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Winbond Electronics Corp.

# 6-MEMORY TONE/PULSE DIALER WITH SAVE AND HANDFREE FUNCTIONS

## GENERAL DESCRIPTION

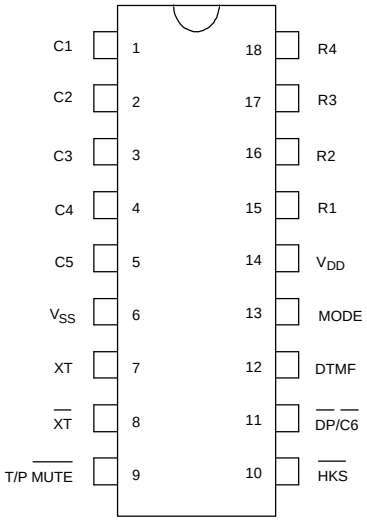
The W91472N series are tone/pulse switchable telephone dialers with five memories, save memory, and handfree dialing control. These chips are fabricated using Winbond's high-performance CMOS technology and thus offer good performance in low-voltage and low-power operations.

## FEATURES

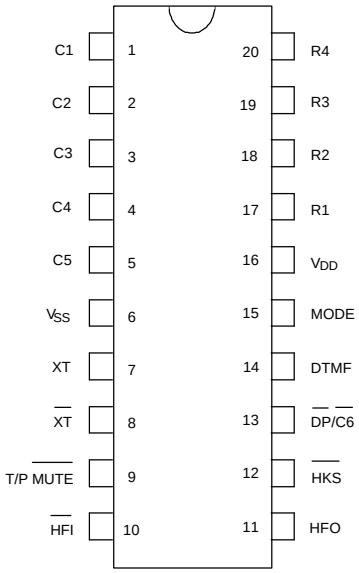
- DTMF/pulse switchable dialer
- Two by 32 digit redial and save memory
- Five by 16 digit one-touch direct repertory memory
- Pulse-to-tone (*/T) keypad for long distance call operation
- Cascaded dialing
- Uses 5 × 6 keyboard
- Easy operation with redial, flash, pause, and */T keypads
- Pause, P→T (pulse-to-tone) can be stored as a digit in memory
- Dialing rate (10 ppS or 20 ppS) selectable by bonding option
- On-hook debounce time: 150 mS
- Minimum tone output duration: 93 mS
- Minimum intertone pause: 93 mS
- Pause time: 3.6 sec.
- Flash break time (73 mS, 100 mS, 300 mS, or 600 mS) selectable by keypad; pause time is 1.0S
- Make/break ratio (40:60 or 33.3:66.7) selectable by MODE pin
- On-chip power-on reset
- Uses 3.579545 MHz crystal or ceramic resonator
- 18 or 20-pin dual-in-line plastic package
- The different dialers in the W91472N series are shown in the following table:

| TYPE NO. | REPLACEMENT TYPE NO. | PULSE (ppS) | FLASH (mS) | M/B | KEY TONE | HANDFREE DIALING | PACKAGE (PINS) |
|---|---|---|---|---|---|---|---|
| W91472N | W91472 | 10 | 600/300/73/100 | Pin | - | - | 18 |
| W91472AN | W91472A | 10 | 600/300/73/100 | Pin | Yes | Yes | 20 |
| W91472BN | W91472B | 20 | 600/300/73/100 | Pin | - | - | 18 |
| W91472CN | W91472C | 20 | 600/300/73/100 | Pin | Yes | Yes | 20 |

## PIN CONFIGURATIONS




W91472N/472BN




W91472AN/472CN

## PIN DESCRIPTION

| SYMBOL | 18-PIN | 20-PIN | I/O | FUNCTION |
|---|---|---|---|---|
| Column-Row Inputs | 1–5 & 15–18 | 1–5 & 17–20 | I | The keyboard input is compatible with a standard 5 x 6 keyboard, an inexpensive single contact (Form A) keyboard, and electronic input.<br>In normal operation, any single button can be pushed to produce dual tone, pulses, or function. Activation of two or more buttons will result in no response except for single tone. |
| XT | 7 | 7 | I | A built-in inverter provides oscillation with an inexpensive 3.579545 MHz crystal. The oscillator ceases when a keypad input is not sensed. The crystal frequency deviation is 0.02%. |
| $\overline{XT}$ | 8 | 8 | O | Crystal oscillator output pin. |
| T/P $\overline{MUTE}$ | 9 | 9 | O | The T/P $\overline{MUTE}$ is a conventional CMOS N-channel open drain output.<br>The output transistor is switched on low level during dialing sequence (both pulse and tone mode). Otherwise, it is switched off. |

