Winbond Electronics Corp.

# TONE/PULSE DIALER WITH HANDFREE LOCK AND KEY TONE FUNCTIONS

## GENERAL DESCRIPTION

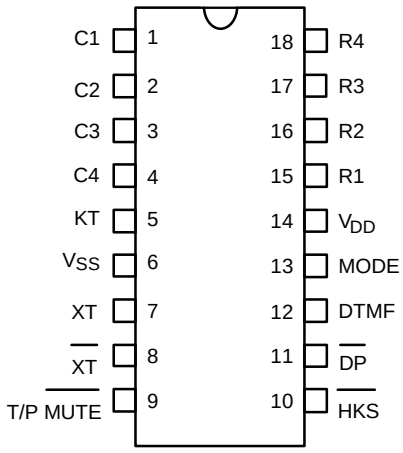
The W91330N series are Si-gate CMOS ICs that provide the necessary signals for tone or pulse dialing. They feature one-key redial, handfree dialing, key tone, redial, and lock functions.

## FEATURES

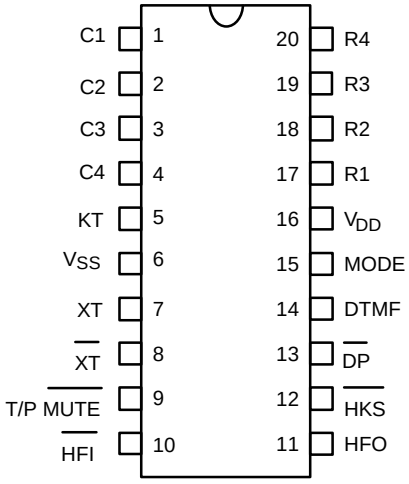
- DTMF/pulse switchable dialer
- 32-digit redial memory
- Pulse-to-tone (*/T) keypad for long distance call operation
- Uses $5 \times 4$ keyboard
- Easy operation with redial, flash, pause, and */T keypads
- Pause, pulse-to-tone (*/T) can be stored as a digit in memory
- 0 or 9 dialing inhibition pin for PABX system or long distance dialing lock out
- Off-hook delay 300 mS in lock mode ($\overline{DP}$ will keep low for 300 mS low while off hook)
- First key-in delay 300 mS output in lock mode
- Dialing rate (10, 20 ppS ) selected by bonding option
- Minimum tone output duration: 93 msec.
- Minimum intertone pause: 93 msec.
- Flash break time (73, 100, 300, 600 msec.) selectable by keypad; pause time is 1.0 sec.
- On-chip power-on reset
- Uses 3.579545 MHz crystal or ceramic resonator
- Packaged in 18 or 20-pin plastic DIP
- The different dialers in the W91330N series are shown in the following table:

| TYPE NO. | REPLACEMENT TYPE NO. | PULSE (ppS) | FLASH (mS) | M/B | KEY TONE | HANDFREE DIALING | LOCK | PACKAGE (PINS) |
|---|---|---|---|---|---|---|---|---|
| W91330N | W91330 | 10 | 600/100/300/73 | Pin | Yes | - | - | 18 |
| W91331N | W91331 | 20 | 600/100/300/73 | Pin | Yes | - | - | 18 |
| W91330AN | W91330A | 10 | 600/100/300/73 | Pin | Yes | Yes | - | 20 |
| W91331AN | W91331A | 20 | 600/100/300/73 | Pin | Yes | Yes | - | 20 |
| W91330LN | W91330L | 10 | 600/100/300/73 | Pin | - | - | Yes | 20 |
| W91330ALN | W91330AL | 10 | 600/100/300/73 | Pin | - | Yes | Yes | 20 |

