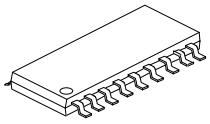
# TONE/PULSE DIALER WITH REDIAL FUNCTION



SOP-18

## ■ DESCRIPTION

The UTC **U9131X** series are monolithic ICs that offer the dialing signals in either pulse or tone mode. The UTC **U9131X** series feature a redial memory.

## ■ FEATURES

* Uses 4×4 keyboard
* Pulse-to-tone (P→T) keypad for long distance call operation
* Easy operation with redial, flash, pause, and P→T keypads
* 32 digits for redial memory
* Flash, Pause, P→T (pulse-to-tone) can be stored as a digit in memory
* Switchable dialing mode：DTMF/Pulse
* Switchable beak/make ratio
* Minimum tone output duration: 100mS
* Minimum intertone pause: 100mS
* On-chip power-on reset
* Uses 3.579545MHz crystal or ceramic resonator

## ■ ORDERING INFORMATION

| Ordering Number | | Package | Packing |
|---|---|---|---|
| Lead Free | Halogen Free | | |
| U9131XL-S18-T | U9131XG-S18-T | SOP-18 | Tube |
| U9131XL-S18-R | U9131XG-S18-R | SOP-18 | Tape Reel |
| U9131XAL-S18-T | U9131XAG-S18-T | SOP-18 | Tube |
| U9131XAL-S18-R | U9131XAG-S18-R | SOP-18 | Tape Reel |

U9131XAL-S18-T

(1)Packing Type
(2)Package Type
(3)Lead Free
(4)Dialer Type

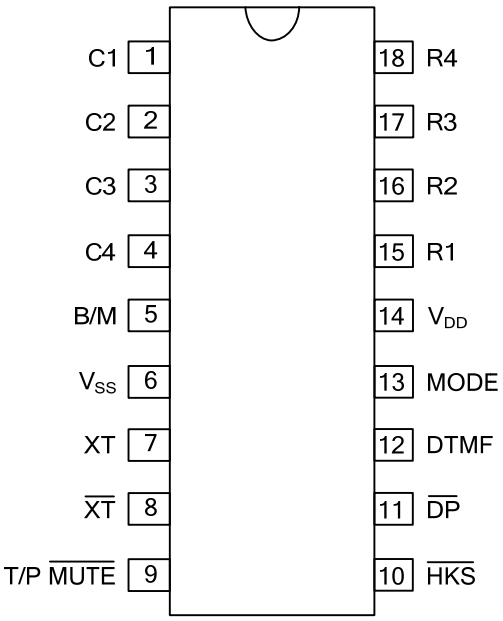
(1) T: Tube, R: Tape Reel
(2) S18: SOP-18
(3) L: Lead Free, G: Halogen Free
(4) refer to DIALER TYPE

## ■ DIALER TYPE

The different dialers in the UTC **U9131X** series are shown in the following table:

| TYPE NO. | PULSE (ppS) | FLASH (mS) | FLASH PAUSE (mS) | PAUSE (S) |
|---|---|---|---|---|
| U91312 | 10/20 | 600 | 600 | 2.0 |
| U91314 | 10/20 | 73 | 140 | 3.6 |
| U91316 | 10/20 | 600 | 600 | 3.6 |
| U91312A | 10/20 | 300 | 300 | 2.0 |
| U91314A | 10/20 | 100 | 100 | 3.6 |

