

W91350N SERIES



13-MEMORY TONE/PULSE DIALER WITH HANDFREE AND HOLD FUNCTIONS

GENERAL DESCRIPTION

The W91350N series are tone/pluse switchable telephone dialers with thirteen memories, hold function, and a handfree dialing control circuit. Fabricated using CMOS technology, the W91350N series offer good performance in low-voltage and low-power applications.

FEATURES

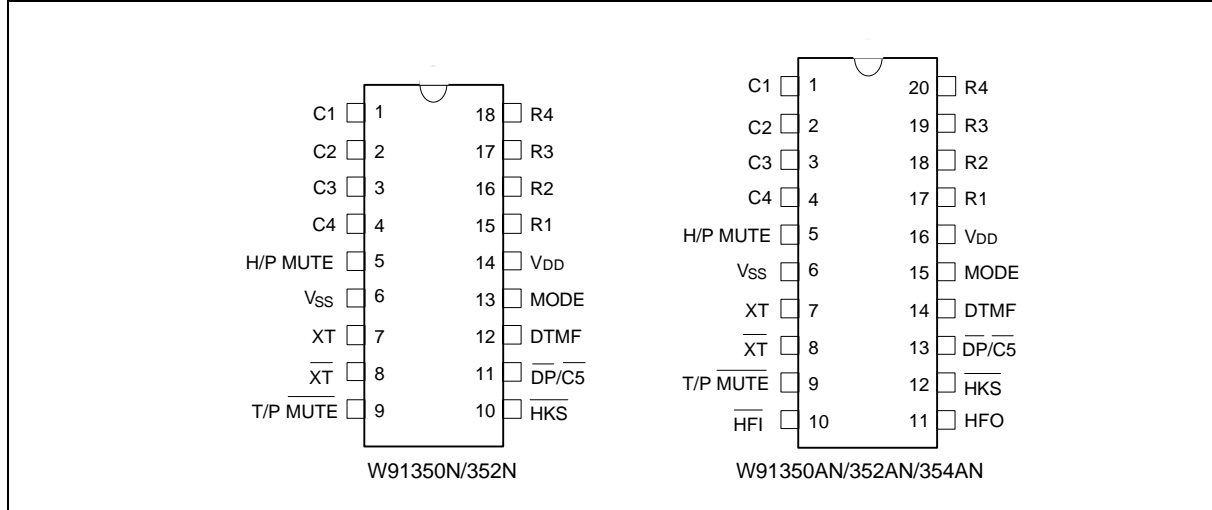
- DTMF/pulse switchable dialer
- Two by 32-digit redial memory and save memory
- Three by 16-digit one-touch direct repertory memory
- Ten by 16-digit two-touch direct repertory memory
- Cascaded dialing allowed, with unlimited dialing length
- Pulse-to-tone (*T) keypad for long distance call operation
- Uses 5×5 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) is selectable by bonding option
- On-hook debounce time: 150 msec.
- Minimum tone output duration: 93 msec. (W91354AN: 87 mS)
- Minimum intertone pause: 93 msec. (W91354AN: 87 mS)
- Flash break time (73, 100, 300, 600 msec) selectable by keypad; pause time is 1.0 sec.
- 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
- Packaged in 18 or 20-pin plastic DIP
- The different dialers in the W91350N series are shown in the following table:

| TYPE NO. | REPLACEMENT TYPE NO. | PULSE (ppS) | FLASH (mS) | M/B | HANDFREE DIALING | PACKAGE (PINS) |
|----------|-------------------------|----------------|----------------|-----|---------------------|-------------------|
| W91350N | W91350 | 10 | 600/300/73/100 | Pin | - | 18 |
| | W91351 | | | | | |
| W91352N | W91352 | 20 | 600/300/73/100 | Pin | - | 18 |
| W91350AN | W91350A | 10 | 600/300/73/100 | Pin | Yes | 20 |
| | W91351A | | | | | |
| W91352AN | W91352A | 20 | 600/300/73/100 | Pin | Yes | 20 |
| W91354AN | New type | 10 | 600/300/73/100 | Pin | Yes | 20 |

Note: The W91354AN is for use in France only. The pause time is not added in pulse-to-tone function mode.