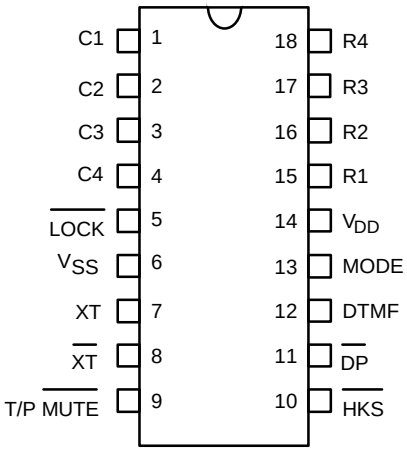
## PIN CONFIGURATIONS



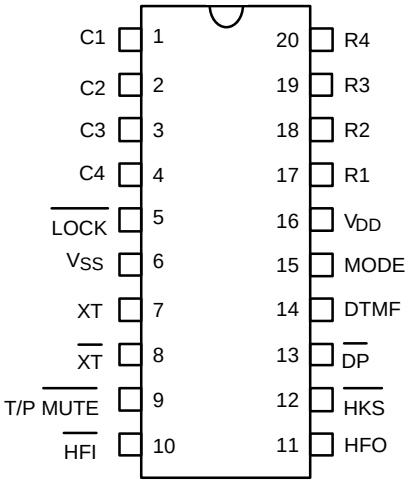

W91330N/W91331N




W91330AN/W91331AN




W91330LN




W91330ALN

## PIN DESCRIPTION

| SYMBOL | 18-PIN | 20-PIN | I/O | FUNCTION |
|---|---|---|---|---|
| Column-Row Inputs | 1–4 & 15–18 | 1–4 & 17–20 | I | The keyboard inputs may be used with either the standard 5 × 4 keyboard or the inexpensive single contact (Form A) keyboard. Electronic input from a µC can also be used.<br>A valid key-in is defined as a single row being connected to a single column. |
| XT, $\overline{XT}$ | 7, 8 | 7, 8 | I, O | A built-in inverter provides oscillation with an inexpensive 3.579545 MHz crystal or ceramic resonator. |
| T/P<br>$\overline{MUTE}$ | 9 | 9 | O | The T/P $\overline{MUTE}$ is a conventional CMOS N-channel open drain output.<br>The output transistor is switched on during dialing sequence, one-key redial break, and flash break time. Otherwise, it is switched off. |
| MODE | 13 | 15 | I | Pulling mode pin to VSS places the dialer in tone mode.<br>Pulling mode pin to VDD places the dialer in pulse mode. (10 ppS; 20 ppS for W91331N/W91331AN, M/B = 40:60)<br>Floating mode pin places the dialer in pulse mode.<br>(10 ppS; 20 ppS for W91331N/W91331AN, M/B = 33.3:66.7). |
| $\overline{HKS}$ | 10 | 12 | I | Hook switch input.<br>$\overline{HKS}$ = VDD: On-hook state. Chip in sleeping mode, no operation.<br>$\overline{HKS}$ = VSS: Off-hook state. Chip enabled for normal operation.<br>$\overline{HKS}$ pin is pulled to VDD by internal resistor. |
| $\overline{DP}$ | 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). |
| VDD, VSS | 14, 6 | 16, 6 | I | Power input pins. |

Pin Description, continued

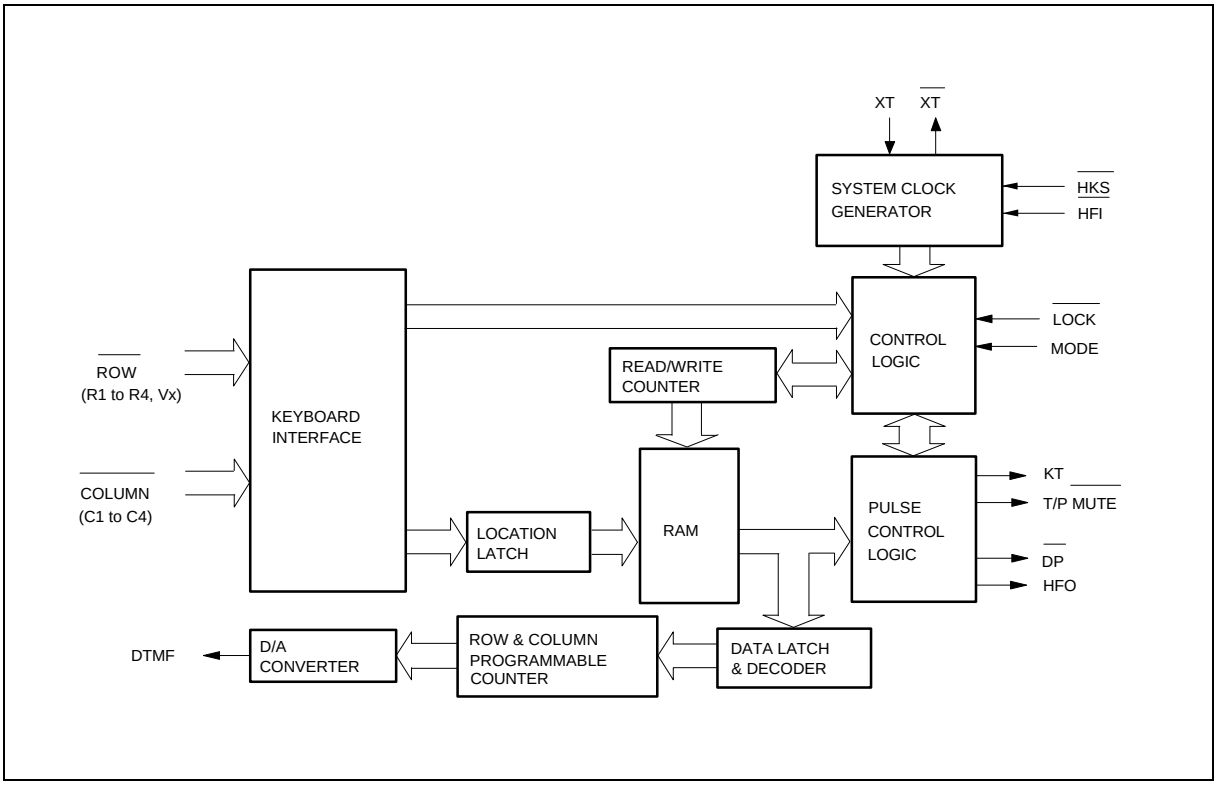
<table>
<tr><th>SYMBOL</th><th>18-PIN</th><th>20-PIN</th><th>I/O</th><th>FUNCTION</th></tr>
<tr><td>DTMF</td><td>12</td><td>14</td><td>O</td><td>In pulse mode, this pin remains in low state at all times. In tone mode, it will output a dual or single tone. Detailed timing diagram for tone mode is shown in Figure 2(a, b, c, d).
<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>$\overline{\text{HFI}}$, HFO</td><td>-</td><td>10, 11</td><td>I, O</td><td>Handfree control pins. The handfree control state is toggled on by a low pulse on the $\overline{\text{HFI}}$ input pin. The status of the handfree control state is described in the following table:
<table>
<tr><th colspan="2">CURRENT STATE</th><th colspan="3">NEXT STATE</th></tr>
<tr><th>Hook SW.</th><th>HFO</th><th>Input</th><th>HFO</th><th>Dialing</th></tr>
<tr><td>–</td><td>Low</td><td>$\overline{\text{HFI}}$ ↓</td><td>High</td><td>Yes</td></tr>
<tr><td>On Hook</td><td>High</td><td>$\overline{\text{HFI}}$ ↓</td><td>Low</td><td>No</td></tr>
<tr><td>Off Hook</td><td>High</td><td>$\overline{\text{HFI}}$ ↓</td><td>Low</td><td>Yes</td></tr>
<tr><td>On Hook</td><td>–</td><td>Off Hook</td><td>Low</td><td>Yes</td></tr>
<tr><td>Off Hook</td><td>Low</td><td>On Hook</td><td>Low</td><td>No</td></tr>
<tr><td>Off Hook</td><td>High</td><td>On Hook</td><td>High</td><td>Yes</td></tr>
</table>
$\overline{\text{HFI}}$ pin is pulled to $V_{DD}$ by internal resistor.<br>Detailed timing diagrams are shown in Figure 3.</td></tr>
<tr><td>KT</td><td>5<br>(except W91330LN)</td><td>5<br>(except W91330ALN)</td><td>O</td><td>Key-tone signal output. The key tone is generated for all valid keys. Frequency is 600 Hz and duration is 35 mS.</td></tr>
</table>