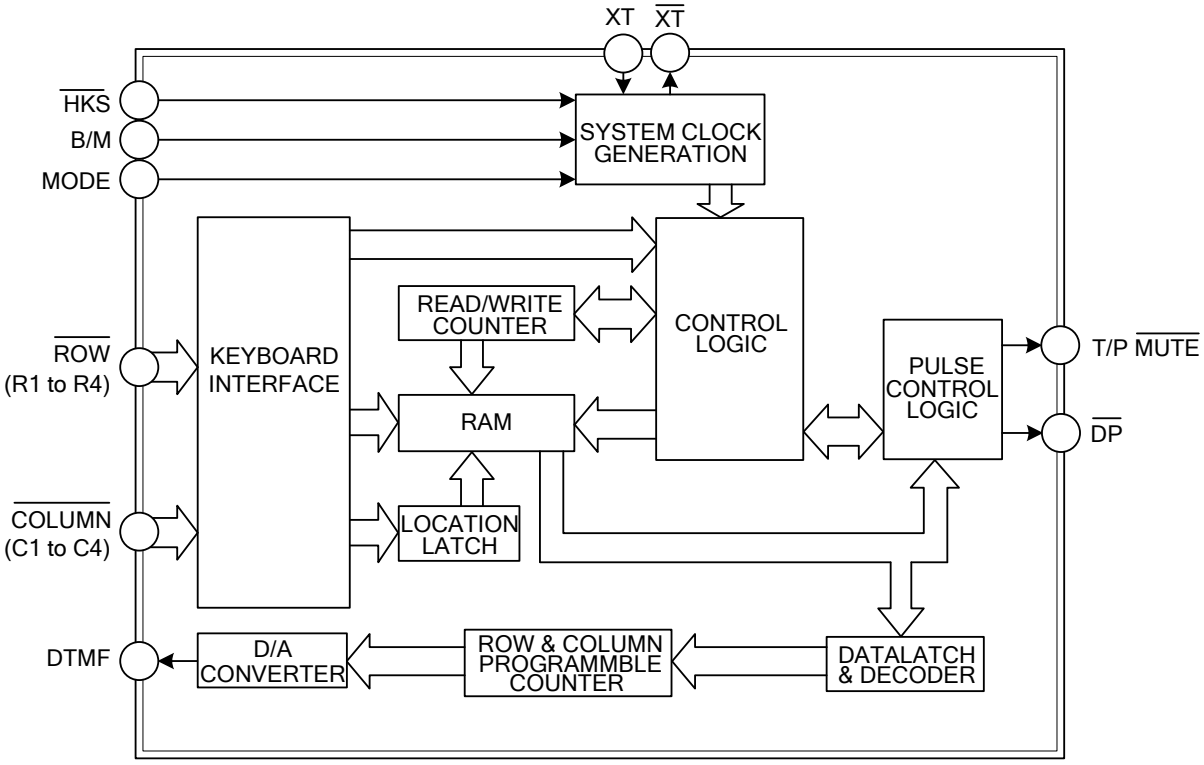
## ■ PIN CONFIGURATION




## ■ PIN DESCRIPTION

<table>
<tr><th>PIN NO.</th><th>PIN NAME</th><th>DESCRIPTION</th></tr>
<tr><td>1-4 &<br>15-18</td><td>Column-Row Inputs</td><td>The keyboard input may be from either the standard 4×4 keyboard or an inexpensive single contact (from A) keyboard. Electronic input from a µC can also be used. A valid key entry is defined as a single row being connected to a single column.</td></tr>
<tr><td>5</td><td>B/M</td><td>The break make ratio is 60:40 if B/M=1 and is 66.6:33.3 if B/M=0. This pin has no function in DTMF mode.</td></tr>
<tr><td>7, 8</td><td>XT, $\overline{XT}$</td><td>A built-in inverter provides oscillation with an inexpensive 3.579545MHz crystal or ceramic resonator.</td></tr>
<tr><td>9</td><td>T/P $\overline{MUTE}$</td><td>The T/P $\overline{MUTE}$ is a conventional CMOS N-channel open drain output. The output transistor is switched on during pulse and tone mode dialing sequence and flash break. Otherwise, it is switched off.</td></tr>
<tr><td>13</td><td>MODE</td><td>Pulling mode pin to $V_{SS}$ places the dialer in tone mode. Pulling mode pin to $V_{DD}$ places the dialer in pulse mode (10ppS). Leaving mode pin floating places the dialer in pulse mode (20ppS).</td></tr>
<tr><td>10</td><td>$\overline{HKS}$</td><td>Hook switch input. $\overline{HKS}$=1: On-book state. Chip in sleeping mode, no operation. $\overline{HKS}$=0: Off-book state. Chip enabled for normal operation. The $\overline{HKS}$ pin is pulled to $V_{DD}$ by an internal resistor.</td></tr>
<tr><td>11</td><td>$\overline{DP}$</td><td>N-channel open drain dialing pulse output (Figure 1). Flash key will cause $\overline{DP}$ to go active in both pulse mode and tone mode.</td></tr>
<tr><td>12</td><td>DTMF</td><td>In pulse mode, remains in low state at all times. In tone mode, outputs a dual or single tone. Detailed timing diagram for tone mode is shown in Figure 2 (a, b).
<table>
<tr><th colspan="4">OUTPUT FREQUENCY</th></tr>
<tr><th></th><th>Specified</th><th>Actual</th><th>Error %</th></tr>
<tr><td>R1</td><td>697</td><td>699</td><td>+0.28</td></tr>
<tr><td>R2</td><td>770</td><td>766</td><td>-0.52</td></tr>
<tr><td>R3</td><td>852</td><td>848</td><td>-0.47</td></tr>
<tr><td>R4</td><td>941</td><td>948</td><td>+0.74</td></tr>