Publication Release Date: May 1997










PIN CONFIGURATIONS



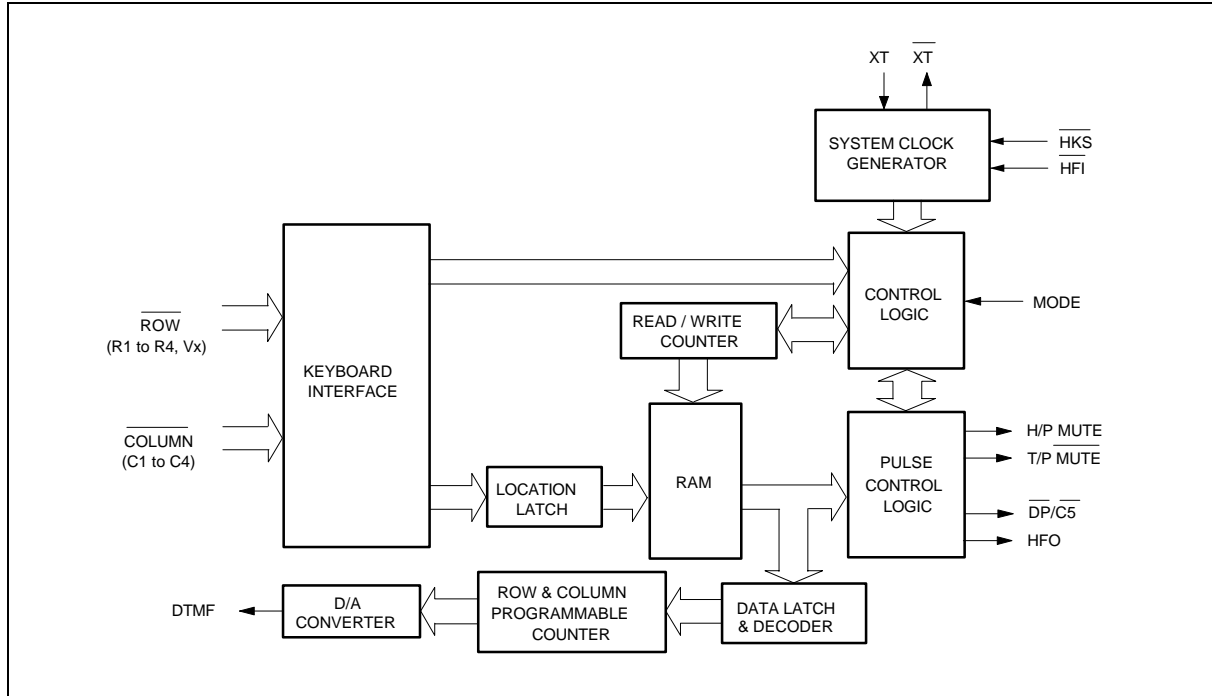
PIN DESCRIPTION

| 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 a standard 5 × 5 keyboard or an inexpensive single contact (Form A) keyboard. Electronic input from a μC can also be used. A valid key in is defined as a single row being connected to a single column. |
| XT, $\overline{\text{XT}}$ | 7, 8 | 7, 8 | I, O | A built-in inverter provides oscillation with an inexpensive 3.579545 MHz crystal or ceramic resonator. |
| T/P MUTE | 9 | 9 | O | The T/P MUTE is a conventional CMOS N-channel open drain output. The output transistor is switched on during dialing sequence and flash break time. Otherwise, it is switched off. |
| MODE | 13 | 15 | I | Pulling mode pin to V _{SS} places the dialer in tone mode. Pulling mode pin to V _{DD} places the dialer in pulse mode with M/B ratio of 40:60 (10 ppS, except for W91352N/352AN = 20 ppS). Floating mode pin places the dialer in pulse mode with M/B ratio of 33.3:66.7 (10 ppS, except for W91352N/352AN = 20 ppS). |
| HKS | 10 | 12 | I | Hook switch input. HKS = V _{DD} : On-hook state. Chip in sleeping mode, no operation. HKS = V _{SS} : Off-hook state. Chip is enabled for normal operation. HKS pin is pulled to V _{DD} by an internal resistor. |

Pin Description, continued

| SYMBOL | 18-PIN | 20-PIN | I/O | FUNCTION | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---------------------------------|-----------|---|---------|---|------------------|--|------------|--|--|-----------|--------|---------|-----|---------|-----|-------|---|------|-----|---------|------|---|-----|-------|----------|------|---|-------|-----|---------|------|----------|-----|------|----------|-------|---------|------|------|----------|------|---------|------|-----|
| $\overline{DP} / \overline{C5}$ | 11 | 13 | O | N-channel open drain dialing pulse output. Flash key will cause $\overline{DP} / \overline{C5}$ to be active in either tone mode or pulse mode. The timing diagram for pulse mode is shown in Figure 1(a, b, c). | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| VDD, VSS | 14, 6 | 16, 6 | I | Power input pins. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| DTMF | 12 | 14 | O | 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). <table border="1"><thead><tr><th colspan="4">Output Frequency</th></tr><tr><th></th><th>Specified</th><th>Actual</th><th>Error %</th></tr></thead><tbody><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></tbody></table> | 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 | | | | |
| 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 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| \overline{HFI} , HFO | - | 10, 11 | I, O | Handfree control pins. The handfree control state is toggled on by a low pulse on the \overline{HFI} input pin. The status of the handfree control state is described in the following table: <table border="1"><thead><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></thead><tbody><tr><td>—</td><td>Low</td><td>\overline{HFI} </td><td>High</td><td>Yes</td></tr><tr><td>On Hook</td><td>High</td><td>\overline{HFI} </td><td>Low</td><td>No</td></tr><tr><td>Off Hook</td><td>High</td><td>\overline{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></tbody></table> \overline{HFI} pin is pulled to VDD by an internal resistor. Detailed timing diagram is shown in Figure 3. | 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 |
| 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 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| H/P MUTE | 5 | 5 | O | The H/P MUTE is a conventional inverter output. During pulse dialing, flash break or hold period, this output is active high; otherwise, it remains in low state. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

BLOCK DIAGRAM



FUNCTIONAL DESCRIPTION

Keyboard Operation

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

- S: Store function key
- H: Hold function key
- A: Indirect repertory memory dialing function key
- R/P: Redial and pause function key
- SAVE: Save function key
- */T: * in tone mode and P→T in pulse mode
- M1, ..., M3: One-touch memory
- F1, ..., F4: Flash keys, F1 = 600 mS, F2 = 300 mS, F3 = 73 mS, F4 = 100 mS

Notes:

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

Mn: M1, ..., M3; Ln: 0, ..., 9; Fn: F1, ..., F4

Normal Dialing

[OFF HOOK] , (or [ON HOOK] & $\overline{\text{HFI}} \text{ i} \underline{\text{1}}$), [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 normal dialing.

Redialing

[OFF HOOK] , (or [ON HOOK] & $\overline{\text{HFI}} \text{ i} \underline{\text{1}}$), [D1] , [D2] , ..., [Dn] Busy, Come
[ON HOOK] , [OFF HOOK] , (or [ON HOOK] & $\overline{\text{HFI}} \text{ i} \underline{\text{1}}$), [R/P]

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

Number Store

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

1. If the sequence of the dialed digits D1, D2, ..., Dn has not finished, [S] will be ignored.
2. D1, D2, ..., Dn will be dialed out and stored in memory location.