Pin Description, continued

| SYMBOL | 18-PIN | 20-PIN | I/O | FUNCTION |
|---|---|---|---|---|
| $\overline{\text{LOCK}}$ | 5 (W91330LN only) | 5 (W91330ALN only) | I | The function of this terminal is to prevent "0" dialing and "9" dialing under PABX system long distance call control. When the first key input after reset is 0 or 9, all key inputs, including the 0 or 9 key, become invalid and the chip generates no output. The telephone is reinitialized by a reset. |

| $\overline{\text{LOCK}}$ PIN | FUNCTION |
|---|---|
| Floating | Normal dialing mode |
| $V_{DD}$ | "0," "9" dialing inhibited |
| $V_{SS}$ | "0" dialing inhibited |

## BLOCK DIAGRAM



## FUNCTIONAL DESCRIPTION

### Keyboard Operation

| C1 | C2 | C3 | C4 | |
|---|---|---|---|---|
| 1 | 2 | 3 | | R1 |
| 4 | 5 | 6 | F1 | R2 |
| 7 | 8 | 9 | F2 | R3 |
| ∗/T | 0 | # | R/P1 | R4 |
| R/P2 | R | F3 | F4 | VX |

- R: One-key redial function
- R/P1, R/P2: Redial and pause function key, P1 is 3.6 sec. and P2 is 2.0 sec.
- ∗/T: ∗ in tone mode and P→T in pulse mode
- F1, ..., F4: Flash keys, F1 = 600 mS, F2 = 100 mS, F3 = 300 mS, F4 = 73 mS

Notes: D1, ..., Dn, D1', ..., Dn': 0, ..., 9, */T, #

R/P: R/P1 or R/P2.

Fn: F1, ..., F4

### Normal Dialing

OFF HOOK (or ON HOOK & $\overline{\text{HFI}}$ ), 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 in normal dialing.

### Redialing

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

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

- The redial memory content will be dialed out.
- The R/P key can execute the redial function only as the first key-in after off-hook; otherwise, it executes pause function.
- If redialing length oversteps 32 digits, the redialing function will be inhibited.

OFF HOOK (or ON HOOK G $\overline{\text{HFI}}$

- If the pulses of the dialed digits [D1] to [Dn] have not finished, [R] will be ignored.
- The redial function by [R] key has no break time (2.2 sec.) if it is the first key in after off-hook.
- The [R] key uses the same redial buffer as the redial function by [R/P1] or [R/P2] key, and it is actived during normal dialing or repertory dialing.

### Access Pause

[OFF HOOK] (or [ON HOOK] & [HFI ï õ_]), [D1] , [D2] , [R/P] , [D3] , ..., [Dn]

1. The pause function can be stored in memory.
2. The pause function is executed in normal dialing, redial dialing, or memory dialing.
3. The pause duration of 2.0 or 3.6 seconds per pause is selected by keypad.
4. The detailed timing diagram for the pause function is shown in Figure 5.
5. Only one pause function can be released to user.

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

[OFF HOOK] (or [ON HOOK] & [HFI ï õ_]), [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 (2.0 sec. or 3.6 sec.), D1', D2', …, Dn'
   (Pulse) (Tone )

   If pause1 is excuted, the pause time of pulse-to-tone function is 3.6S. If pause2 is excuted, the pause time of the pulse-to-tone function is 2.0S.
2. If the mode switch is set to tone mode, then the output signal will be as follows:

   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 pulse-to-tone function timing diagram is shown in Figure 6.

### Flash

[OFF HOOK] (or [ON HOOK] & [HFI ï õ_]), [Fn]

1. Fn = F1, …, F4
2. The dialer will execute flash break time of 600 mS (F1), 100 mS (F2), 300 mS (F3), or 73 mS (F4) before the next digit is dialed out. In each case, the pause time is 1.0 sec.

3. Flash key cannot be stored as a digit in memory. The flash key has the first priority among the 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 7.

