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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$\rightarrow$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
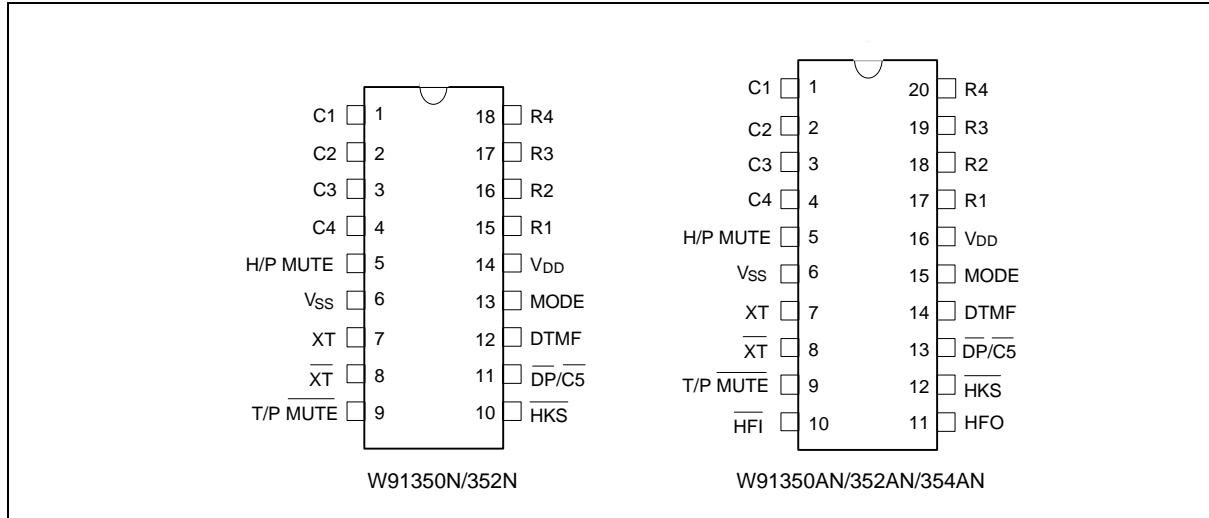- The different dialers in the W91350N series are shown in the following table:

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.

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PIN CONFIGURATIONS

```
                    ┌───┬───┐
          C1 ▯  1   │   U   │  18  ▯ R4
          C2 ▯  2   │       │  17  ▯ R3
          C3 ▯  3   │       │  16  ▯ R2
          C4 ▯  4   │       │  15  ▯ R1
       H/P MUTE ▯  5│       │  14  ▯ VDD
          VSS ▯  6  │       │  13  ▯ MODE
           XT ▯  7  │       │  12  ▯ DTMF
          X̄T ▯  8   │       │  11  ▯ DP̄/C̄5
       T/P MŪTE ▯ 9 │       │  10  ▯ H̄KS
                    └───────┘
              W91350N/352N
```

```
                    ┌───┬───┐
          C1 ▯  1   │   U   │  20  ▯ R4
          C2 ▯  2   │       │  19  ▯ R3
          C3 ▯  3   │       │  18  ▯ R2
          C4 ▯  4   │       │  17  ▯ R1
       H/P MUTE ▯  5│       │  16  ▯ VDD
          VSS ▯  6  │       │  15  ▯ MODE
           XT ▯  7  │       │  14  ▯ DTMF
          X̄T ▯  8   │       │  13  ▯ DP̄/C̄5
       T/P MŪTE ▯ 9 │       │  12  ▯ H̄KS
          H̄FI ▯  10 │       │  11  ▯ HFO
                    └───────┘
           W91350AN/352AN/354AN
```

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, $\overline{XT}$	7, 8	7, 8	I, O	A built-in inverter provides oscillation with an inexpensive 3.579545 MHz crystal or ceramic resonator.
T/P $\overline{MUTE}$	9	9	O	The T/P $\overline{MUTE}$ 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 VSS places the dialer in tone mode. Pulling mode pin to VDD 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).
$\overline{HKS}$	10	12	I	Hook switch input. $\overline{HKS}$ = VDD: On-hook state. Chip in sleeping mode, no operation. $\overline{HKS}$ = VSS: Off-hook state. Chip is enabled for normal operation. HKS pin is pulled to VDD by an internal resistor.

