

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

### GENERAL DESCRIPTION

The W91350N series are tone/pulse 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

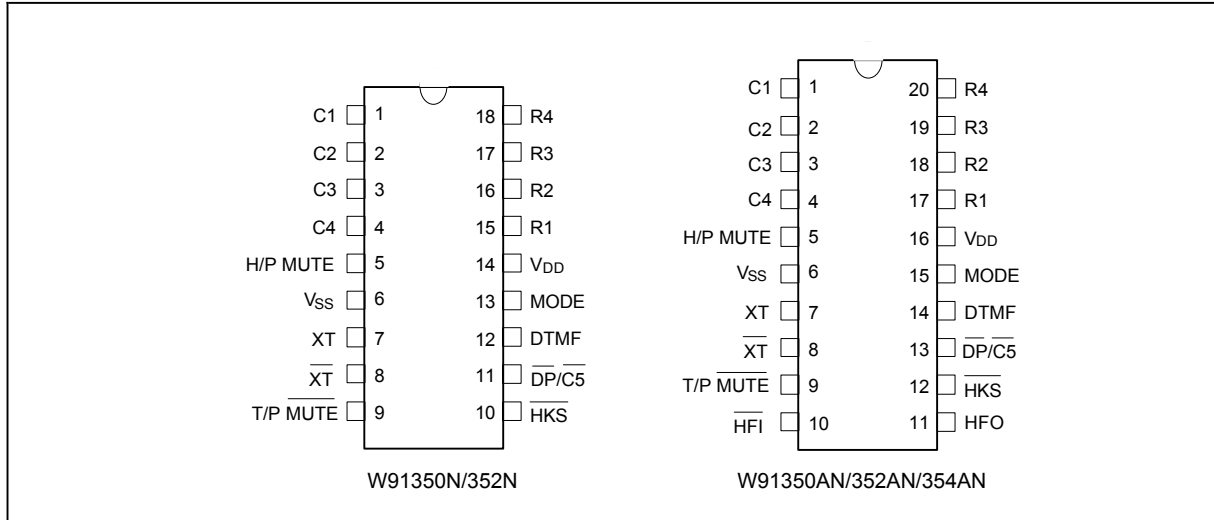
- DTMF/pulse switchable dialer
- Two by 32-digit redial memory and save memory
- Three by 16-digit one-touch direct repertory memory
- Ten by 16-digit two-touch direct repertory memory
- Cascaded dialing allowed, with unlimited dialing length
- Pulse-to-tone (\*T) keypad for long distance call operation
- 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.

# W91350N SERIES

## 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 $\mu\text{C}$ 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 $\overline{\text{MUTE}}$	9	9	O	The T/P $\overline{\text{MUTE}}$ 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 $V_{\text{SS}}$ places the dialer in tone mode. Pulling mode pin to $V_{\text{DD}}$ 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).
$\overline{\text{HKS}}$	10	12	I	Hook switch input. $\overline{\text{HKS}} = V_{\text{DD}}$ : On-hook state. Chip in sleeping mode, no operation. $\overline{\text{HKS}} = V_{\text{SS}}$ : Off-hook state. Chip is enabled for normal operation. $\overline{\text{HKS}}$ pin is pulled to $V_{\text{DD}}$ by an internal resistor.