## 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 |
| Operation 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, $F_{OSC.}$ = 3.579545 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, Unloaded | - | 0.4 | 0.6 | mA |
| | | Pulse, Unloaded | - | 0.2 | 0.4 | |
| Standby Current | $I_{SB}$ | $\overline{HKS}$ = $V_{SS}$, No load & No key entry | - | - | 15 | µA |
| Memory Retention Current | $I_{MR}$ | $\overline{HKS}$ = $V_{DD}$, $V_{DD}$ = 1.0V | - | - | 0.2 | µA |
| DTMF 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 |

DC Characteristics, continued

| PARAMETER | SYMBOL | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| 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 |
| T/P $\overline{MUTE}$ Output Sink Current | $I_{TML}$ | $V_{TMO}$ = 0.5V | 0.5 | - | - | mA |
| Key Tone Output Current | $I_{KTH}$ | $V_{KTH}$ = 2.0V | 0.5 | - | - | mA |
| | $I_{KTL}$ | $V_{KTL}$ = 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 | - | - | mA |
| Keypad Input Drive Current | $I_{KD}$ | $V_I$ = 0.0V | 30 | - | - | µA |
| Keypad Input Sink Current | $I_{KS}$ | $V_I$ = 2.5V | 200 | 400 | - | µA |
| $\overline{HKS}$ I/P Pull-High Resistor | $R_{HK}$ | - | - | 300 | - | KΩ |
| Keypad Resistance | $R_K$ | - | - | - | 5 | KΩ |

## AC CHARACTERISTICS

($V_{DD}$–$V_{SS}$ = 2.5V, $F_{OSC.}$ = 3.579545 MHz, $T_A$ = 25° C, all outputs unloaded.)

| PARAMETER | SYMBOL | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| Key-in Debounce | $T_{KID}$ | - | - | 20 | - | mS |
| Key Release Debounce | $T_{KRD}$ | - | - | 20 | - | mS |
| Off-Hook Delay | $T_{OFD}$ | Lock only | - | 300 | - | mS |
| First Key-in Delay | $T_{FKD}$ | Lock only | - | 300 | - | mS |
| Pre-digit-pause1 | $T_{PDP1}$ | Mode = $V_{DD}$ | - | 40 | - | mS |
| | 10 ppS | Mode = Floating | - | 33.3 | - | |
| Pre-digit-pause2 | $T_{PDP2}$ | Mode = $V_{DD}$ | - | 20 | - | mS |
| | 20 ppS | Mode = Floating | - | 16.7 | - | |
| Interdigit Pause (Auto Dialing) | $T_{IDP}$ | 10 ppS | - | 800 | - | mS |
| | | 20 ppS | - | 500 | - | |

AC Characteristics, continued

| PARAMETER | SYMBOL | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| Make/Break Ratio | M:B | Mode = $V_{DD}$ | - | 40:60 | - | % |
| | | Mode = Floating | - | 33.3:66.7 | - | |
| Tone Output Duration | $T_{TD}$ | Auto dialing | - | 93 | - | mS |
| Intertone Pause | $T_{ITP}$ | Auto dialing | - | 93 | - | mS |
| Flash Break Time | $T_{FB}$ | F1 | - | 600 | - | mS |
| | | F2 | - | 100 | - | |
| | | F3 | | 300 | | |
| | | F4 | - | 73 | - | |
| Flash Pause Time | $T_{FP}$ | F1, F2, F3, F4 | - | 1.0 | - | S |
| Pause Time | $T_P$ | R/P1 | - | 3.6 | - | S |
| | | R/P2 | - | 2.0 | - | |
| Key Tone Frequency | $F_{KT}$ | - | - | 600 | - | Hz |
| Key Tone Duration | $T_{KTD}$ | - | - | 35 | - | mS |
| One-Key Redial Break Time | $T_{RB}$ | - | - | 2.2 | - | S |
| One-Key Redial Pause Time | $T_{RP}$ | - | - | 0.6 | - | 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

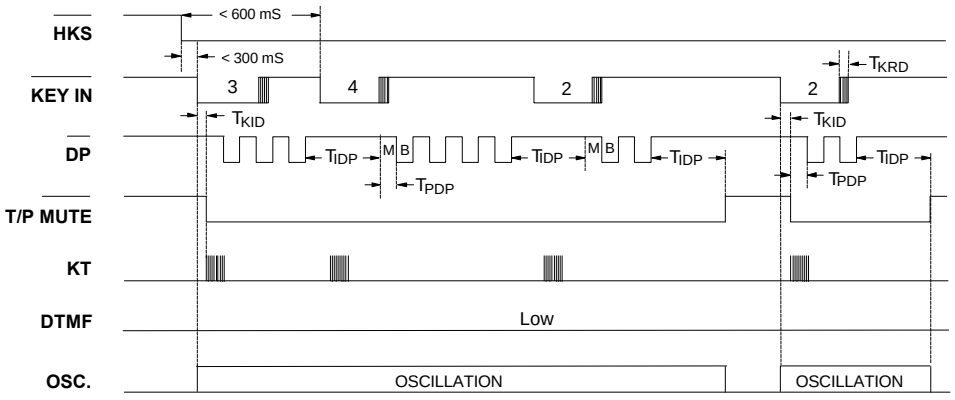



Figure 1(a). Normal Dialing Timing Diagram (Pulse Mode Without Lock Function)