<tr><td>C1</td><td>1209</td><td>1216</td><td>+0.57</td></tr>
<tr><td>C2</td><td>1336</td><td>1332</td><td>-0.30</td></tr>
<tr><td>C3</td><td>1477</td><td>1472</td><td>-0.34</td></tr>
</table></td></tr>
<tr><td>14, 6</td><td>$V_{DD}$, $V_{SS}$</td><td>Power input pins.</td></tr>
</table>

■ BLOCK DIAGRAM



## ■ ABSOLUTE MAXIMUM RATING

| PARAMETER | SYMBOL | RATINGS | UNIT |
|---|---|---|---|
| DC Supply Voltage | $V_{DD}$-$V_{SS}$ | -0.3~+7.0 | V |
| Input/Output Voltage | $V_{IL}$ | $V_{SS}$-0.3 | V |
| | $V_{IH}$ | $V_{DD}$+0.3 | V |
| | $V_{OL}$ | $V_{SS}$-0.3 | V |
| | $V_{OH}$ | $V_{DD}$+0.3 | V |
| Power Dissipation | $P_D$ | 120 | mW |
| Operating Temperature | $T_{OPR}$ | -20~+70 | °C |
| Storage Temperature | $T_{STG}$ | -55~+125 | °C |

Note: Absolute maximum ratings are those values beyond which the device could be permanently damaged. Absolute maximum ratings are stress ratings only and functional device operation is not implied.

## ■ DC CHARACTERISTICS ($V_{DD}$-$V_{SS}$=2.5V, $F_{OSC.}$=3.58MHz, $T_A$=25°C, all outputs unloaded)

| PARAMETER | SYMBOL | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|
| Operating Voltage | $V_{DD}$ | | 2.0 | | 5.5 | V |
| Operating Current | $I_{OP}$ | Tone | | 0.3 | 0.5 | mA |
| | | Pulse | | 0.15 | 0.3 | mA |
| Standby Current | $I_{SB}$ | $\overline{HKS}$=0, No load, & No key entry | | | 15 | μA |
| Memory Retention Current | $I_{MR}$ | $\overline{HKS}$=1, $V_{DD}$=1.0V | | | 0.2 | μA |
| DTMF Output Voltage | $V_{TO}$ | Row group, $R_L$=5KΩ | 130 | 150 | 170 | mVrms |
| Pre-emphasis | | Col/Row, $V_{DD}$=2.0~5.5V | 1 | 2 | 3 | dB |
| DTMF Distortion | $T_{HD}$ | $R_L$=5KΩ, $V_{DD}$=2.0~5.5V | | -30 | -23 | dB |
| DTMF Output DC Level | $V_{TDC}$ | $R_L$=5KΩ, $V_{DD}$=2.0~5.5V | 1.0 | | 3.0 | V |
| DTMF Output Sink Current | $I_{TL}$ | $V_{TO}$=0.5V | 0.2 | | | mA |
| $\overline{DP}$ Output Sink Current | $I_{PL}$ | $V_{PO}$=0.5V | 0.5 | | | mA |
| T/P $\overline{MUTE}$ Output Sink Current | $I_{ML}$ | $V_{MO}$=0.5V | 0.5 | | | mA |
| $\overline{HKS}$ I/P Pull-high Resistor | $R_{KH}$ | | | 300 | | KΩ |
| Keypad Input Drive Current | $I_{KD}$ | $V_I$=0V | 30 | | | μA |
| Keypad Input Sink Current | $I_{KS}$ | $V_I$=2.5V | 200 | 400 | | μA |
| Keypad Resistance | | | | | 5.0 | KΩ |

