single or dual tone. For a detailed description, please refer to Table 1. In normal dialing,, the tone duration depends on the length of key-in. When a keypad is held down less than 100 ms, the tone duration will remain fixed at 100 ms. If it is held down longer, the tone duration will last as long as key-in continues. The intertone pause will be different under the following conditions: when key release lasts less than 105 ms, the pause will be fixed at 105 ms; otherwise, it will be equal to the length of time the key was released. When redialing, the tone duration and intertone pause are internally set at 100 ms and 105 ms, respectively. Detailed timing diagrams of the tone modes are shown in Figures 4-(a) and (b). |

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Pin Description (Continued)

| Pin No. | Symbol | I/O | Description |
|---------|--------------------------|-----|--|
| 12 | KEY TONE | O | The key tone is from a conventional CMOS inverter. An NPN transistor is needed to drive the piezo. The output frequency is 1.2 KHz. No matter whether it is in DTMF or Pulse mode, the key tone will be accurate for any keypad entry (including row 5 and column 4) that is detected and will cease when the button is released. There will be no key tone output when two or more buttons on the keyboard are pushed simultaneously. |
| 13 | XMUTE | O | The XMUTE is a conventional CMOS inverter. An NPN transistor is used to turn off the LED. In the DTMF mode, output is actuated for the duration of DTMF signal transmission. But output remains low in pulse mode. In addition to controlling LED indication, it can also be used for muting operation in the Tone mode. |
| 14 | MODE SELECT | I | Pulls Pin 14 to V_{DD} when the dialer is in Pulse mode. Otherwise, it is in DTMF mode. |
| 15 | $\overline{\text{TEST}}$ | I | In normal operation, the $\overline{\text{TEST}}$ pin is tied to V_{DD} , the single tone is inhibited and the pulse rate is 10 pps. During testing, the $\overline{\text{TEST}}$ pin is tied to ground, a single tone can be created by the method shown in Table 1, and all of the time parameters for pulse dialing are 60 times faster. |
| 16 | M/B | I | The Make/Break ratio is 2/3, if M/B = 1 and is 1/2 if M/B = 0. This pin influences nothing in the DTMF mode. |
| 17 5 | V_{DD} V_{SS} | | Power supply pins. Operating voltage range: 2.0V ~ 5.5V |

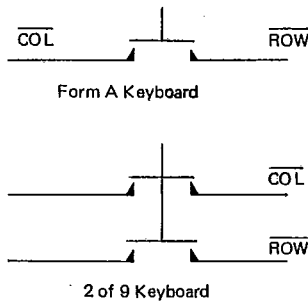


Figure 1. KEYBOARD CONFIGURATIONS

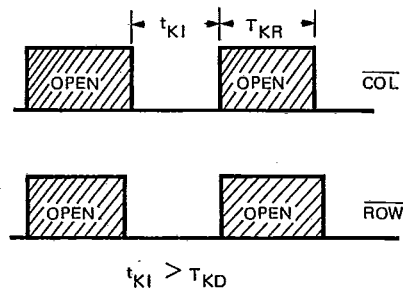


Figure 2. ELECTRONIC INPUTS



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Table 1. Address Keypad Truth Table

| Output | | Active Low Inputs | | Output Tone (Pin 11) Pulse (Pin 10) |
|-----------------------|--------------------------|---------------------|----------------------|---|
| | | ROW (Pins 18-21) | COLUMN (Pins 1-3) | |
| Tone (Pin 14 = 0) | Normal (Pin 15 = 1) | One | One | Dual Tone |
| | | Two or more | One | Pin 11 = 0 |
| | | One | Two or more | |
| | | Two or more | Two or more | |
| | Single Tone (Pin 15 = 0) | One | One | Dual Tone |
| | | Two or more | One | Column Tone |
| | | One | Two or more | Row Tone |
| | | Two or more | Two or more | Pin 11 = 0 |
| Pulse (Pin 14 = 1) | 10 pps (Pin 15 = 1) | One | One | 10 pps |
| | | Two or more | One | Pin 10 = 1 |
| | | One | Two or more | |
| | | Two or more | Two or more | |
| Pulse (Pin 14 = 1) | 600 pps (Pin 15 = 0) | One | One | 600 pps |
| | | Two or more | One | Pin 10 = 1 |
| | | One | Two or more | |
| | | Two or more | Two or more | |

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- Note 1: In pulse mode, Pin 10 = 1 for * and # buttons.
 Note 2: In pulse mode, Pin 11 always equals 0. In DTMF mode, Pin 10 always equals 1.
 Note 3: Pin 10 = 1, Pin 11 = 0 for any button in Row 5 and Column 4, regardless of mode.