Timing Waveforms, continued

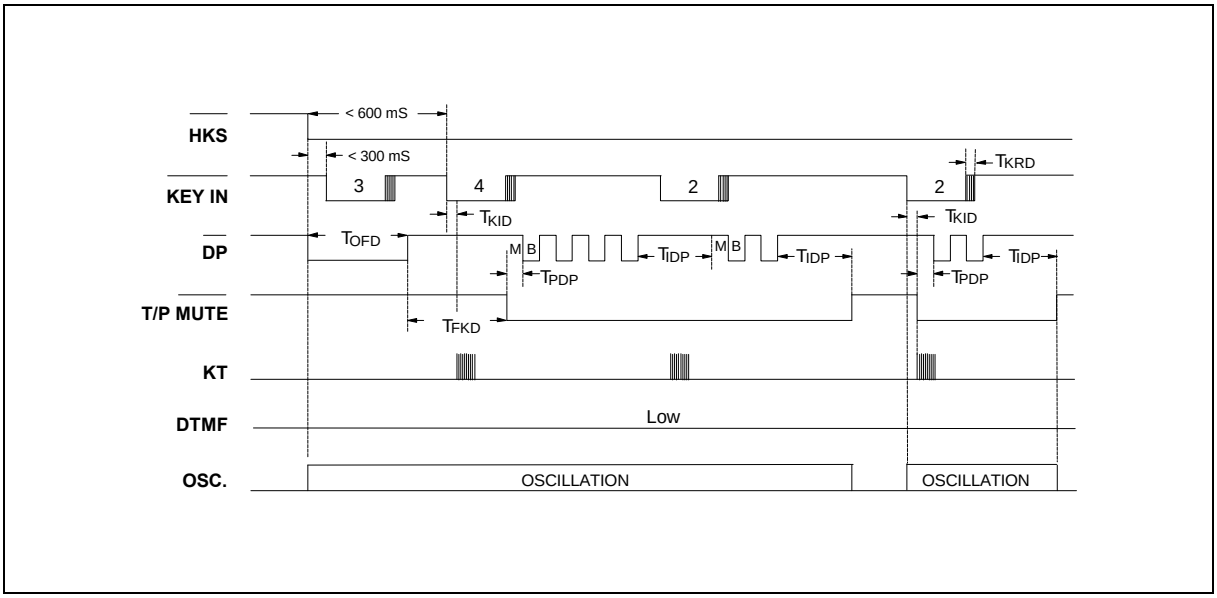



Figure 1(b). Normal Dialing Timing Diagram (Pulse Mode with Lock Function)

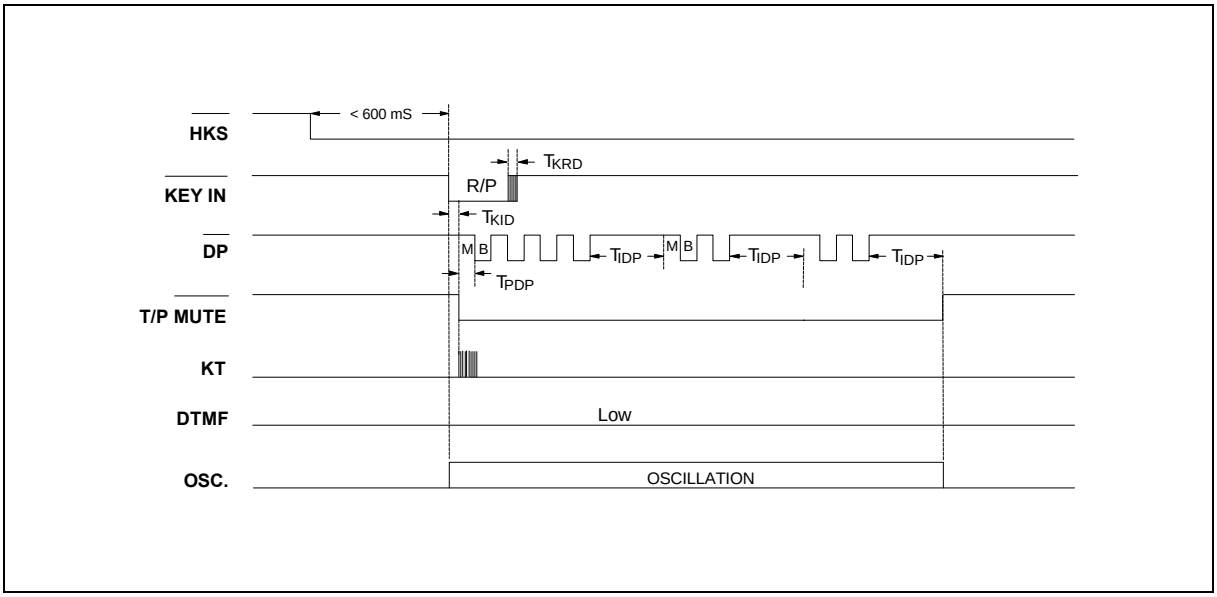



Figure 1(c). Auto Dialing Timing Diagram (Pulse Mode Without Lock Function)