## ■ AC CHARACTERISTICS

| PARAMETER | SYMBOL | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|
| Keypad Active in Debounce | $T_{KID}$ | | | 20 | | mS |
| Key Release Debounce | $T_{KRD}$ | | | 20 | | mS |
| Pre-digit Pause (Note 1) | $T_{PDP}1$ | B/M=1 | | 40 | | mS |
| | 10ppS | B/M=0 | | 33.3 | | |
| Pre-digit Pause (Note 2) | $T_{PDP}2$ | B/M=1 | | 20 | | mS |
| | 20ppS | B/M=0 | | 16.7 | | |
| Interdigit Pause (Auto dialing) | $T_{IDP}$ | 10ppS | | 800 | | mS |
| | | 20ppS | | 500 | | |
| Make/Break Ratio | M/B | B/M=1 | | 40:60 | | % |
| | | B/M=0 | | 33:67 | | |
| DTMF Output Duration | $T_{TD}$ | Auto Dialing | | 100 | | mS |
| Intertone Pause | $T_{ITP}$ | Auto Dialing | | 100 | | mS |
| Flash Break Time | $T_{FB}$ | U91314 | | 73 | | mS |
| | | U91314A | | 100 | | |
| | | U91312A | | 300 | | |
| | | U91312/U91316 | | 600 | | |
| Flash Pause Time | $T_{FP}$ | U91314A | | 100 | | mS |
| | | U91314 | | 140 | | |
| | | U91312A | | 300 | | |
| | | U91312/U91316 | | 600 | | |
| Pause Time | $T_P$ | U91312 | | 2.0 | | S |
| | | U91314/A/U91316 | | 3.6 | | |

Notes: 1. Crystal parameters suggested for proper operation are Rs<100Ω, Lm=96mH, Cm=0.02pF, Cn=5pF, $C_l$=18pF, $F_{OSC}$=3.579545MHz ± 0.02%.
2. Crystal oscillator accuracy directly affects these times.

## ■ FUNCTIONAL DESCRIPTION

### Keyboard Operation

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

* R/P：Redial and pause function key
* F：Flash key
* P→T：Pulse mode to tone mode

### Normal Dialin

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.

### Redialing

OFF HOOK, D1 , D2 , … , Dn BUSY, COME ON HOOK , OFF HOOK , R/P

The RP Key can execute redial function only as the first key-in after off-hook; otherwise, it will execute pause function.

### 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 or memory dialing.
3. The pause function timing diagram is shown in Figure 3.

### Pulse-To-Tone (P→T)

OFF HOOK, D1 , D2 , … , Dn , R→T , D1’ , D2’ , … , Dn’

1. If the mode switch is set to pulse mode, then the output signal will be:
   D1, D2, …, Dn, Pause, D1’, D2’, …, Dn’
   (Pulse) (Tone)
2. If the mode switch is set to tone mode, then the output signal will be:
   D1, D2, …, Dn, P→T D1’, D2’, …, Dn’
   (Pulse) (Pause) (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.
4. The P→T function timing diagram is shown in Figure 4.

### Flash

OFF HOOK , F

1. Flash key can be stored as a digit in memory.
2. The system will return to the initial state after the break time is finished.
3. The flash function timing diagram is shown in Figure 5.