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

3. D1, D2, ..., Dn will be stored in memory location but will not be dialed out.
4. [R/P] and [*T] keys can be stored as a digit in memory.

In store mode, [R/P] is the pause function key.

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

Repertory Dialing

[OFF HOOK] , (or [ON HOOK] & $\overline{\text{HFI}} \text{ i} \underline{\text{1}}$), [Mn]

[OFF HOOK] , (or [ON HOOK] & $\overline{\text{HFI}} \text{ i} \underline{\text{1}}$), [A] , [Ln]

Access Pause

[OFF HOOK] , (or [ON HOOK] & $\overline{\text{HFI}} \text{ i} \underline{\text{1}}$), [D1] , [D2] , [R/P] , [D3] , ..., [Dn]

1. The pause function can be stored as a digit in memory.

- The pause function is executed in normal dialing, redial dialing, or memory dialing.
- A detailed timing diagram for the pause function is shown in Figure 4.

Pulse-to-tone (*T)

OFF HOOK , (or ON HOOK & $\overline{\text{HFI}} \downarrow$), D1 , D2 , ..., Dn , */T , D1' ,
 , D2' , ..., Dn'

- If the mode switch is set to pulse mode, then the output signal will be:
 D1, D2, ..., Dn, Pause (3.6 sec.), D1', D2', ..., Dn'
 (Pulse) (Tone)
 The pause time will be added in all versions except for the W91354AN.
- If the mode switch is set to tone mode, then the output signal will be:
 D1, D2, ..., Dn, *, D1', D2', ..., Dn'
 (Tone) (Tone)
- 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.
- The pulse-to-tone function timing diagram is shown in Figure 5(a, b).

Flash

OFF HOOK , (or ON HOOK & $\overline{\text{HFI}} \downarrow$), Fn

- Fn = F1, ..., F4
- The dialer will execute a flash break time of 600 mS (F1), 300 mS (F2), 73 mS (F3), or 100 mS (F4).
 In each case the flash pause time is 1.0 sec. before the next digit is dialed out.
- Flash key cannot be stored as a digit in memory, and it has first priority among keyboard functions.
- The system will return to the initial state after the flash pause time is finished.
- The flash function timing diagram is shown in Figure 6.

Save

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

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

Cascaded Dialing

- Normal Dialing + Repertory Dialing + Normal Dialing
- Repertory Dialing + Normal Dialing + Repertory Dialing
- Redialing + Normal Dialing + Repertory Dialing

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

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, Fosc. = 3.579545 MHz, T_A = 25° C, All outputs unloaded)

| PARAMETER | SYM. | 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} | $\overline{\text{HKS}} = \text{V}_{\text{SS}}$, No load & No key entry | - | - | 15 | μA |
| Memory Retention Current | I _{MR} | $\text{HKS} = \text{V}_{\text{DD}}$, 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 |
| 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 |
| $\overline{\text{DP}}$ Output Sink Current | I _{PL} | V _{PO} = 0.5V | 0.5 | - | - | mA |
| T/P $\overline{\text{MUTE}}$ Output Sink Current | I _{ML} | V _{MO} = 0.5V | 0.5 | - | - | mA |
| H/P Mute Output Drive/Sink Current | I _{HPH} | V _{HPH} = 2.0V | 0.5 | - | - | mA |
| | I _{HPL} | V _{HPL} = 0.5V | 0.5 | - | - | mA |

DC Characteristics, continued

| PARAMETER | SYMBOL | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|----------------------------|--------|-------------|------|------|------|------|
| HFO Drive/Sink Current | IHFH | VHFH = 2.0V | 0.5 | - | - | mA |
| | IHFL | VHFL = 0.5V | 0.5 | - | - | mA |
| Keypad Input Drive Current | IKD | VI = 0.0V | 30 | - | - | μA |
| Keypad Input Sink Current | IKS | VI = 2.5V | 200 | 400 | - | μA |
| HKS I/P Pull-high Resistor | RHK | - | - | 300 | - | KΩ |
| Keypad Resistance | RK | - | - | - | 5.0 | KΩ |

AC CHARACTERISTICS

(VDD-VSS = 2.5V, Fosc. = 3.579545 MHz, TA = 25° C, All outputs unloaded)

| PARAMETER | SYMBOL | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|------------------------------------|--------|-----------------|------|-----------|------|------|
| Key-in Debounce | TKID | - | - | 20 | - | mS |
| Key Release Debounce | TKRD | - | - | 20 | - | mS |
| On-hook Debounce | TOHD | - | - | 150 | - | mS |
| Pre-digit Pause ¹ | TPDP1 | Mode = VDD | - | 40 | - | mS |
| | 10 ppS | Mode = Floating | - | 33.3 | - | |
| Pre-digit Pause ² | TPDP2 | Mode = VDD | - | 20 | - | mS |
| | 20 ppS | Mode = Floating | - | 16.7 | - | |
| Interdigit Pause (Auto Dialing) | TIDP | 10 ppS | - | 800 | - | mS |
| | | 20 ppS | - | 500 | - | |
| Make/Break Ratio | M/B | Mode = VDD | - | 40:60 | - | % |
| | | Mode = Floating | - | 33.3:66.7 | - | |
| Tone Output Duration | TTD | Auto dialing | - | 93 | - | mS |
| | | W91354AN Only | - | 87 | - | |
| Intertone Pause | TITP | Auto dialing | - | 93 | - | mS |
| | | W91354AN Only | - | 87 | - | |
| Flash Break Time | TFB | F1 | - | 600 | - | mS |
| | | F2 | - | 300 | - | |
| | | F3 | - | 73 | - | |
| | | F4 | - | 100 | - | |
| Flash Pause Time | TFP | F1, F2, F3, F4 | - | 1.0 | - | S |
| Pause Time | TP | R/P | - | 3.6 | - | S |

Notes:

- Crystal parameters suggested for proper operation are Rs<100 ohms, Lm = 96 mH, Cm = 0.02 pF, Cn = 5 pF, Cl = 18 pF, Fosc. = 3.579545 MHz ± 0.02%.
- Crystal oscillator accuracy directly affects these times.