Timing Waveforms, continued

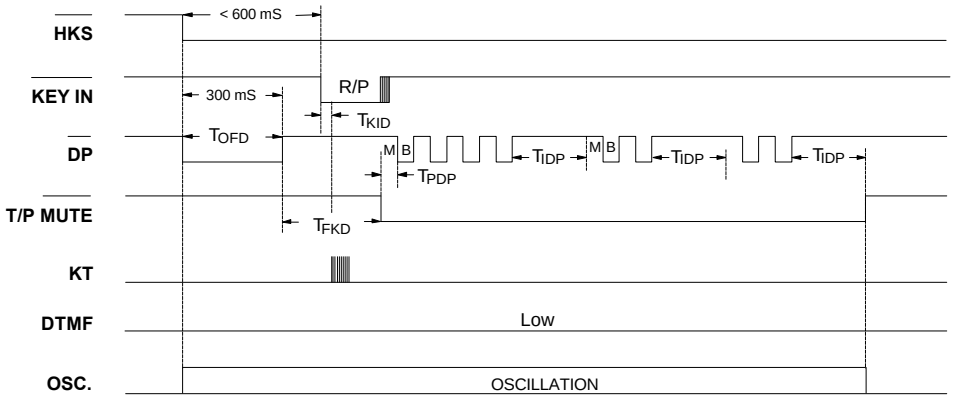



Figure 1(d). Auto Dialing Timing Diagram (Pulse Mode with Lock Function)

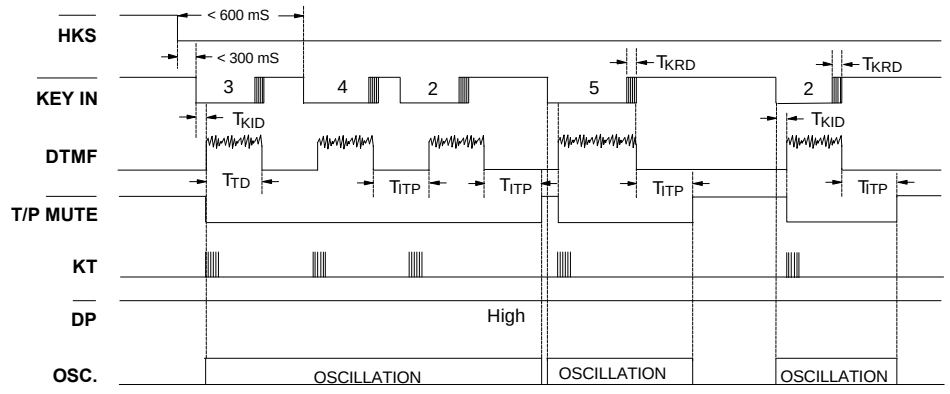



Figure 2(a). Normal Dialing Timing Diagram (Tone Mode Without Lock Function)

Timing Waveforms, continued

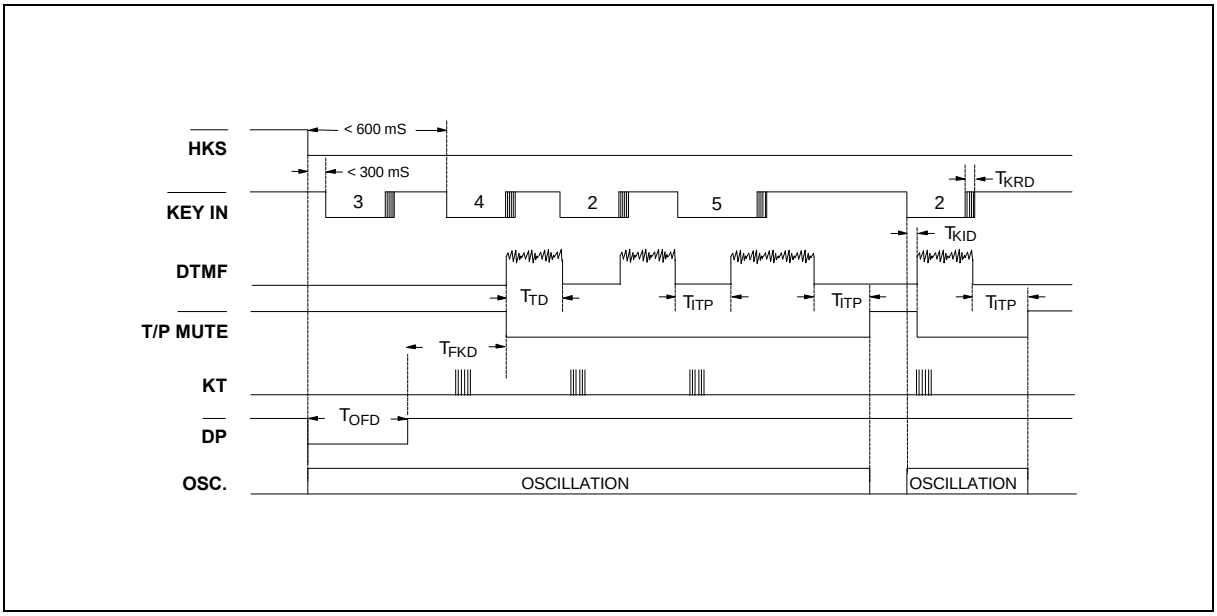



Figure 2(b). Normal Dialing Timing Diagram (Tone Mode with Lock Function)