## ■ TIMING WAVEFORMS

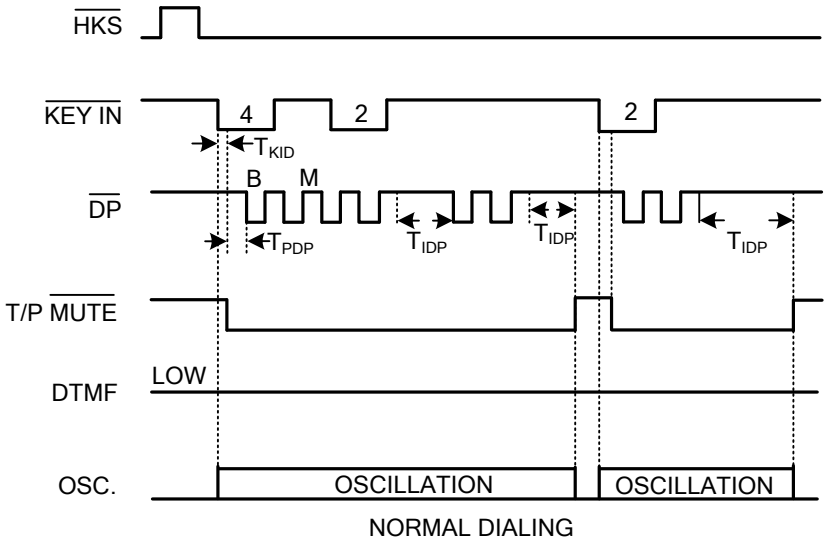



**Fig 1 (a). Pulse Mode Timing Diagram**

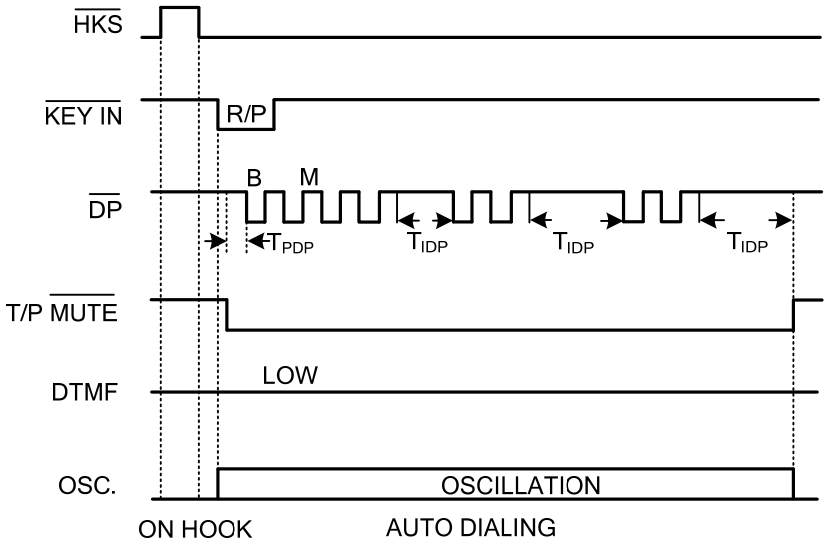



**Fig. 1 (b). Pulse Mode Timing Diagram**

■ TIMING WAVEFORMS(Cont.)