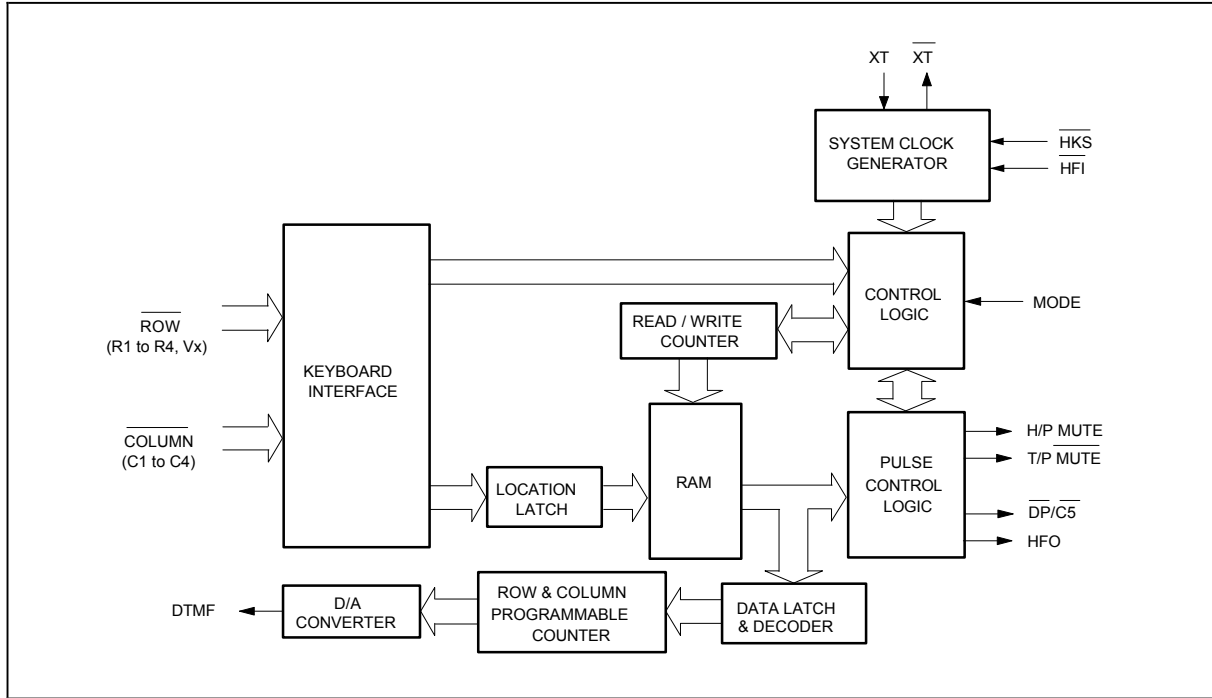
# W91350N SERIES

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" style="margin: 10px auto;"> <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				
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$\overline{HFI}$ , 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" style="margin: 10px auto;"> <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><math>\overline{HFI}</math> </td> <td>High</td> <td>Yes</td> </tr> <tr> <td>On Hook</td> <td>High</td> <td><math>\overline{HFI}</math> </td> <td>Low</td> <td>No</td> </tr> <tr> <td>Off Hook</td> <td>High</td> <td><math>\overline{HFI}</math> </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> <p><math>\overline{HFI}</math> pin is pulled to VDD by an internal resistor. Detailed timing diagram is shown in Figure 3.</p>	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
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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.																																								

# W91350N SERIES

## BLOCK DIAGRAM



## FUNCTIONAL DESCRIPTION

### Keyboard Operation

C1	C2	C3	C4	$\overline{DP/C5}$	
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

# W91350N SERIES

## Normal Dialing

OFF HOOK , (or  ON HOOK &   $\overline{\text{HFI}} \cdot \underline{\quad}$  ),  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 &   $\overline{\text{HFI}} \cdot \underline{\quad}$  ),  D1 ,  D2 , ...,  Dn Busy, Come  
 ON HOOK ,  OFF HOOK , (or  ON HOOK &   $\overline{\text{HFI}} \cdot \underline{\quad}$  ),  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 &   $\overline{\text{HFI}} \cdot \underline{\quad}$  ),  D1 ,  D2 , ...,  Dn ,  S ,  S ,  
 Mn ( or  Ln )

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

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

OFF HOOK , (or  ON HOOK &   $\overline{\text{HFI}} \cdot \underline{\quad}$  ),  A ,  Ln

## Access Pause

# W91350N SERIES

OFF HOOK , (or  ON HOOK &   $\overline{\text{HF}}\text{I} \cdot \underline{\quad}$  ),  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, redial dialing, or memory dialing.
3. A detailed timing diagram for the pause function is shown in Figure 4.

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

OFF HOOK , (or  ON HOOK &   $\overline{\text{HF}}\text{I} \cdot \underline{\quad}$  ),  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 (3.6 sec.), D1', D2', ..., Dn'  
 (Pulse) (Tone)  
 The pause time will be added in all versions except for the W91354AN.
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 pulse-to-tone function timing diagram is shown in Figure 5(a, b).

## Flash

OFF HOOK , (or  ON HOOK &   $\overline{\text{HF}}\text{I} \cdot \underline{\quad}$  ),  Fn

1. Fn = F1, ..., F4
2. 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.
3. Flash key cannot be stored as a digit in memory, and it 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.

## Save

OFF HOOK , (or  ON HOOK &   $\overline{\text{HF}}\text{I} \cdot \underline{\quad}$  ),  D1 ,  D2 , ...,  Dn ,  SAVE

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

## Cascaded Dialing

1.  Normal Dialing +  Repertory Dialing +  Normal Dialing
2.  Repertory Dialing +  Normal Dialing +  Repertory Dialing

# W91350N SERIES

3. 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 <sub>DD</sub> -V <sub>SS</sub>	-0.3 to +7.0	V
Input/Output Voltage	V <sub>IL</sub>	V <sub>SS</sub> -0.3	V
	V <sub>IH</sub>	V <sub>DD</sub> +0.3	V
	V <sub>OL</sub>	V <sub>SS</sub> -0.3	V
	V <sub>OH</sub>	V <sub>DD</sub> +0.3	V
Power Dissipation	P <sub>D</sub>	120	mW
Operation Temperature	T <sub>OPR</sub>	-20 to +70	°C
Storage Temperature	T <sub>STG</sub>	-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<sub>DD</sub>-V<sub>SS</sub> = 2.5V, F<sub>osc</sub> = 3.579545 MHz, T<sub>A</sub> = 25° C, All outputs unloaded)

PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Operating Voltage	V <sub>DD</sub>	-	2.0	-	5.5	V
Operating Current	I <sub>OP</sub>	Tone, Unloaded	-	0.4	0.6	mA
		Pulse, Unloaded	-	0.2	0.4	
Standby Current	I <sub>SB</sub>	$\overline{HKS} = V_{SS}$ , No load & No key entry	-	-	15	μA
Memory Retention Current	I <sub>MR</sub>	$\overline{HKS} = V_{DD}$ , V <sub>DD</sub> = 1.0V	-	-	0.2	μA
DTMF Output Voltage	V <sub>TO</sub>	Row group, R <sub>L</sub> = 5 KΩ	130	150	170	mV <sub>rms</sub>
Pre-emphasis	-	Col/Row, V <sub>DD</sub> = 2.0 to 5.5V	1	2	3	dB
DTMF Distortion	THD	R <sub>L</sub> = 5 KΩ, V <sub>DD</sub> = 2.0 to 5.5V	-	-30	-23	dB
DTMF Output DC Level	V <sub>TDC</sub>	R <sub>L</sub> = 5 KΩ, V <sub>DD</sub> = 2.0 to 5.5V	1.0	-	3.0	V
DTMF Output Sink Current	I <sub>TL</sub>	V <sub>TO</sub> = 0.5V	0.2	-	-	mA
$\overline{DP}$ Output Sink Current	I <sub>PL</sub>	V <sub>P0</sub> = 0.5V	0.5	-	-	mA

# W91350N SERIES

T/P MUTE Output Sink Current	IML	VMO = 0.5V	0.5	-	-	mA
H/P Mute Output Drive/Sink Current	IHPH	VHPH = 2.0V	0.5	-	-	mA
	IHPL	VHPL = 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 <sup>1</sup>	TPDP1	Mode = VDD	-	40	-	mS
		10 ppS	-	33.3	-	
Pre-digit Pause <sup>2</sup>	TPDP2	Mode = VDD	-	20	-	mS
		20 ppS	-	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	-	



# W91350N SERIES

Flash Pause Time	TFP	F1, F2, F3, F4	-	1.0	-	S
Pause Time	TP	R/P	-	3.6	-	S

Notes:

1. Crystal parameters suggested for proper operation are  $R_s < 100$  ohms,  $L_m = 96$  mH,  $C_m = 0.02$  pF,  $C_n = 5$  pF,  $C_l = 18$  pF,  $F_{osc} = 3.579545$  MHz  $\pm$  0.02%.
2. Crystal oscillator accuracy directly affects these times.