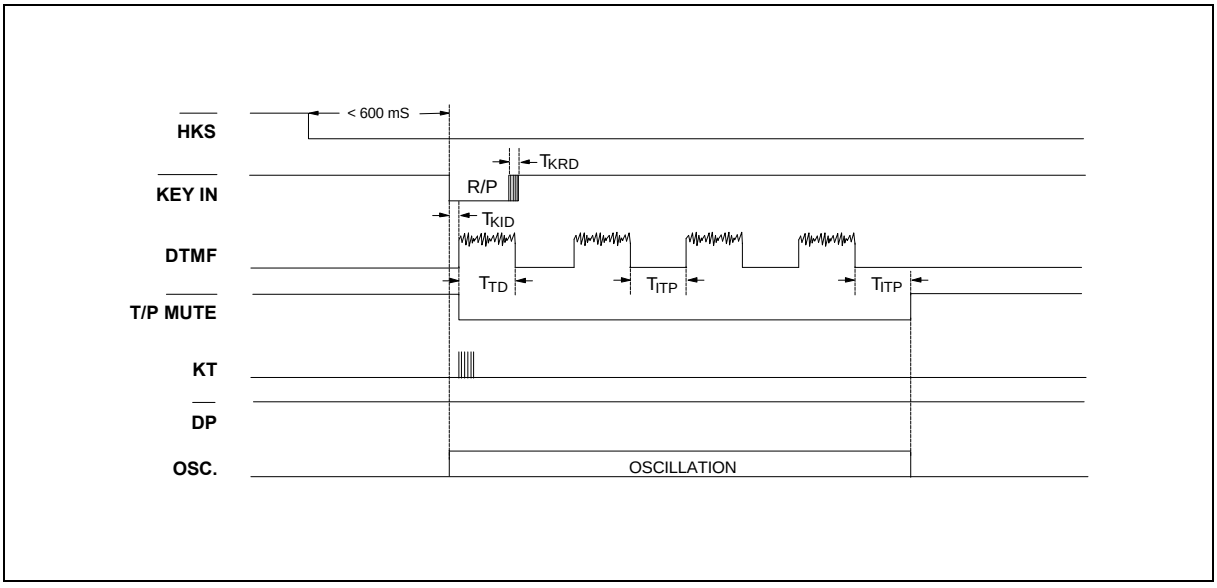



Figure 2(c). Auto Dialing Timing Diagram (Tone Mode Without Lock Function)

Timing Waveforms, continued

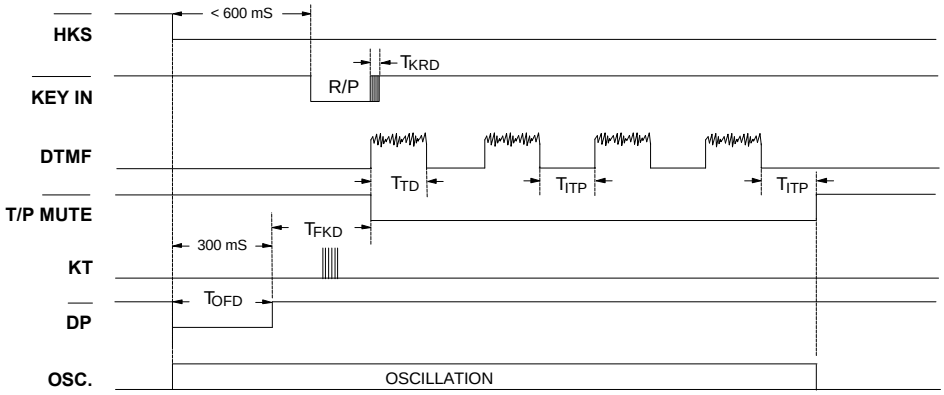



Figure 2(d). Auto Dialing Timing Diagram (Tone Mode with Lock Function)

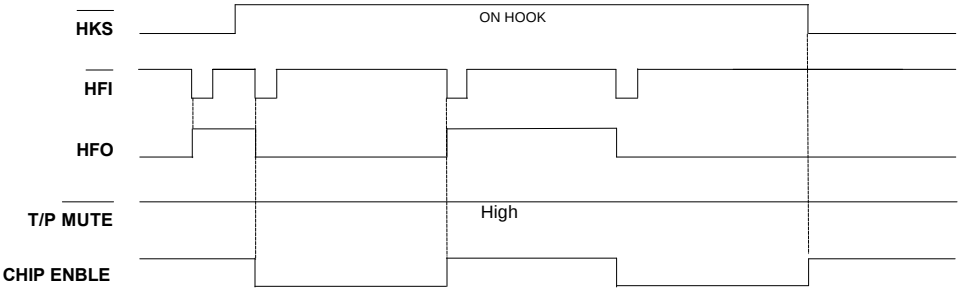



Figure 3. Handfree Dialing Timing Diagram

Timing Waveforms, continued

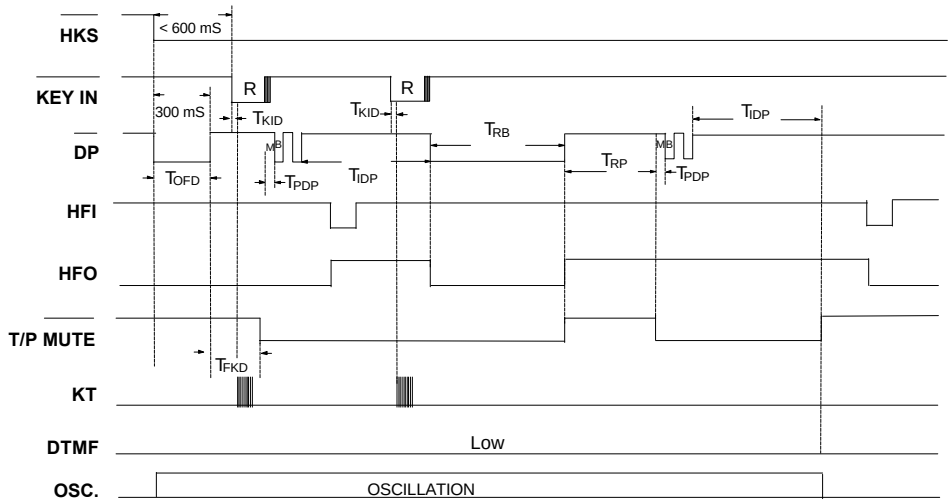



Figure 4. One-key Redial Timing Diagram (Pulse Mode)