Operational Procedures

Symbol definitions

- a. Dp: Pulse digit, 0, 1, 2, 3, 4, 5, 6, 7, 8, 9
- b. Dt: Tone digit, 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, *, #
- c. LOC_i: Location i, i = 0, 1, 2, 3, 4, 5, 6, 7, 8, 9
- d. ZiZiZi: conversation
- e. 0-0 ↓: ON-HOOK
- f. 0-0 ↑: OFF-HOOK
- g. P: Pause Key
- h. A/L: Auto-Dial/Location Key
- i. R: Redially Key.
- j. Emi: Emergency key i = 1, 2, 3.
- k. S: Store key
- l. LDC: Long Distance Call Key.

A. Normal dialing

- 1. Pulse mode

- 0-0 ↑, DpDp... ZiZiZi 0-0 ↓
- 2. Tone mode
- 0-0 ↑, DtDt... ZiZiZi 0-0 ↓

B. Redialing

- 0-0 ↑ DpDp... 0-0 ↓ 0-0 ↑
- R, ZiZiZi: 0-0 ↓
- 0-0 ↑ DtDt... 0-0 ↓ 0-0 ↑
- R, ZiZiZi: 0-0 ↓

C. Storing

- S, Dx Dx Dx... S, LOC i,

D. Memory dialing

- 0-0 ↑ A/L, LOC_i, ZiZiZi, 0-0 ↓

E. Pause Key Operation

- 1. Storing with pause
- S, Dx Dx Dx... P, Dx Dx Dx... S, LOC_i



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2. Dialing with Pause

0-0 ↑ A/L, LOCi, ZiZiZi, 0-0 ↓

Note: Every pause occupies one digit. Pause digit can be stored many times.

F. Emergency dialing

1. Storing emergency numbers.

S, Dx Dx Dx , S, Emi

2. Emergency dialing

0-0 ↑, Emi, ZiZiZi, 0-0 ↓

G. Long distance service memory dialing

The UM91265 provides a special memory location for storing a long distance service company access code. It also provides an automatic switching function which

changes from Pulse mode to Tone mode after a pause. This function makes it easier for a subscriber to use a long distance service company (such as MCI or SPRINT) without confusing the Pulse/Tone switching operation.

1. Storing the long distance service company code, to LDC memory.

S, Dx Dx Dx , P, P, Dx Dx Dx S, LDC

Two Pause Authorized Access codes.

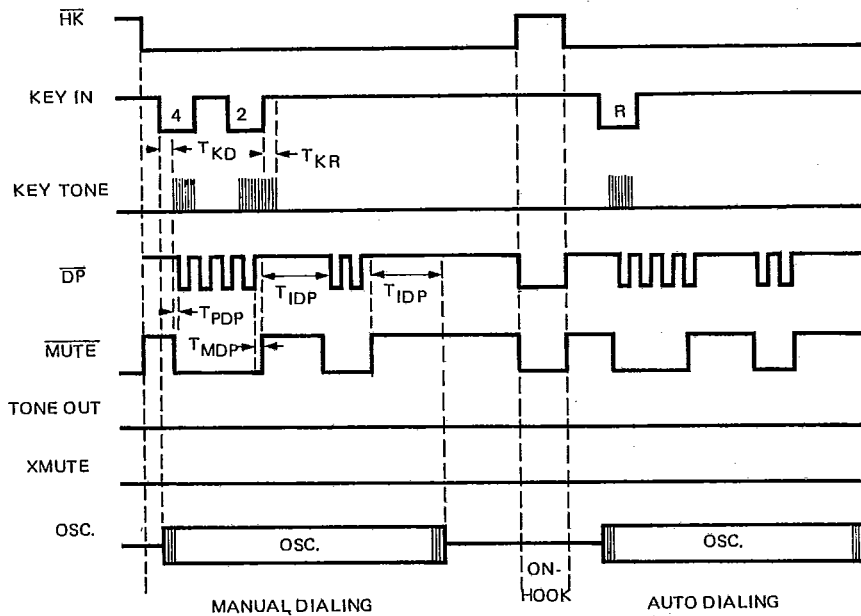
2. LDC dialing

0-0 ↑, LDC, ZiZiZi 0-0 ↓

Note: The chip will automatically switch to tone mode after the two pause duration (6.2ms) even if the Authorized Access Codes you Store are pulse codes.