# W91350N SERIES

## TIMING WAVEFORMS

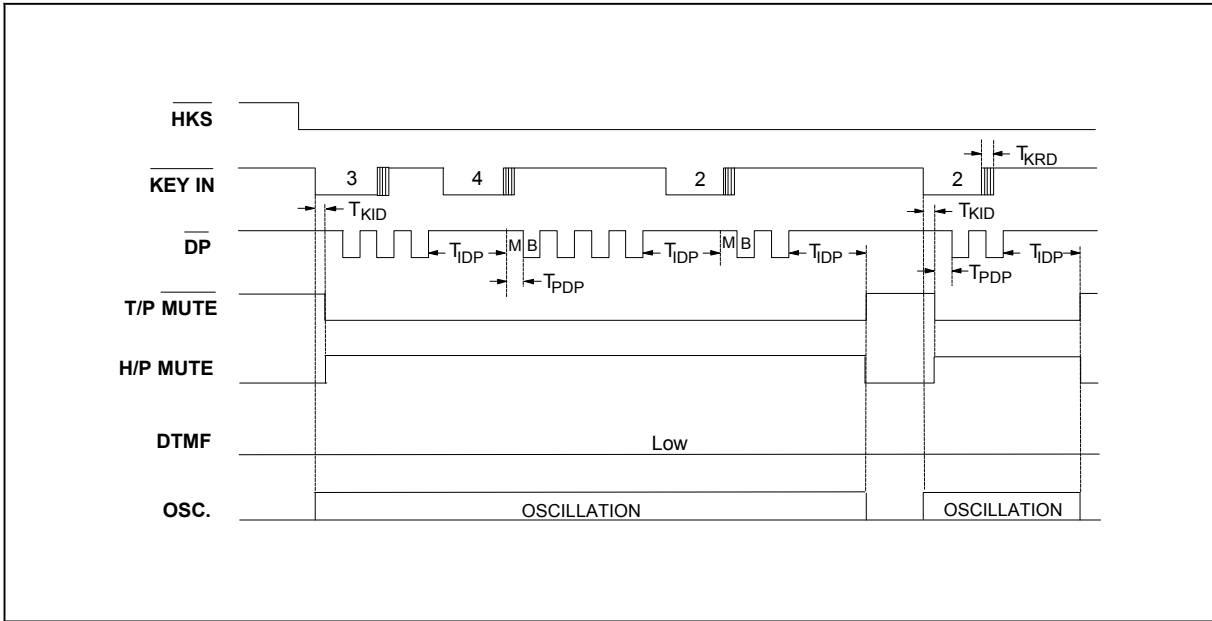


Figure 1(a). Normal Dialing Timing Diagram

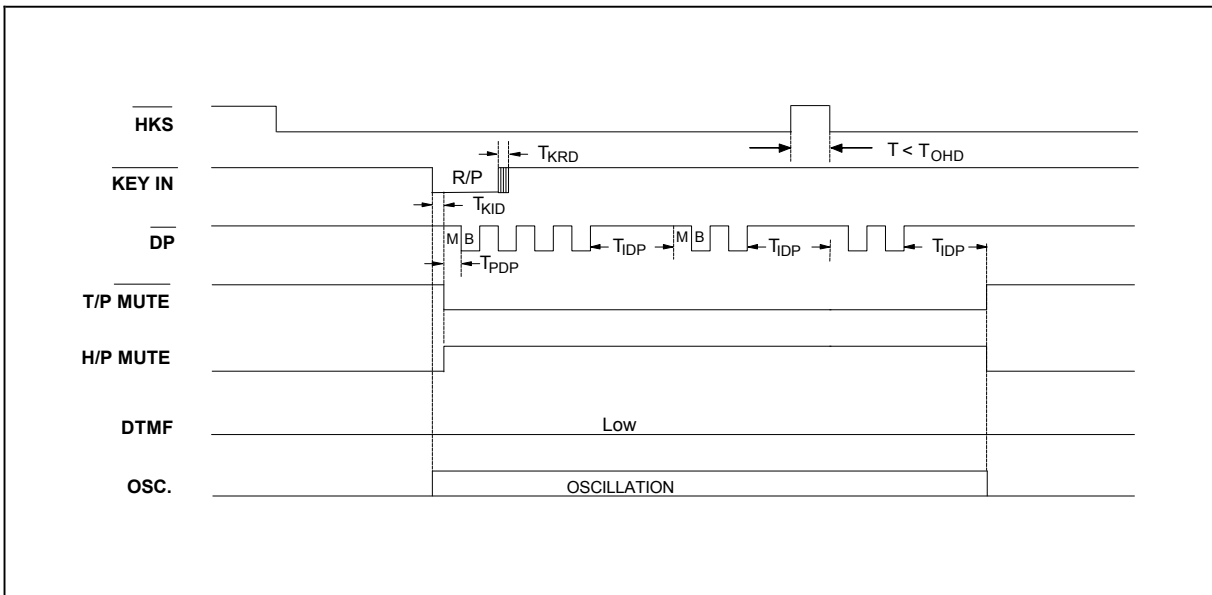


Figure 1(b) Pulse Mode Auto Dialing Timing Diagram