Pin Description, continued

| SYMBOL | 18-PIN | 20-PIN | I/O | FUNCTION |
|---|---|---|---|---|
| MODE | 13 | 15 | I | Pulling mode pin to VSS places dialer in tone mode.<br>Pulling mode pin to VDD places dialer in pulse mode with M/B ratio of 40:60 (10 ppS, except for 91472BN/472CN = 20 ppS).<br>Leaving mode pin floating places dialer in pulse mode with M/B ratio of 33.3:66.7 (10 ppS, except for W91472BN/472CN = 20 ppS). |
| $\overline{HKS}$ | 10 | 12 | I | The $\overline{HKS}$ input is used to sense whether the handset is on-hook or off-hook.<br>In on-hook state, $\overline{HKS}$ = 1: chip is in sleeping mode, no operation.<br>In off-hook state, $\overline{HKS}$ = 0: chip is enabled for normal operation.<br>$\overline{HKS}$ pin is pulled to VDD by internal resistor. |
| $\overline{DP}$ / $\overline{C6}$ | 11 | 13 | O | N-channel open drain dialing pulse output.<br>Flash key will cause $\overline{DP}$ to be active in either tone mode or pulse mode.<br>The timing diagram for pulse mode is shown in Figure 1 (a, b, c, d). |
| DTMF | 12 | 14 | O | During pulse dialing, this pin remains in low state regardless of keypad input. In the tone mode, it will output a dual or single tone.<br>A detailed timing diagram for tone mode is shown in Figure 2 (a, b, c, d). |
| VDD, VSS | 14, 6 | 16, 6 | I | Power input pins for the dialer chip. VDD is the main power and VSS is the ground. |

**OUTPUT FREQUENCY**

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

Pin Description, continued

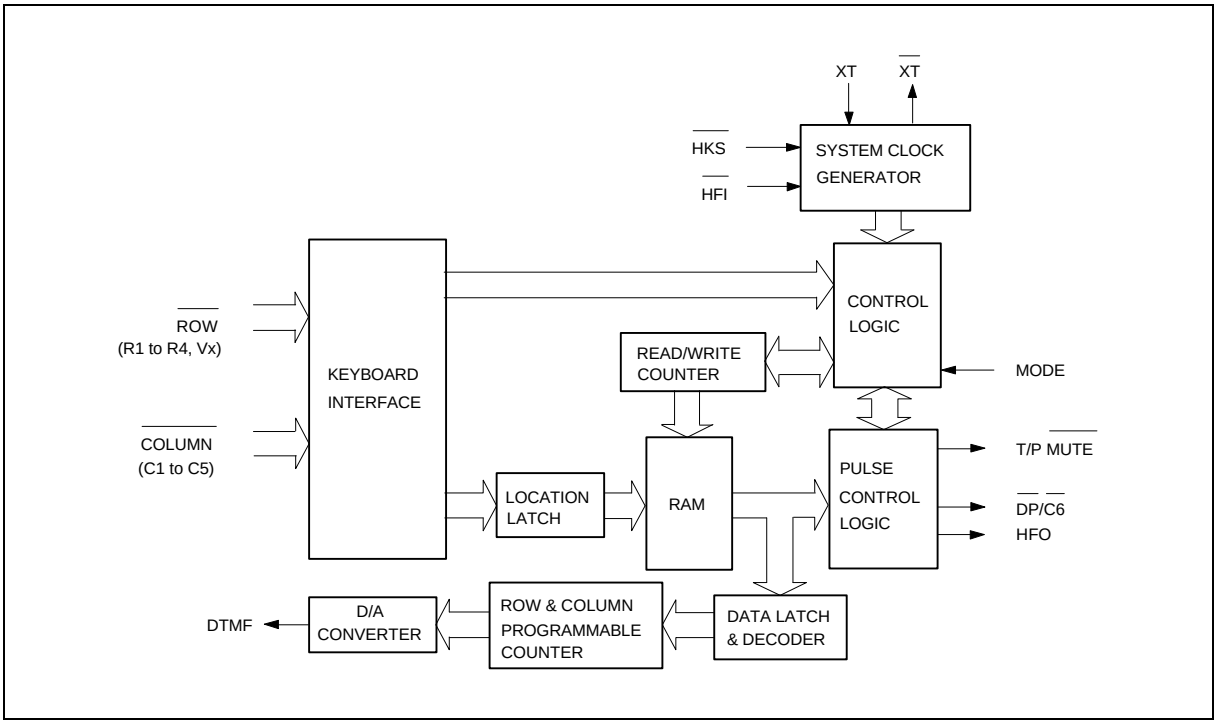
| SYMBOL | 18-PIN | 20-PIN | I/O | FUNCTION |
|---|---|---|---|---|
| $\overline{HFI}$, HFO | - | 10, 11 | I, O | Handfree control pins.<br>A low pulse on the $\overline{HFI}$ input pin toggles the handfree control state.<br>Status of the handfree control state is listed in the following table: |