TIMING WAVEFORMS

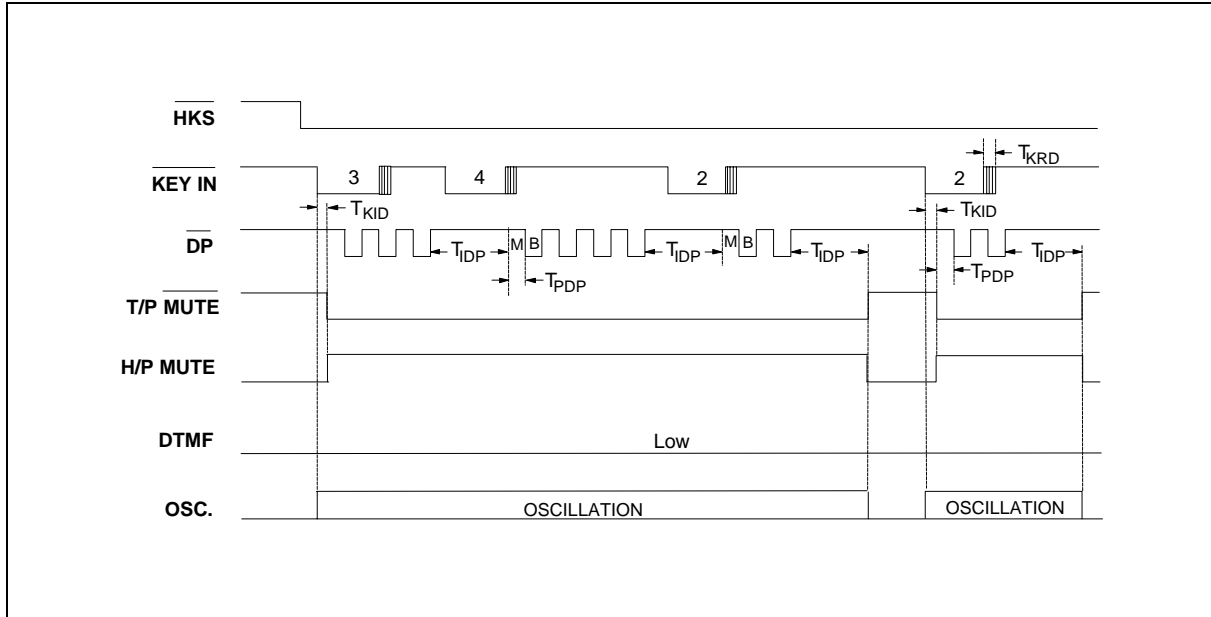


Figure 1(a). Normal Dialing Timing Diagram

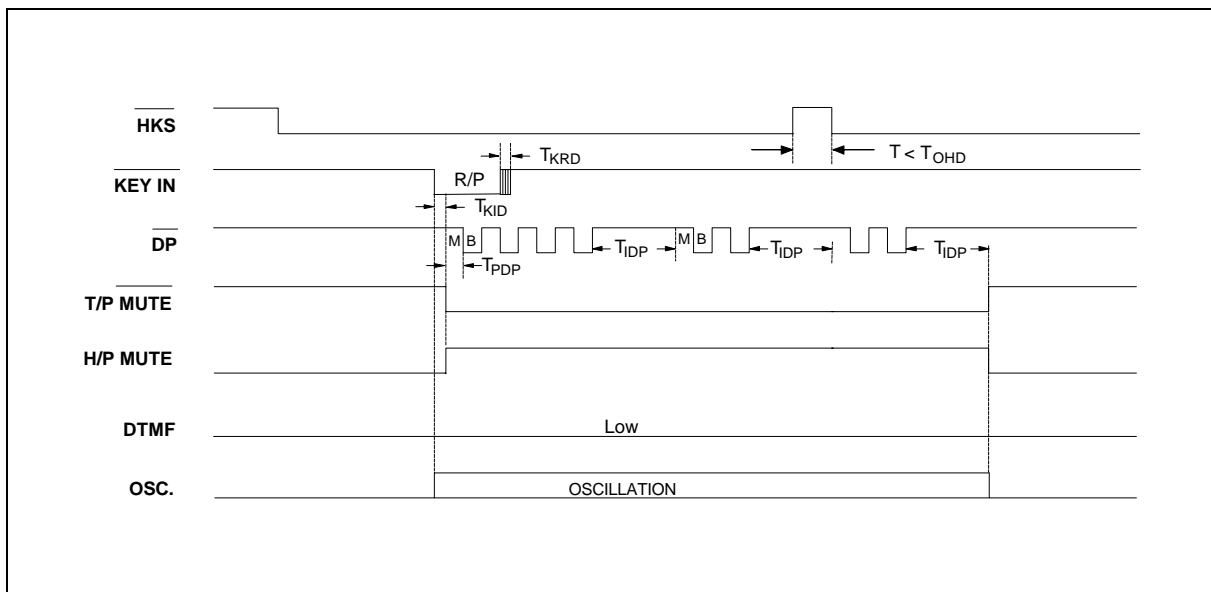


Figure 1(b) Pulse Mode Auto Dialing Timing Diagram

Timing Waveforms, continued