# W91350N SERIES

Timing Waveforms, continued

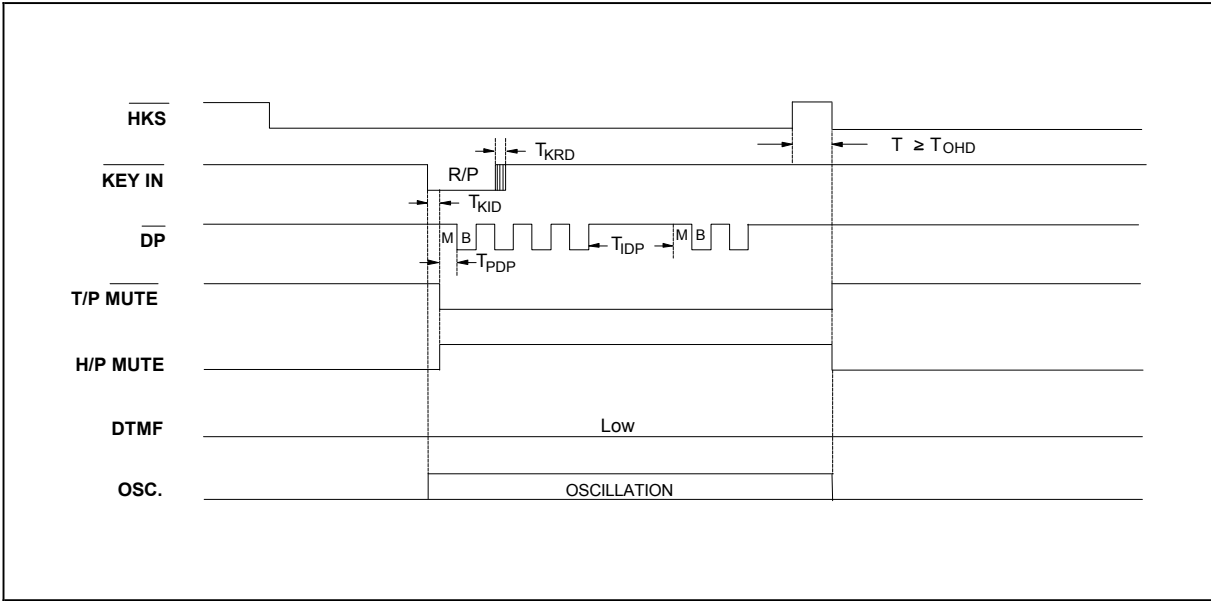


Figure 1(c) Pulse Mode Auto Dialing Timing Diagram

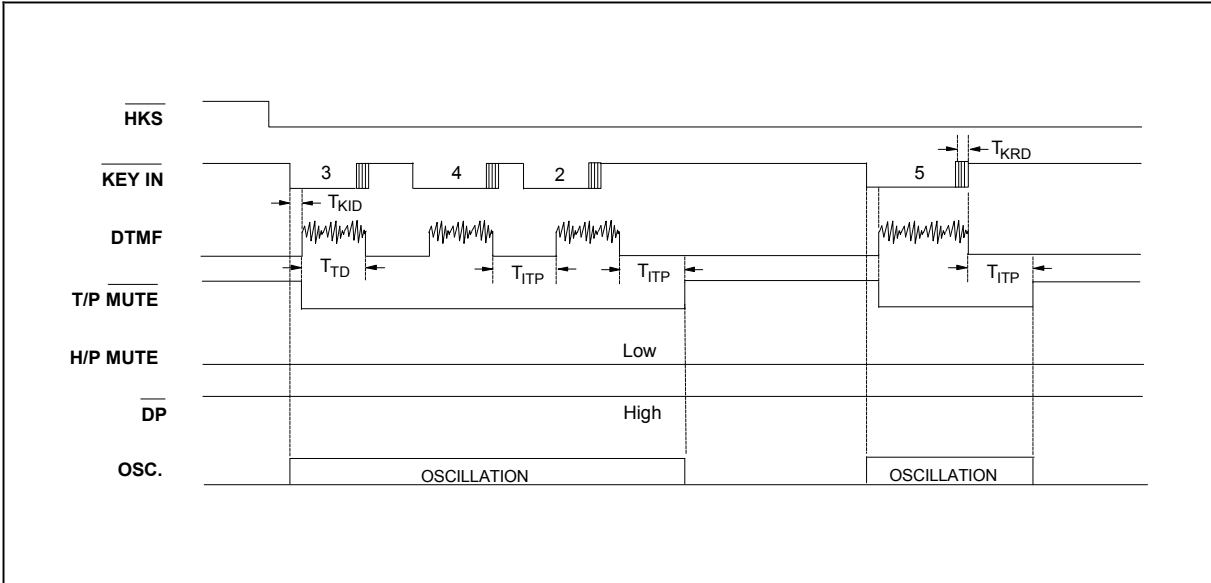