| CURRENT STATE | | NEXT STATE | | |
|---|---|---|---|---|
| HOOK SW. | HFO | INPUT | HFO | DIALING |
| - | Low | $\overline{HFI}$ ↓ | High | Yes |
| On Hook | High | $\overline{HFI}$ ↓ | Low | No |
| Off Hook | High | $\overline{HFI}$ ↓ | Low | Yes |
| On Hook | - | Off Hook | Low | Yes |
| Off Hook | Low | On Hook | Low | No |
| Off Hook | High | On Hook | High | Yes |

$\overline{HFI}$ pin is pulled to $V_{DD}$ by an internal resistor.

Detailed timing diagram is shown in Figure 3.

## BLOCK DIAGRAM



## FUNCTIONAL DESCRIPTION

| C1 | C2 | C3 | C4 | $\overline{DP}$/ $\overline{C6}$ | C5 | |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | S | M1 | M4 | R1 |
| 4 | 5 | 6 | F4 | M2 | M5 | R2 |
| 7 | 8 | 9 | | M3 | | R3 |
| */T | 0 | # | R/P | SAVE | | R4 |
| F1 | F2 | F3 | | | | Vx |

- S: Store function key
- R/P: Redial and pause function key
- */T: * in tone mode and P→T key in pulse mode
- SAVE: Save function key for one-touch 32-digit memory
- M1, ..., M5: One-touch memory
- F1, ..., F4: Flash function keys: F1 = 600 mS, F2 = 300 mS, F3 = 73 mS, F4 = 100 mS, and all flash pause time is 1.0 mS

Note: Mn = M1 , ..., M5; Dn = 0, ..., 9, */T, #, Pause.

### Normal Dialing

OFF HOOK (or ON HOOK & $\overline{HFI}$ ), D1 , D2 , ..., Dn

1. D1, D2, ..., Dn will be dialed out.
2. Dialing length is unlimited, but redial is inhibited if length exceeds 32 digits in nomal dialing.

### Redialing

OFF HOOK (or ON HOOK & $\overline{HFI}$ ), D1 , D2 , ..., Dn Busy, Come

ON HOOK , OFF HOOK (or ON HOOK & $\overline{HFI}$ ), R/P

1. The redial memory content will be D1, D2, ..., Dn.
2. The R/P key can execute the redial function only as first key-in after off-hook. Otherwise, it will execute the pause function.

### Number Store

1. OFF HOOK (or ON HOOK & $\overline{\text{HFI}}$ ), D1 , D2 , ..., Dn , S , S , Mn

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

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

2. OFF HOOK (or ON HOOK & $\overline{\text{HFI}}$ ), S , D1 , D2 , ..., Dn , S , Mn

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

b. R/P and */T keys can be stored as a digit in memory, but R/P key cannot be the first digit. In store mode, R/P is the pause function key.

c. The store mode is released after the store function is executed or when the state of the hook switch changes or the flash function is executed.

### Save

1. OFF HOOK (or ON HOOK & $\overline{\text{HFI}}$ ), D1 , D2 , ..., Dn , SAVE

a. D1, D2, ..., Dn will be dialed out.

b. If the dialing D1 to Dn is finished, pressing SAVE will cause D1 to Dn to be of duplicated to save memory.

2. ON HOOK , OFF HOOK (or $\overline{\text{HFI}}$ ), SAVE

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

### Repertory Dialing

OFF HOOK (or ON HOOK & $\overline{\text{HFI}}$ ), Mn (or SAVE )

The content of memory location Mn (or save) will be dialed out.

### Access Pause

OFF HOOK (or ON HOOK & $\overline{\text{HFI}}$ ), D1 , D2 , R/P , D3 , ..., Dn

1. The pause function can be stored as a digit in memory.
2. The pause function is executed in normal dialing or redialing or memory dialing.
3. The pause function timing diagram is shown in Figure 4.