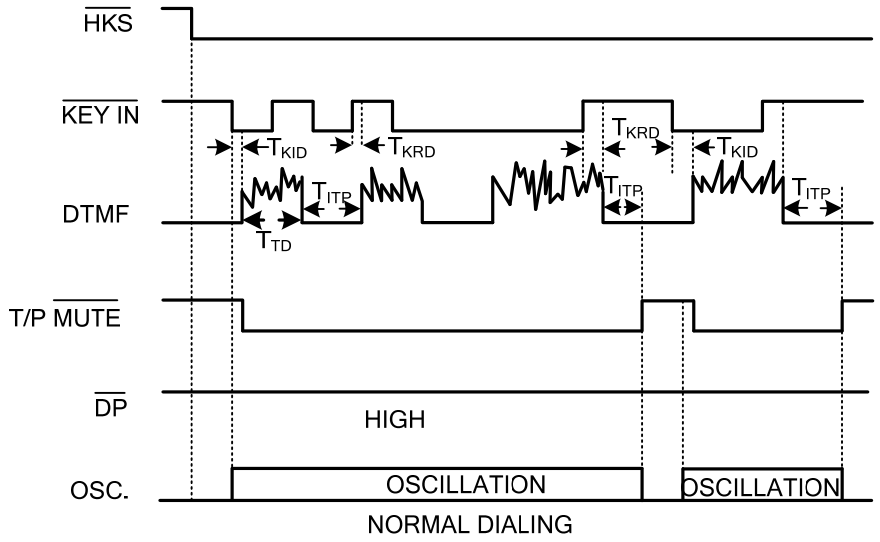



**Fig. 2 (a). Tone Mode Timing Diagram**

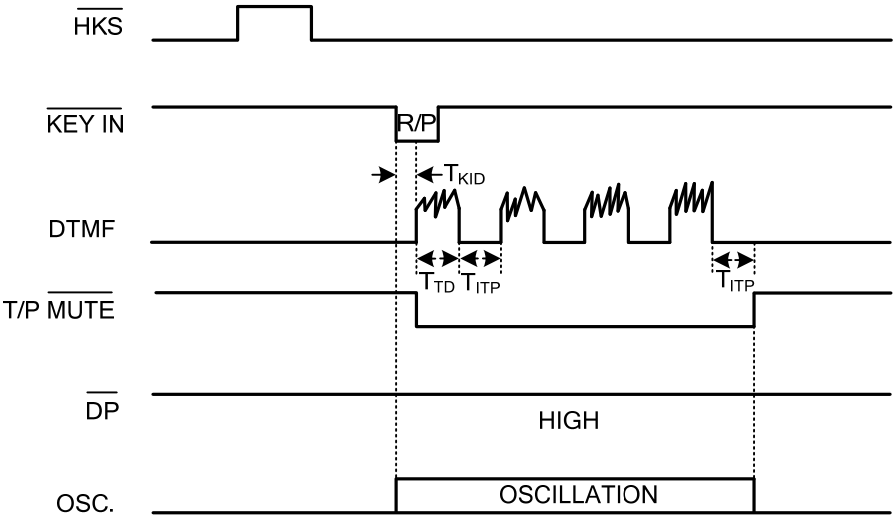



**Fig. 2 (b). Tone Mode Auto Dialing Timing Diagram**

■ TIMING WAVEFORMS(Cont.)