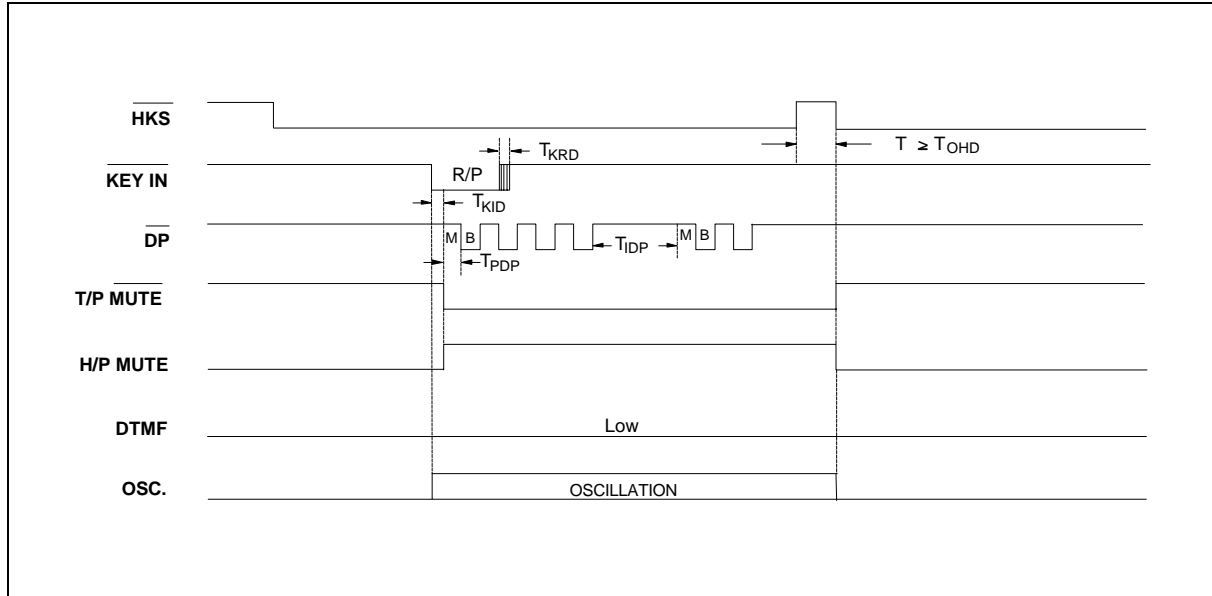


Figure 1(c) Pulse Mode Auto Dialing Timing Diagram

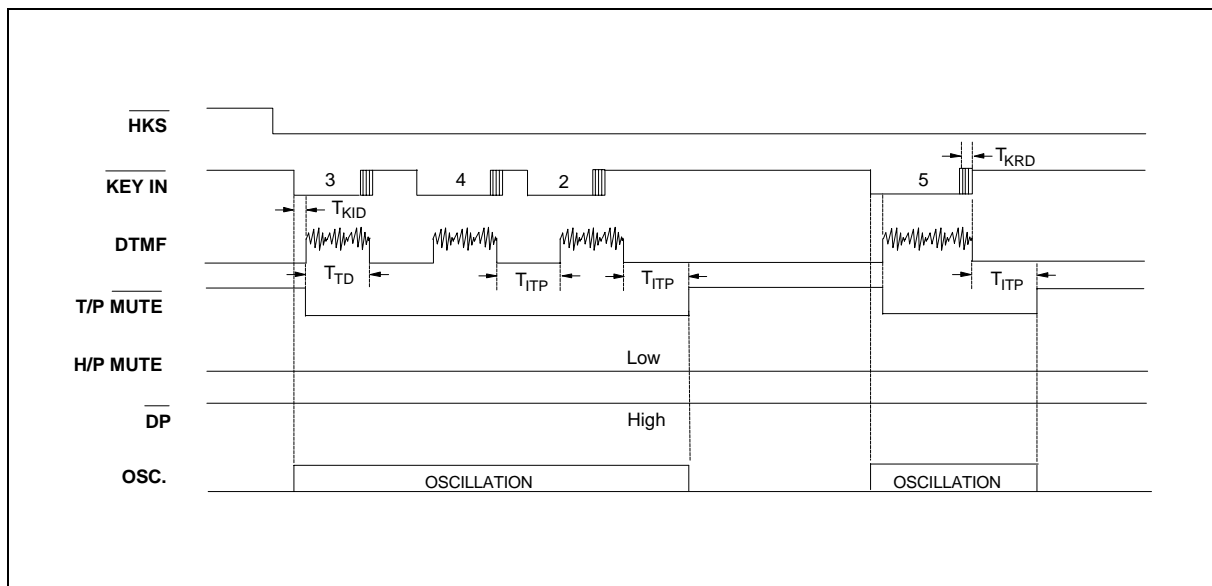


Figure 2(a) Tone Mode Normal Dialing Timing Diagram

Timing Waveforms, continued

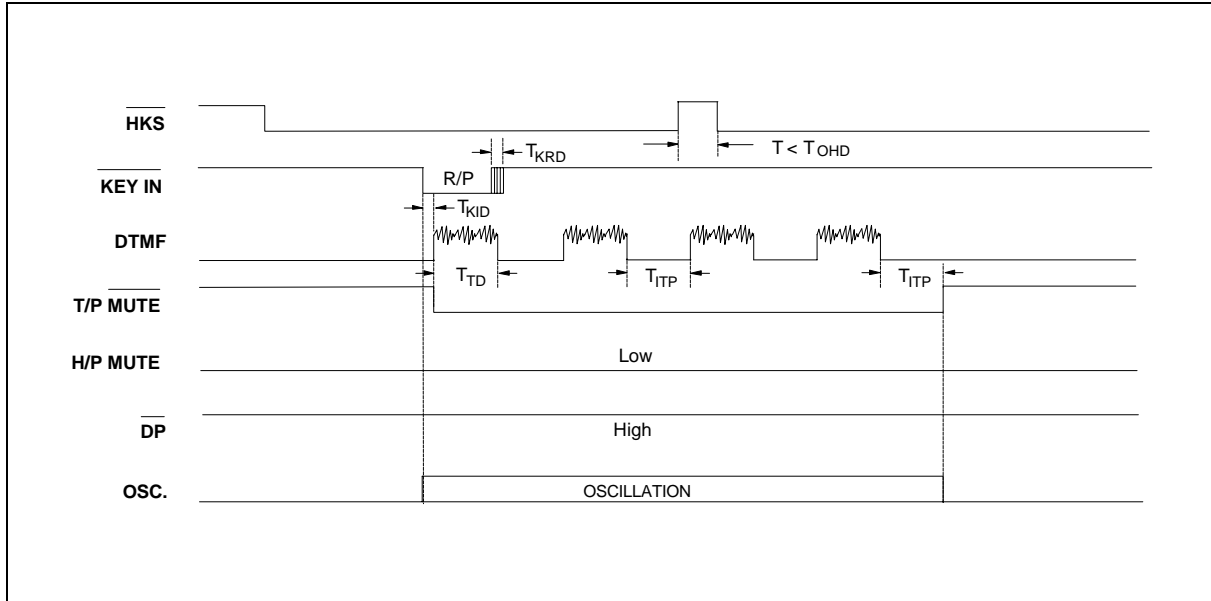