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

OFF HOOK (or ON HOOK & HFI ), D1 , D2 , ..., Dn , */T ,

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

1. If the mode switch is set to pulse mode, then the output signal will be:
   D1, D2, ..., Dn, Pause, D1', D2', ..., Dn'
   (Pulse) (Tone)
2. If the mode switch is set to tone mode, then the output signal will be:
   D1, D2, ..., Dn, * , D1', D2', ..., Dn'
   (Tone) (Tone)
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 function timing diagram is shown in Figure 5.

### Flash

OFF HOOK (or ON HOOK & HFI ), Fn

1. Fn = F1, ..., F4.
2. If Fn is pressed, the dialer will execute flash break time of 600 mS (F1), 300 mS (F2), 73 mS (F3), or 100 mS (F4). The pause time is 1.0 second.
3. Flash key cannot be stored as a digit in memory. The flash key has first priority among keyboard functions.
4. The system will return to the initial state after the flash pause time is finished.
5. The flash function timing diagram is shown in Figure 6.

### Cascaded Dialing

OFF HOOK (or ON HOOK & HFI ),

1. Normal dialing + Repertory dialing + Normal dialing
   (1st sequence) (2nd sequence)
2. Repertory dialing + Normal dialing + Repertory dialing
   (1st sequence) (2nd sequence)
3. Redialing + Normal dialing + Repertory dialing
   (1st sequence) (2nd sequence)

Redialing and save dialing is valid only as the first key-in.

## ABSOLUTE MAXIMUM RATINGS

| PARAMETER | SYMBOL | RATING | UNIT |
|---|---|---|---|
| DC Supply Voltage | $V_{DD}$–$V_{SS}$ | -0.3 to +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 to +70 | °C |
| Storage Temperature | $T_{STG}$ | -55 to +150 | °C |

Note: Exposure to conditions beyond those listed under Absolute Maximum Ratings may adversely affect the life and reliability of the device.

## DC CHARACTERISTICS

($V_{DD}$-$V_{SS}$ = 2.5V, Fosc. = 3.58 MHz, $T_A$ = 25° C, All outputs unloaded)

| PARAMETER | SYMBOL | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| Operating Voltage | $V_{DD}$ | - | 2.0 | - | 5.5 | V |
| Operating Current | $I_{OP}$ | Tone | - | 0.40 | 0.60 | mA |
| | | Pulse | - | 0.20 | 0.40 | 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 |
| Tone Output Voltage | $V_{TO}$ | Row group, $R_L$ = 5 KΩ | 130 | 150 | 170 | mVrms |
| Pre-emphasis | - | Col/Row, $V_{DD}$ = 2.0 to 5.5V | 1 | 2 | 3 | dB |
| DTMF Distortion | THD | $R_L$ = 5 KΩ, $V_{DD}$ = 2.0 to 5.5V | - | -30 | -23 | dB |
| DTMF Output DC Level | $V_{TDC}$ | $R_L$ = 5 KΩ, $V_{DD}$ = 2.0 to 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 |

DC Characteristics, continued

| PARAMETER | SYMBOL | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| T/P $\overline{\text{MUTE}}$ Output Sink Current | $I_{ML}$ | $V_{MO}$ = 0.5V | 0.5 | - | - | mA |
| HFO Drive/Sink Current | $I_{HFH}$ | $V_{HFH}$ = 2.0V | 0.5 | - | - | mA |
| | $I_{HFL}$ | $V_{HFL}$ = 0.5V | 0.5 | - | - | |
| Keypad Input Drive Current | $I_{KD}$ | $V_I$ = 0V | 4 | - | - | µA |
| Keypad Input Sink Current | $I_{KS}$ | $V_I$ = 2.5V | 200 | 400 | - | µA |
| Keypad Resistance | - | - | - | - | 5.0 | KΩ |