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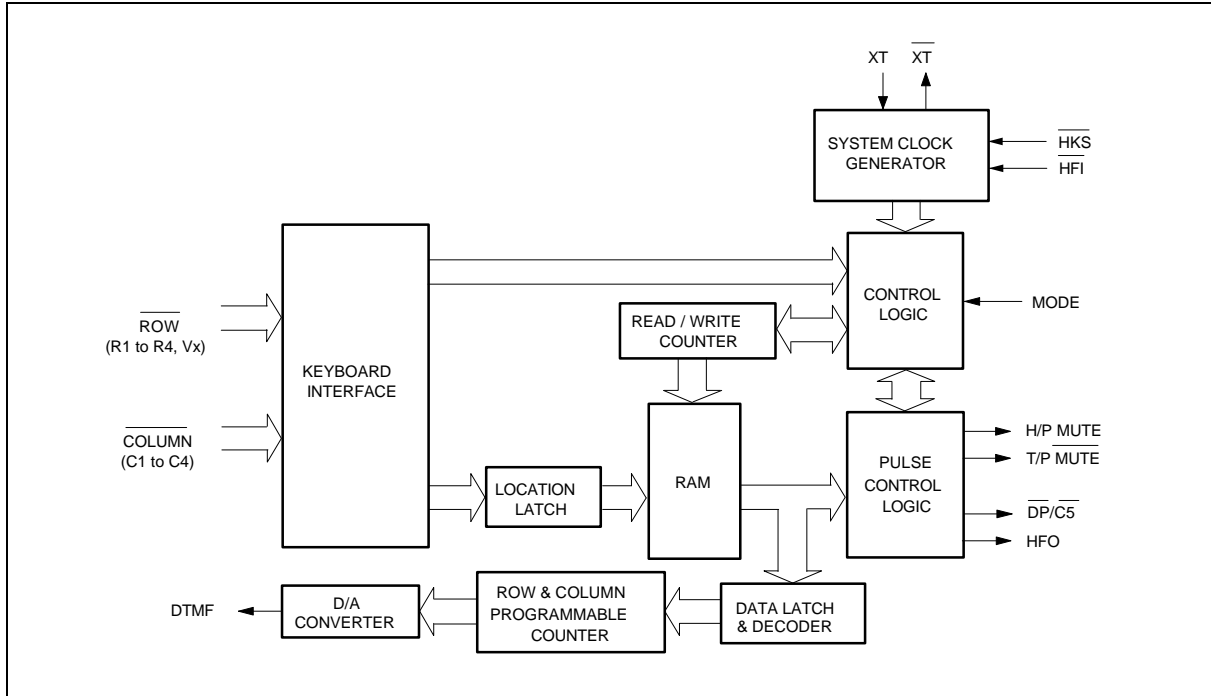Pin Description, continued

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).
V_{DD}, V_{SS}	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).
$\overline{HFI}$, 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:
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.

Output Frequency table (within DTMF row):

	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

Handfree control state table (within $\overline{HFI}$, HFO row):

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

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

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Normal Dialing

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

| ON HOOK | , | OFF HOOK | , (or | ON HOOK | & | $\overline{HFI}$ 亻ổ |), | 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 | & | $\overline{HFI}$ 亻ổ |), | 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 | & | $\overline{HFI}$ 亻ổ |), | 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 | & | $\overline{HFI}$ 亻ổ |), | Mn |

| OFF HOOK | , (or | ON HOOK | & | $\overline{HFI}$ 亻ổ |), | A | , | Ln |

Access Pause

| OFF HOOK | , (or | ON HOOK | & | HFI ¡õ̲ |), | 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 | & | HFI ¡õ̲ |), | 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 | & | HFI ¡õ̲ |), | 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 | & | HFI ¡õ̲ |), | 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

1. | Normal Dialing | + | Repertory Dialing | + | Normal Dialing |

2. | Repertory Dialing | + | Normal Dialing | + | Repertory Dialing |

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	$V_{DD}-V_{SS}$	-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
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 $\overline{\text{MUTE}}$ Output Sink Current	I_{ML}	V_{MO} = 0.5V	0.5	-	-	mA
H/P Mute Output	I_{HPH}	V_{HPH} = 2.0V	0.5	-	-	mA
Drive/Sink Current	I_{HPL}	V_{HPL} = 0.5V	0.5	-	-	mA

DC Characteristics, continued

PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNIT
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
$\overline{\text{HKS}}$ I/P Pull-high Resistor	R_{HK}	-	-	300	-	KΩ
Keypad Resistance	R_K	-	-	-	5.0	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
On-hook Debounce	T_{OHD}	-	-	150	-	mS
Pre-digit Pause[1]	T_{PDP1}	Mode = V_{DD}	-	40	-	mS
	10 ppS	Mode = Floating	-	33.3	-	
Pre-digit Pause[2]	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	-	
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
		W91354AN Only	-	87	-	
Intertone Pause	T_{ITP}	Auto dialing	-	93	-	mS
		W91354AN Only	-	87	-	
Flash Break Time	T_{FB}	F1	-	600	-	mS
		F2	-	300	-	
		F3		73		
		F4	-	100	-	

Flash Pause Time	T_{FP}	F1, F2, F3, F4	**-**	1.0	**-**	S
Pause Time	T_P	R/P	**-**	3.6	**-**	S

Notes:

1. 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%.