Figure 2(b) Tone Mode Auto Dialing Timing Diagram

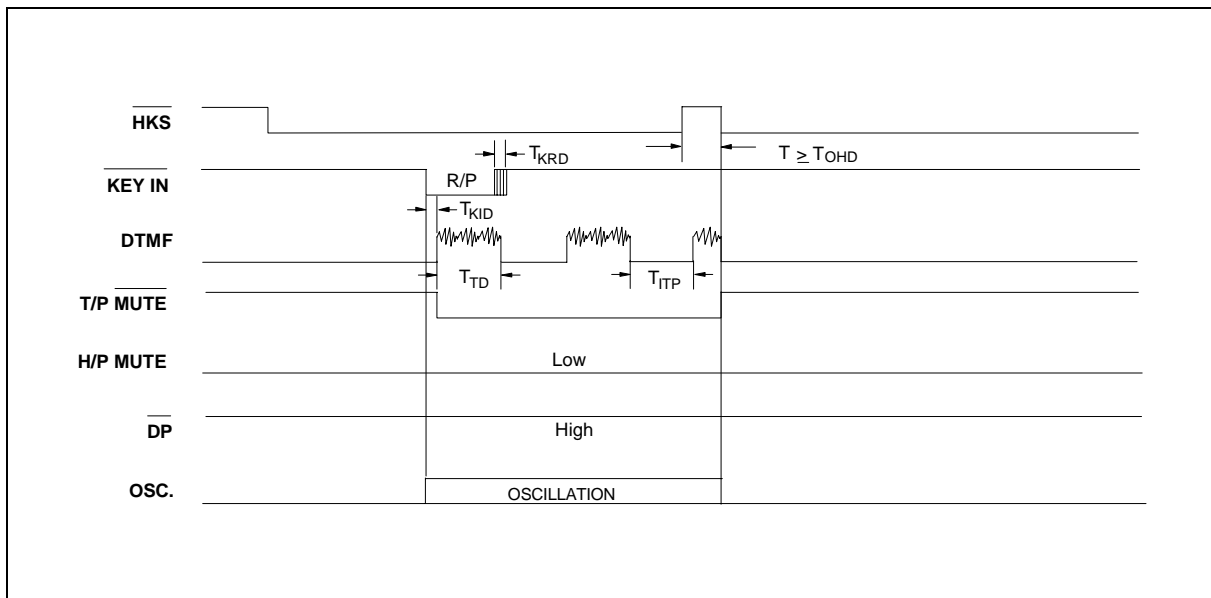


Figure 2(c) Tone Mode Auto Dialing Timing Diagram



Timing Waveforms, continued

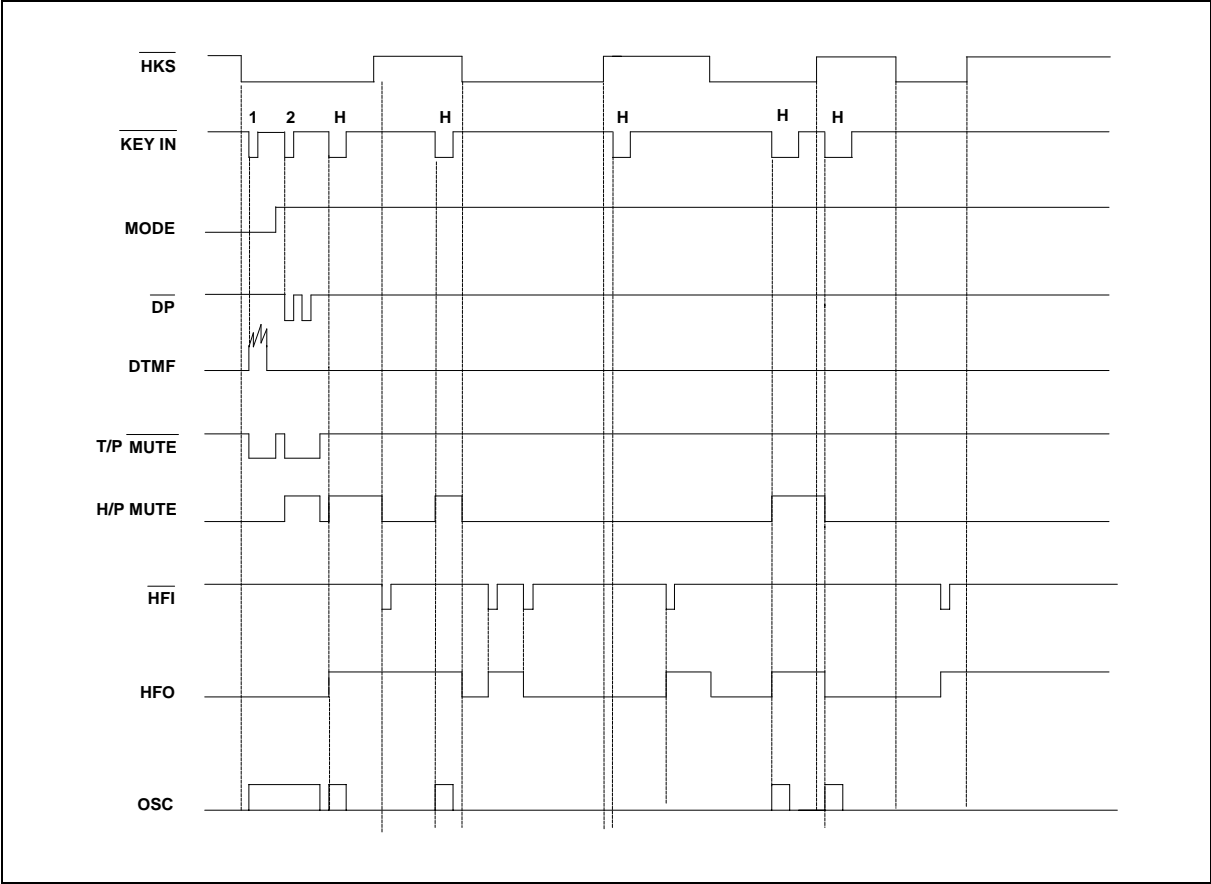


Figure 3. Handfree Function Timing Diagram