Timing Waveforms

(1) PULSE MODE TIMING



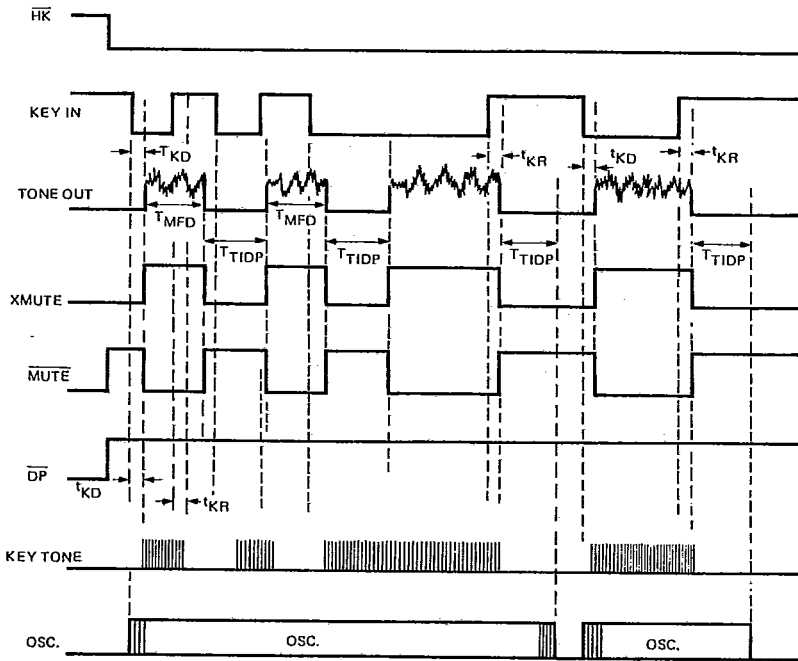


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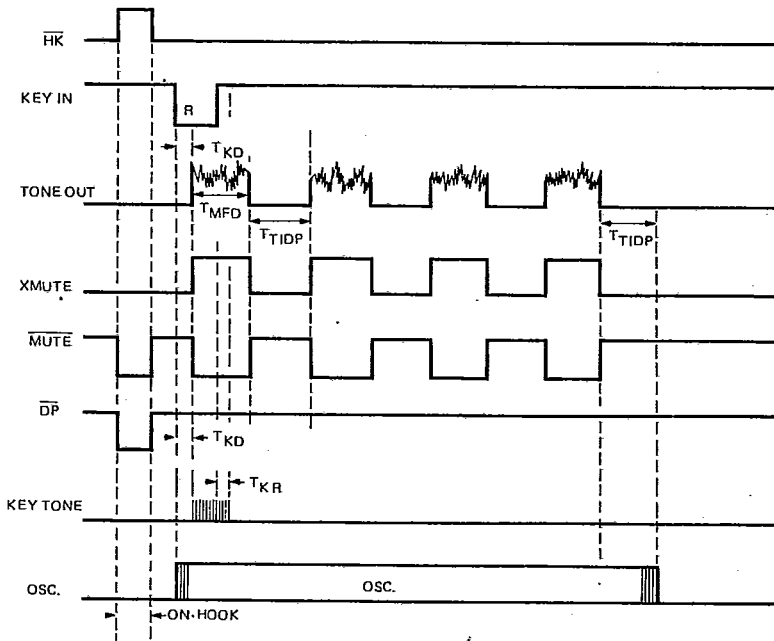
(2) TONE MODE TIMING