Figure 2(a) Tone Mode Normal Dialing Timing Diagram

# W91350N SERIES

Timing Waveforms, continued

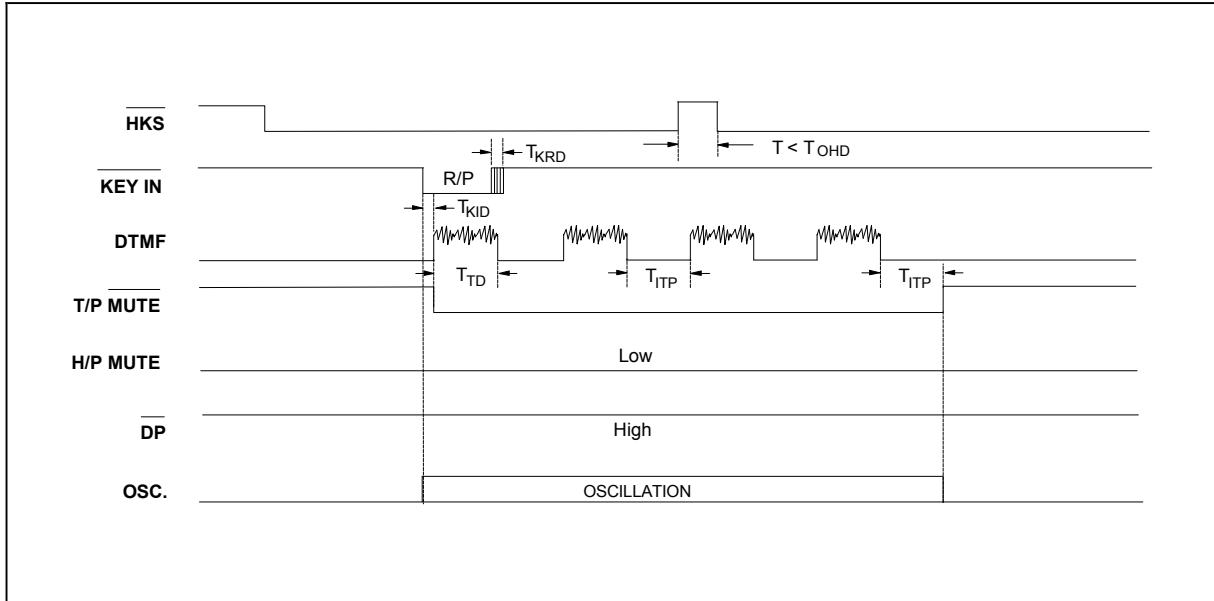
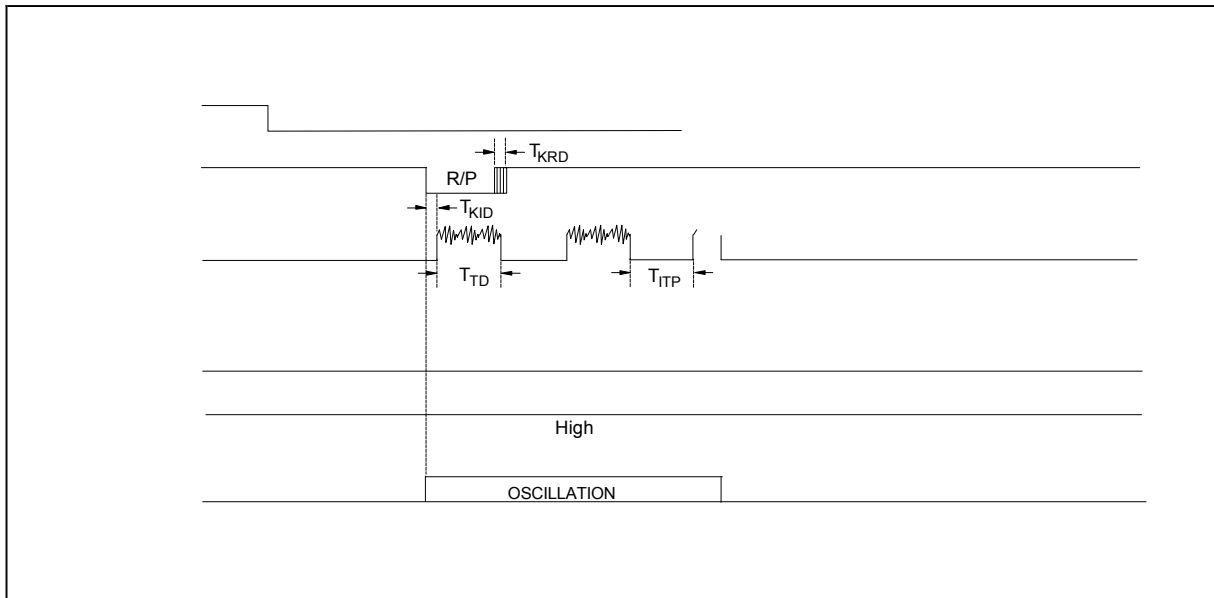