## AC CHARACTERISTICS

| PARAMETER | SYMBOL | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| Key-in Debounce | $T_{KID}$ | - | - | 20 | - | mS |
| Key Release Debounce | $T_{KRD}$ | - | - | 20 | - | mS |
| On-hook Debounce | $T_{OHD}$ | - | - | 150 | - | mS |
| Pre-digit Pause[1] | $T_{PDP1}$ | Mode Pin = $V_{DD}$ | - | 40 | - | mS |
| 10 ppS | | Mode Pin = Floating | - | 33.3 | - | mS |
| Pre-digit Pause[2] | $T_{PDP2}$ | Mode Pin = $V_{DD}$ | - | 20 | - | mS |
| 20 ppS | | Mode Pin = Floating | - | 16.7 | - | mS |
| Interdigit Pause | $T_{IDP}$ | 10 ppS | - | 800 | - | mS |
| (Auto dialing) | | 20 ppS | - | 500 | - | mS |
| Make/Break Ratio | M:B | Mode Pin = $V_{DD}$ | - | 40:60 | - | % |
| | | Mode Pin = Floating | - | 33.3:66.7 | - | % |
| Tone Output Duration | $T_{TD}$ | | - | 93 | - | mS |
| Intertone Pause | $T_{ITP}$ | | - | 93 | - | mS |
| Flash Break Time | $T_{FB}$ | F1 | - | 600 | - | mS |
| | | F2 | - | 300 | - | |
| | | F3 | - | 73 | - | |
| | | F4 | - | 100 | - | |
| Flash Pause Time | $T_{FP}$ | | - | 1.0 | - | S |
| Pause Time | $T_P$ | | - | 3.6 | - | S |

Notes:

1. Crystal parameters suggested for proper operation are Rs < 100 Ω, Lm = 96 mH, Cm = 0.02 pF, Cn = 5 pF, Cl = 18 pF, $F_{OSC.}$ = 3.579545 MHz ± 0.02%.