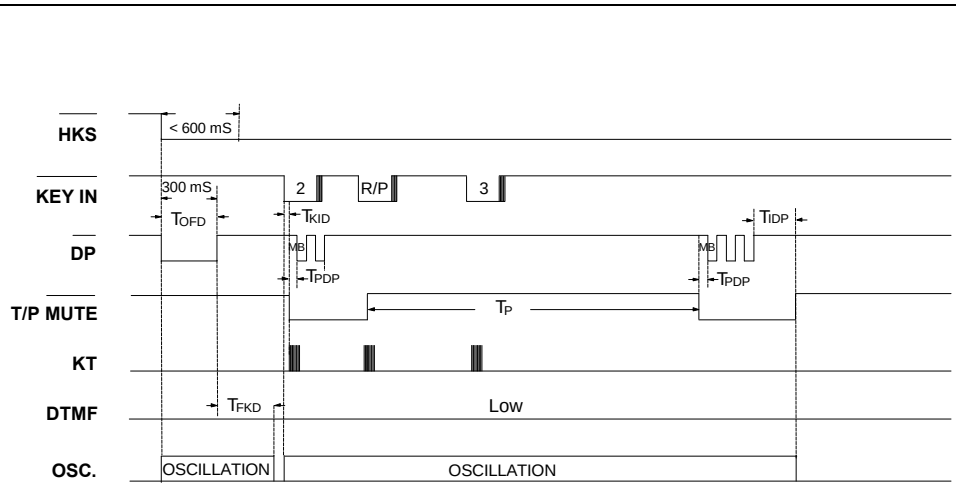



Figure 5. Pause Function Timing Diagram

Timing Waveforms, continued

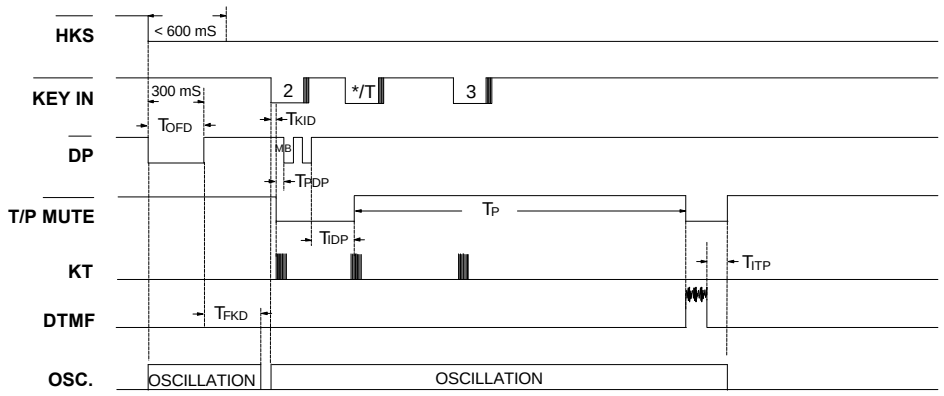



Figure 6. Pulse-to-tone Timing Diagram

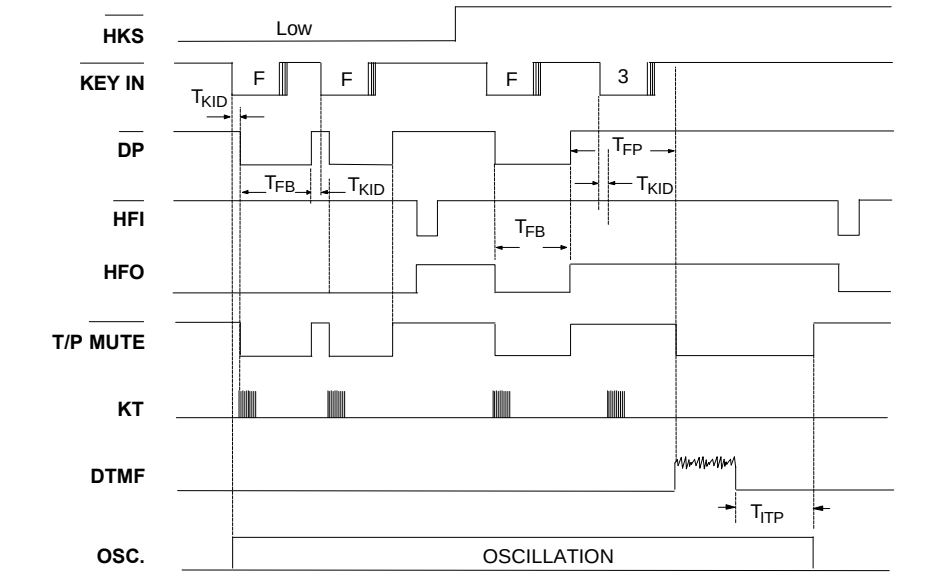



Figure 7. Flash Timing Diagram

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