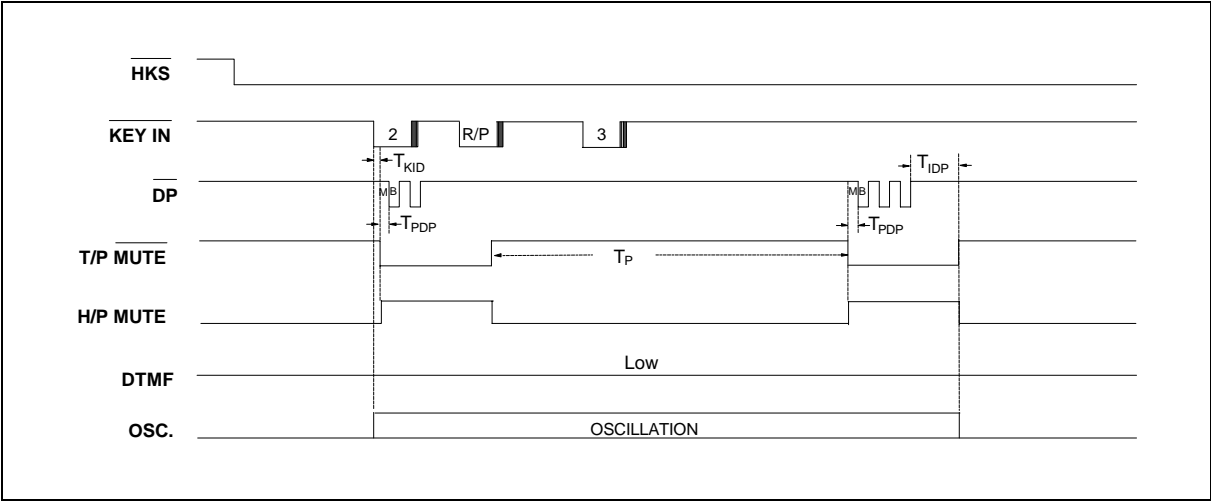


Figure 4. Pause Function Timing Diagram

Timing Waveforms, continued

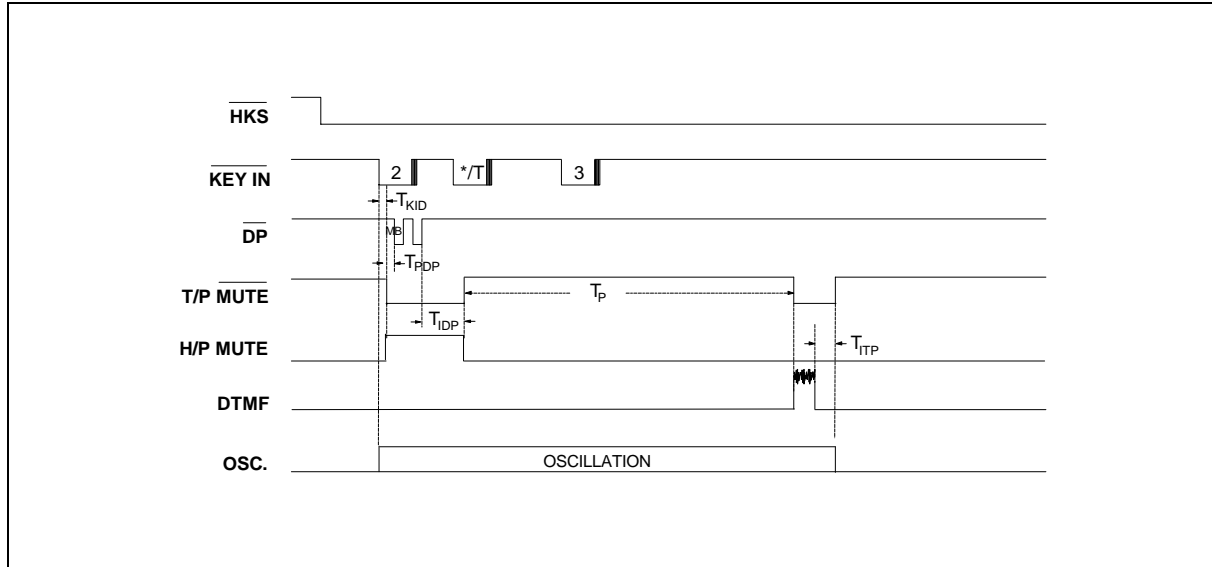


Figure 5(a). Pulse-to-tone Timing Diagram (All Versions Except W91354AN)