2. Crystal oscillator accuracy directly affects these times.

## TIMING WAVEFORMS

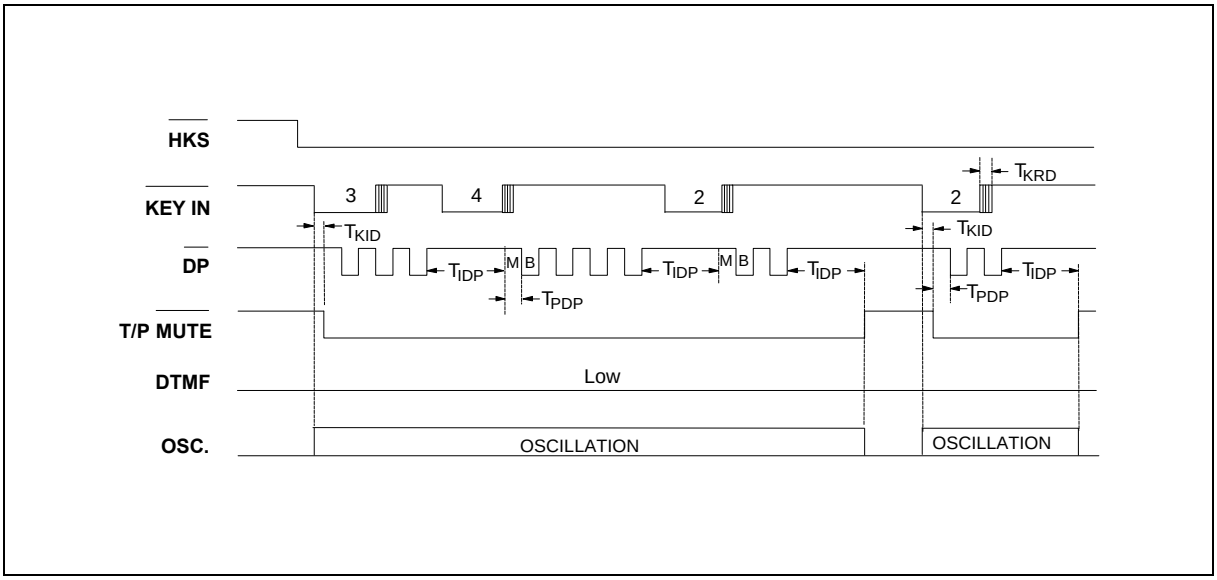



Figure 1(a). Normal Dialing Timing Diagram

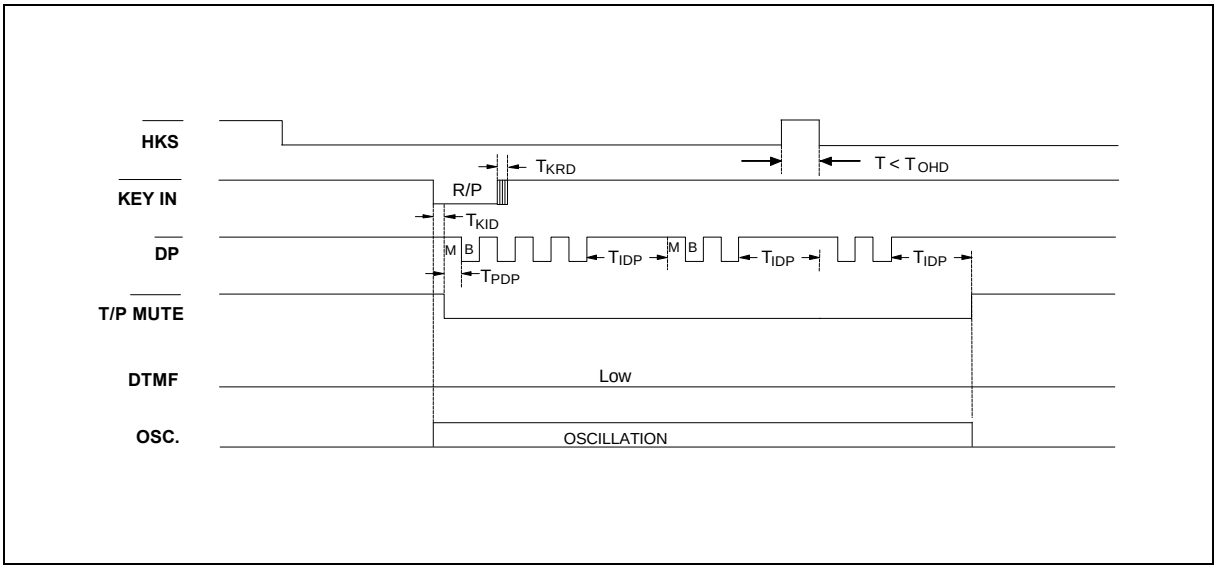



Figure 1(b). Pulse Mode Auto Dialing Timing Diagram

Timing Waveforms, continued

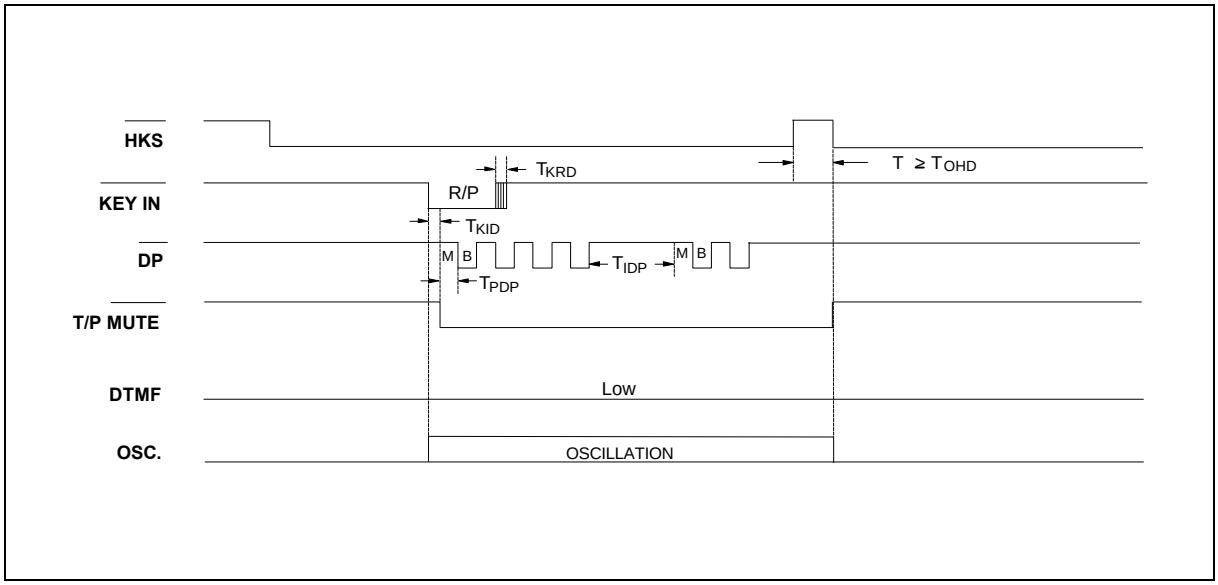