(a) NORMAL



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(b) REDIALING

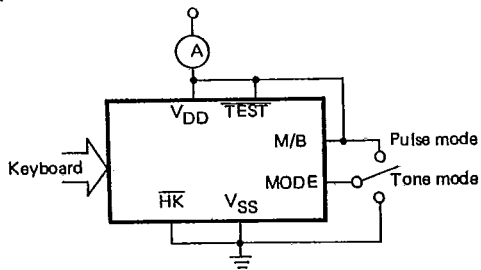




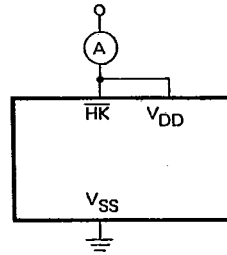
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Test Circuits

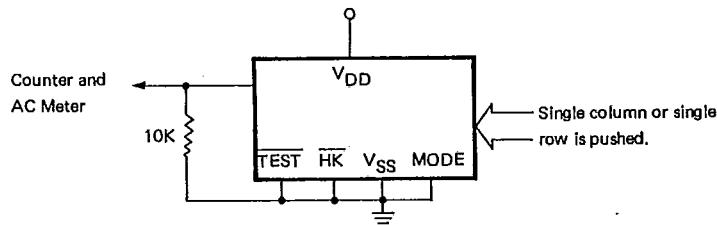
1.



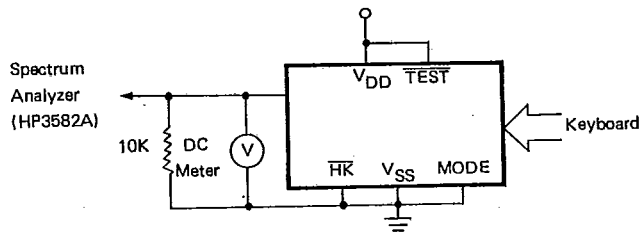
2.



3.



4.



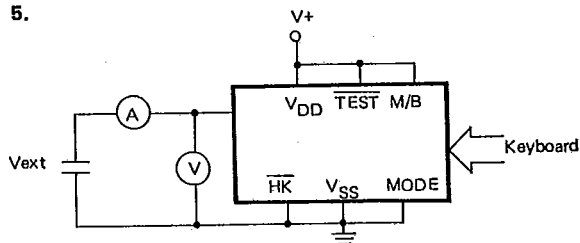
$$DIST_{db} = 20 \log \frac{\sqrt{(V_1)^2 + (V_2)^2 + \dots + (V_n)^2}}{\sqrt{(V_L)^2 + (V_H)^2}}$$

* $V_1 \dots V_n$ are extraneous frequency (i. e. intermodulation and harmonic) components in the 500HZ to 3400HZ band.

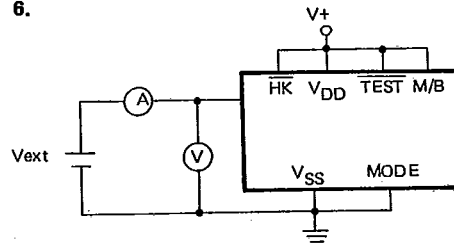
* V_L, V_H are the individual frequency components of the DTMF signal.

Note: Whether keyboard is pushed, refer to the DTMF mode timing diagram.

5.



6.



Note: Whether keyboard is pushed, refer to the DTMF mode timing diagram.

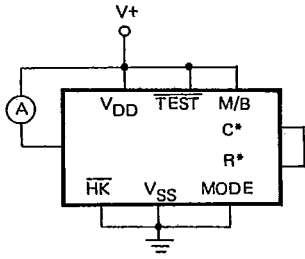
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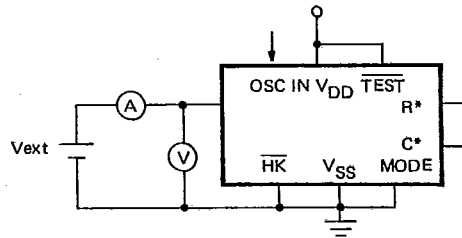
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7.



R*: any row of R1 - R6
 C*: any column of C1 - C4
 $I_{sink} = I / (1 - \text{Duty Cycle})$
 I is the net dc current.

8.



Procedure:
 1 Provide clocks until output changes to high.
 2 Test the current.
 Note: $\overline{\text{TEST}}$ pin can be combined with V_{SS} in order to speed up testing.