Figure 2(b) Tone Mode Auto Dialing Timing Diagram



# W91350N SERIES

Timing Waveforms, continued

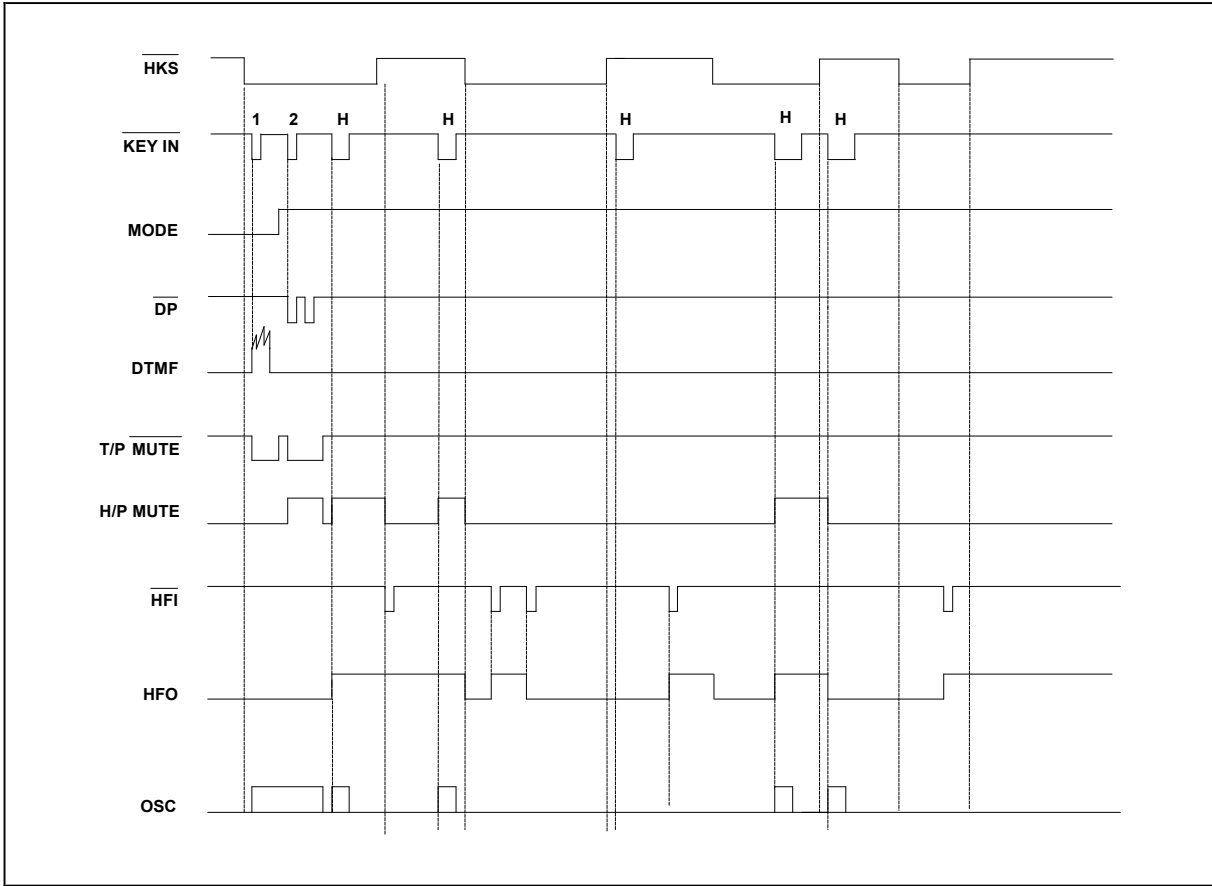


Figure 3. Handfree Function Timing Diagram

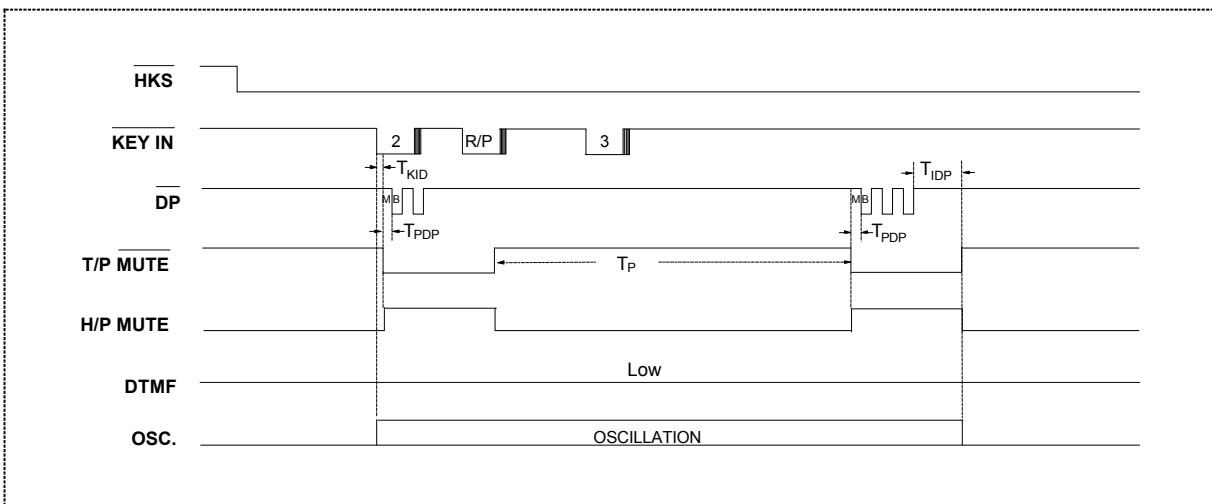


Figure 4. Pause Function Timing Diagram

# W91350N SERIES

Timing Waveforms, continued

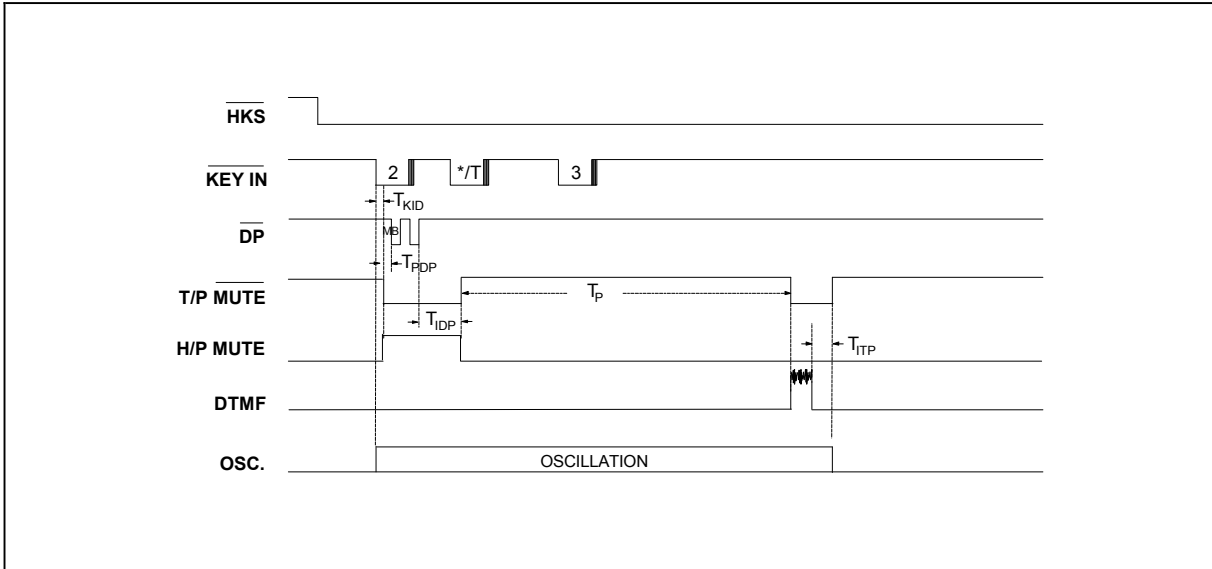


Figure 5(a). Pulse-to-tone Timing Diagram (All Versions Except W91354AN)