Figure 1(c). Pulse Mode Auto Dialing Timing Diagram

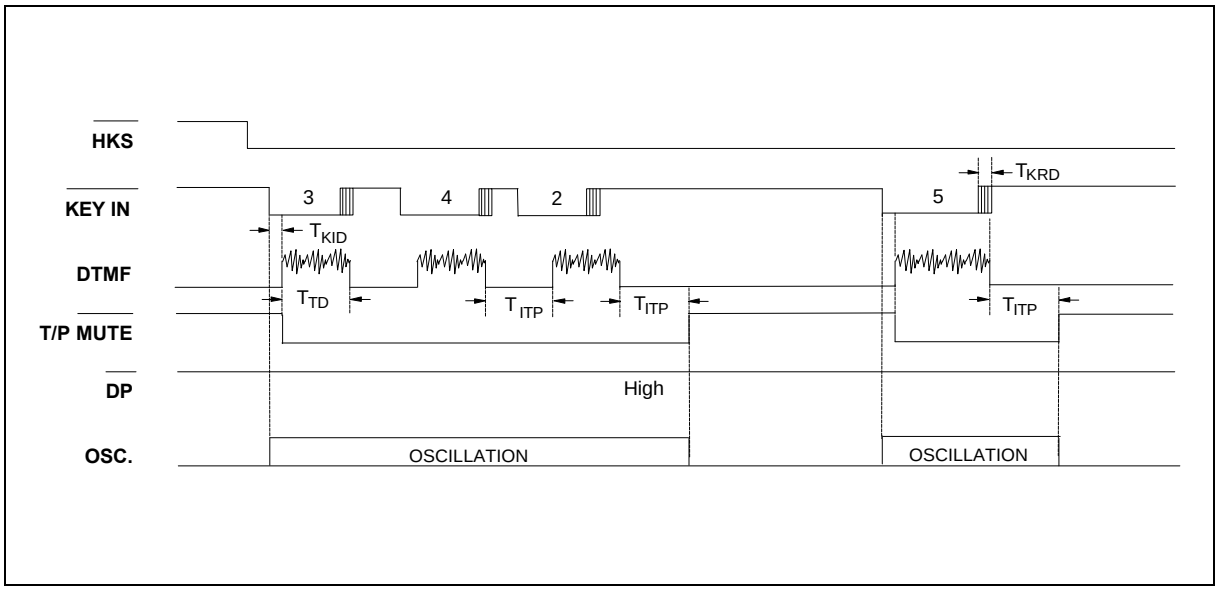



Figure 2(a). Tone Mode Normal Dialing Timing Diagram

Timing Waveforms, continued

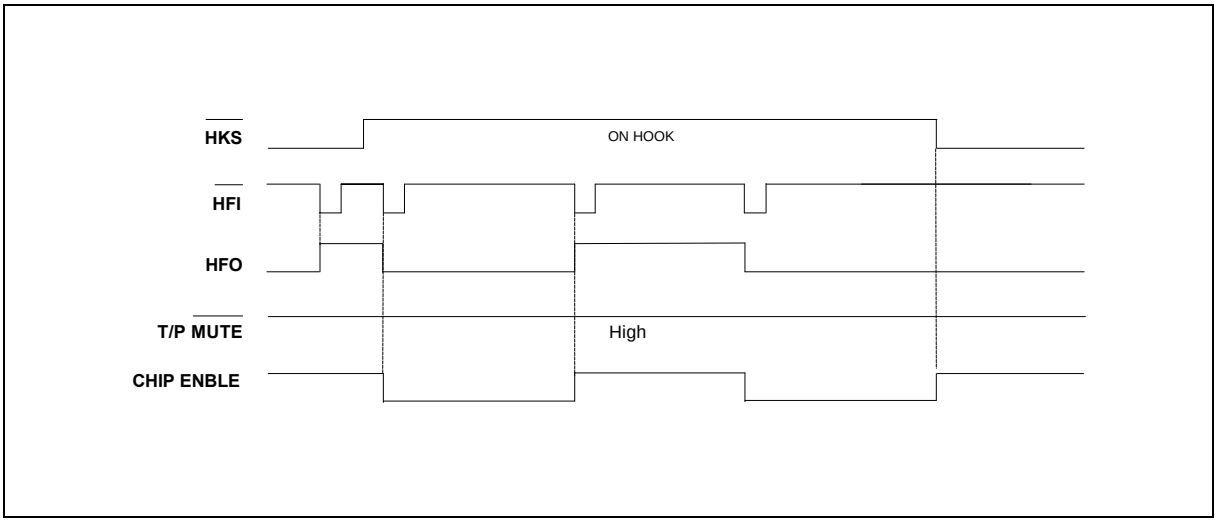



Figure 3. Handfree Timing diagram

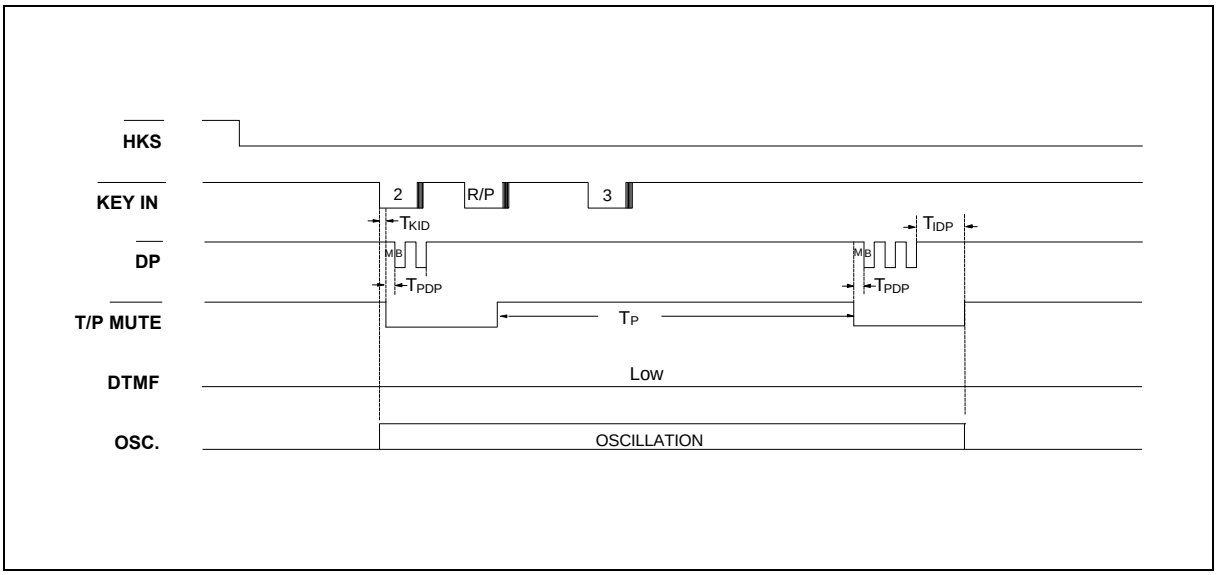



Figure 4. Pause Function Timing Diagram