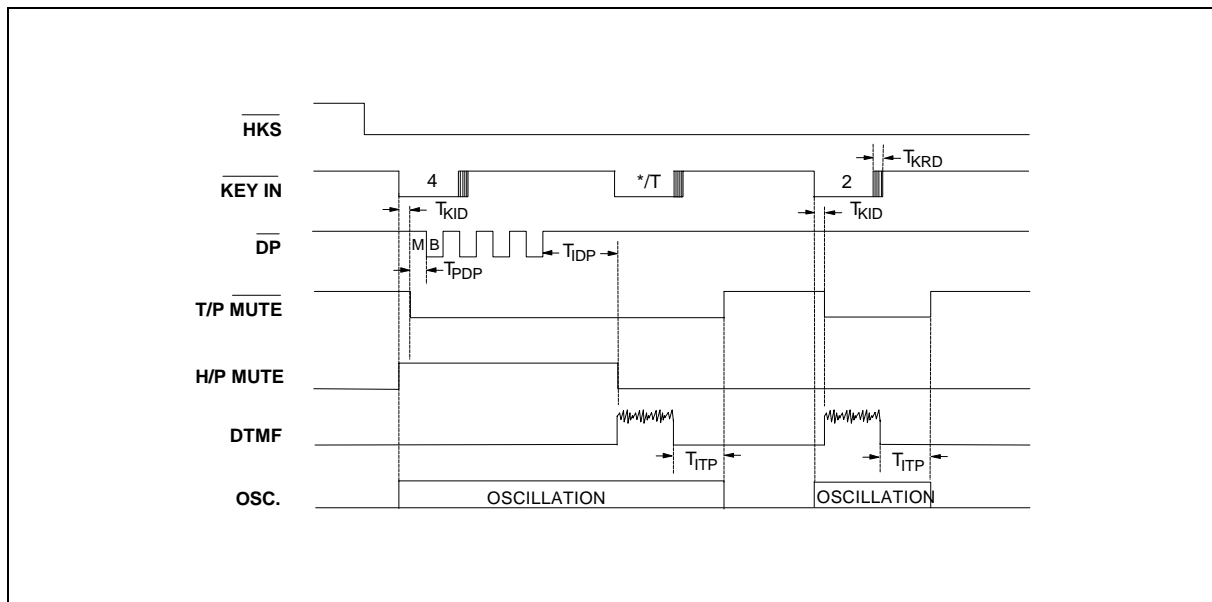


Figure 5(b). Pulse-to-tone Timing Diagram (W91354AN Only)

Timing Waveforms, continued

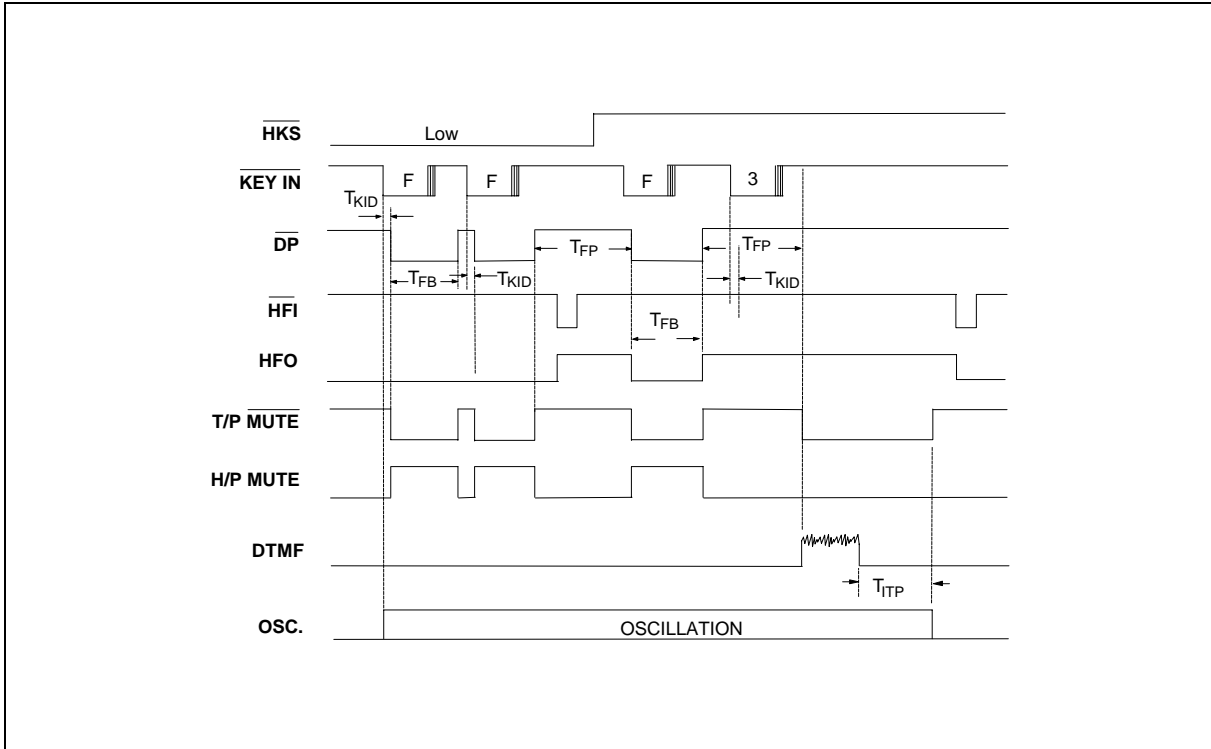


Figure 6. Flash Timing Diagram



W91350N SERIES



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