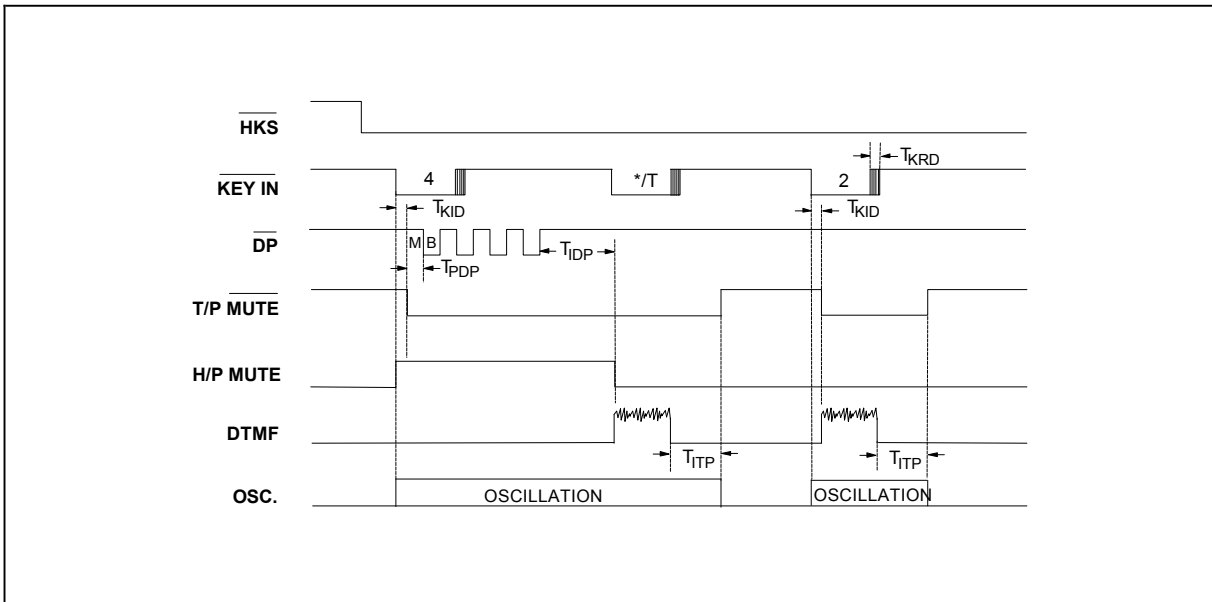


Figure 5(b). Pulse-to-tone Timing Diagram (W91354AN Only)

# W91350N SERIES

Timing Waveforms, continued

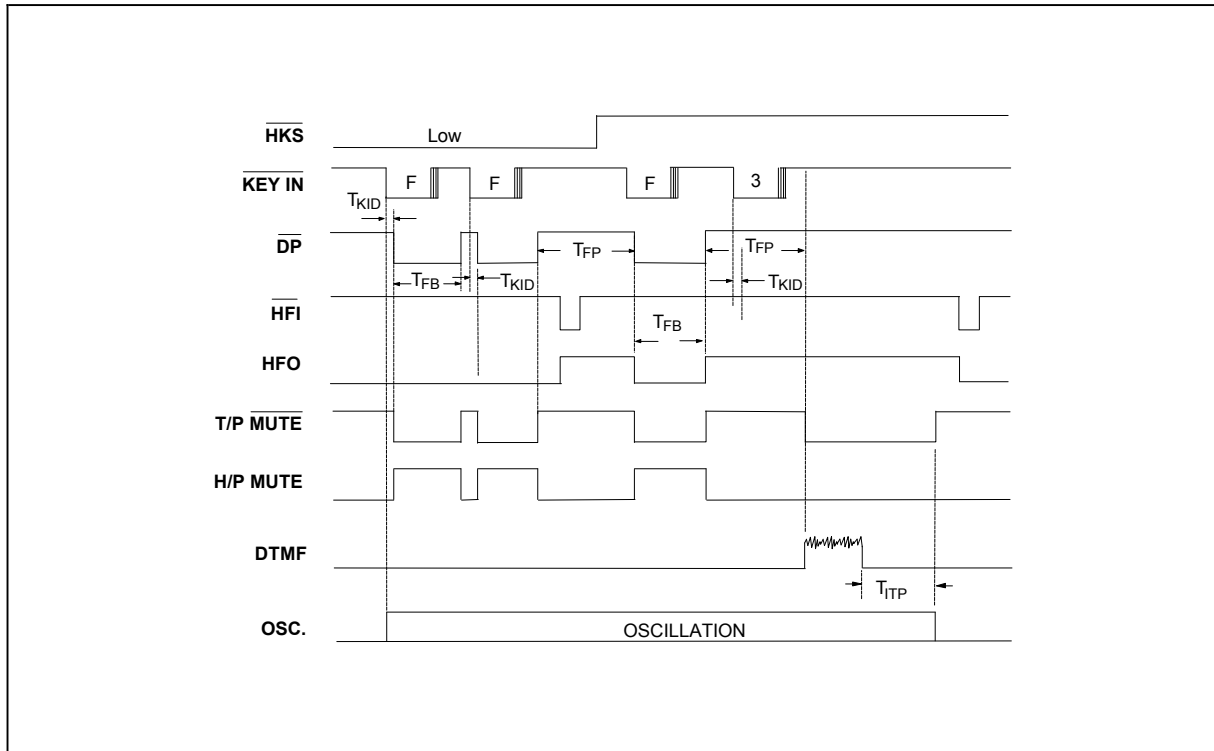


Figure 6. Flash Timing Diagram