Timing Waveforms, continued

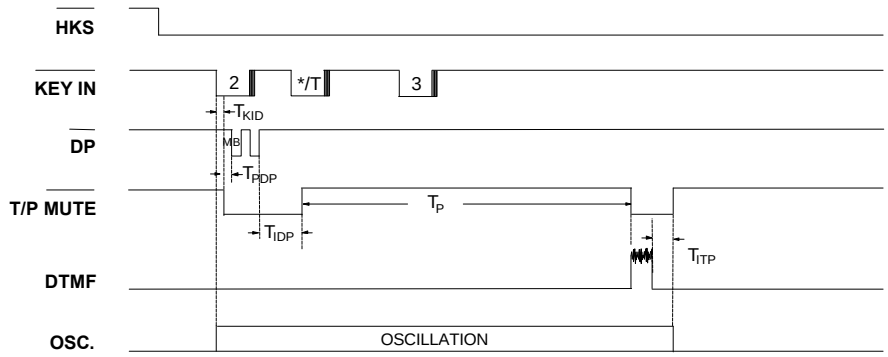



Figure 5. Pulse-to-Tone Timing Diagram

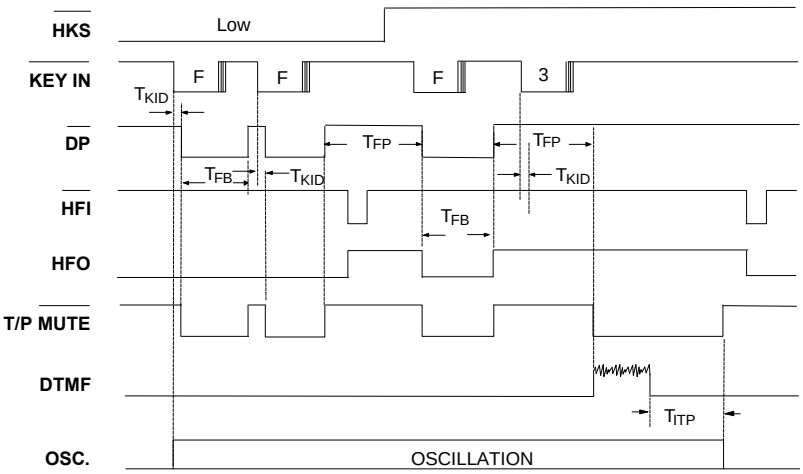



Figure 6. Flash Timing Diagram

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Note: All data and specifications are subject to change without notice.