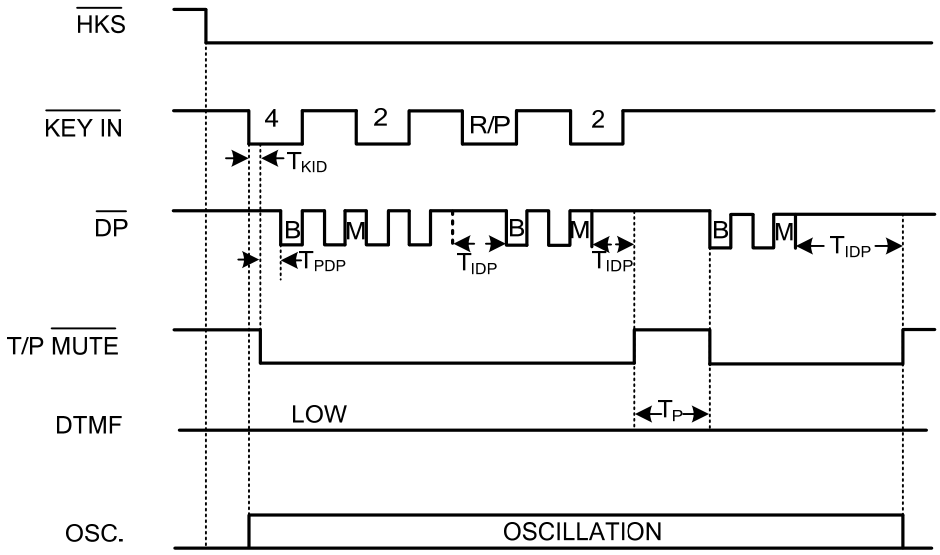



**Fig. 3 Pulse Function Timing Diagram**

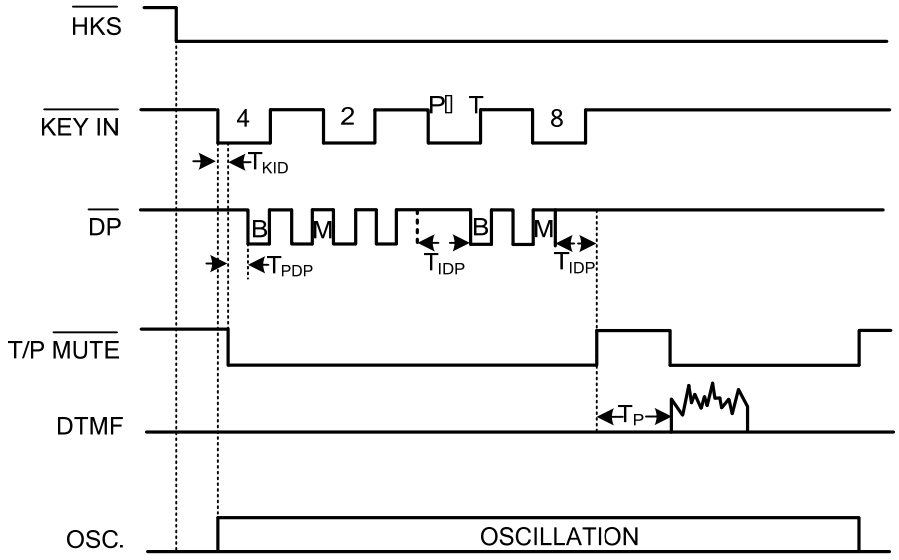



**Fig. 4 Pulse-to-tone Function Timing Diagram**

■ TIMING WAVEFORMS(Cont.)

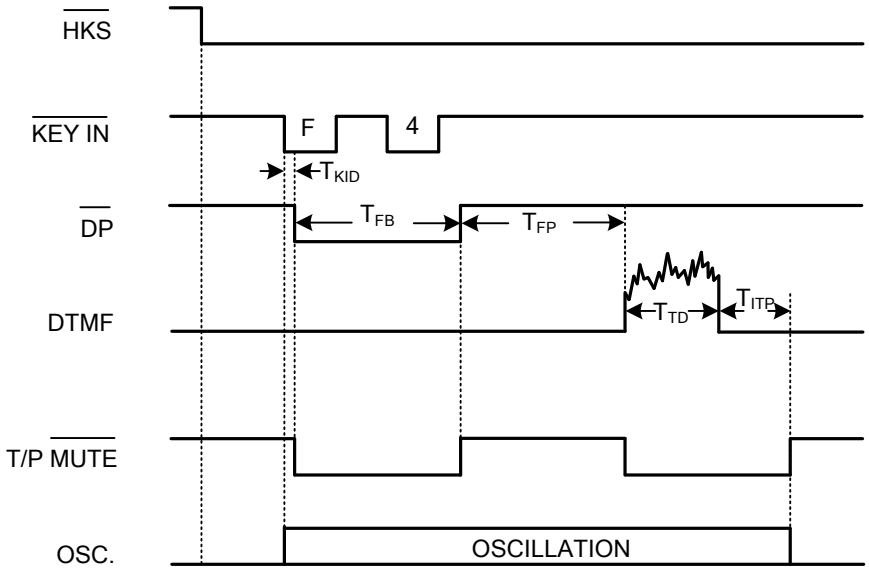



**Fig. 5 Flash Function Timing Diagram**

## ■ TYPICAL APPLICATION CIRCUIT