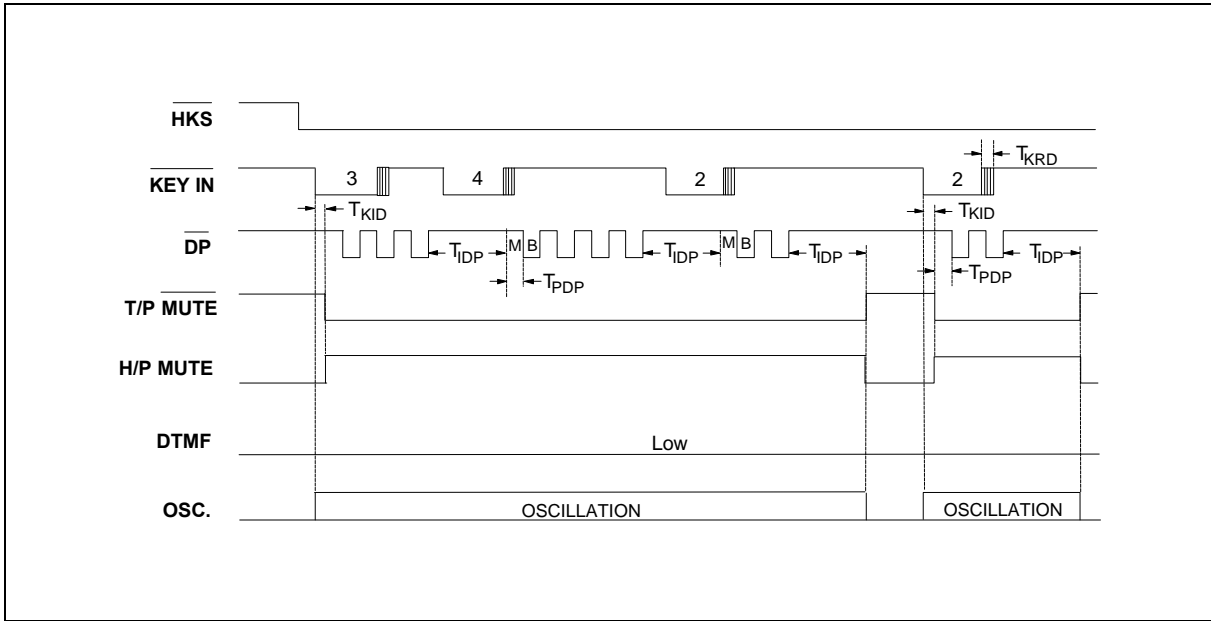2. Crystal oscillator accuracy directly affects these times.

W91350N SERIES
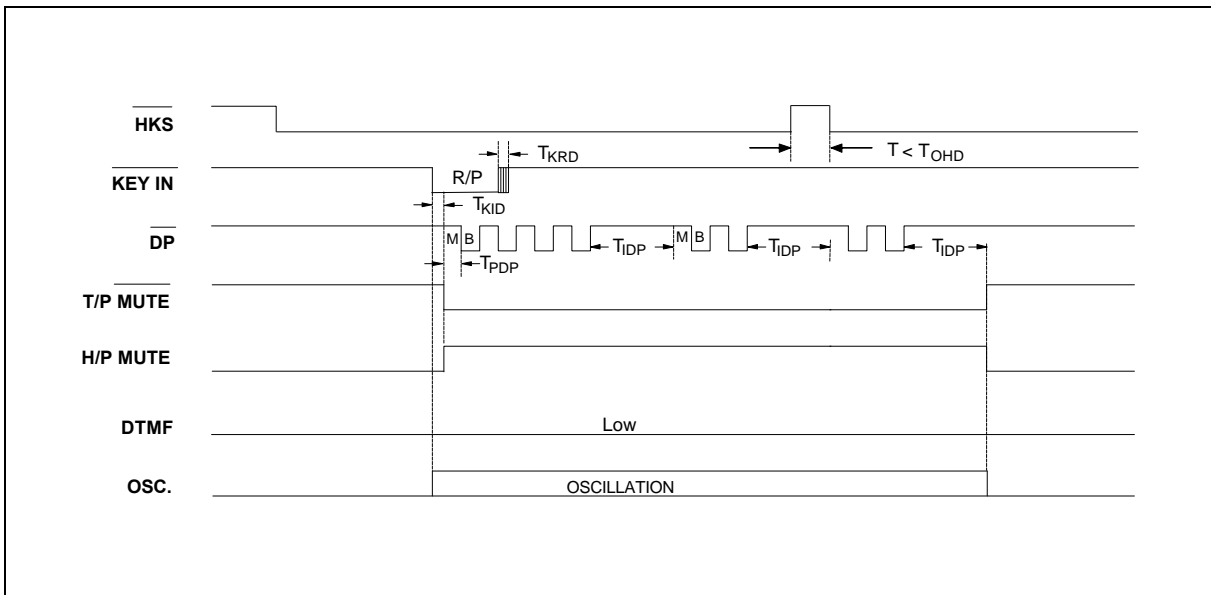
TIMING WAVEFORMS

Figure 1(a). Normal Dialing Timing Diagram

Figure 1(b) Pulse Mode Auto Dialing Timing Diagram

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Timing Waveforms, continued
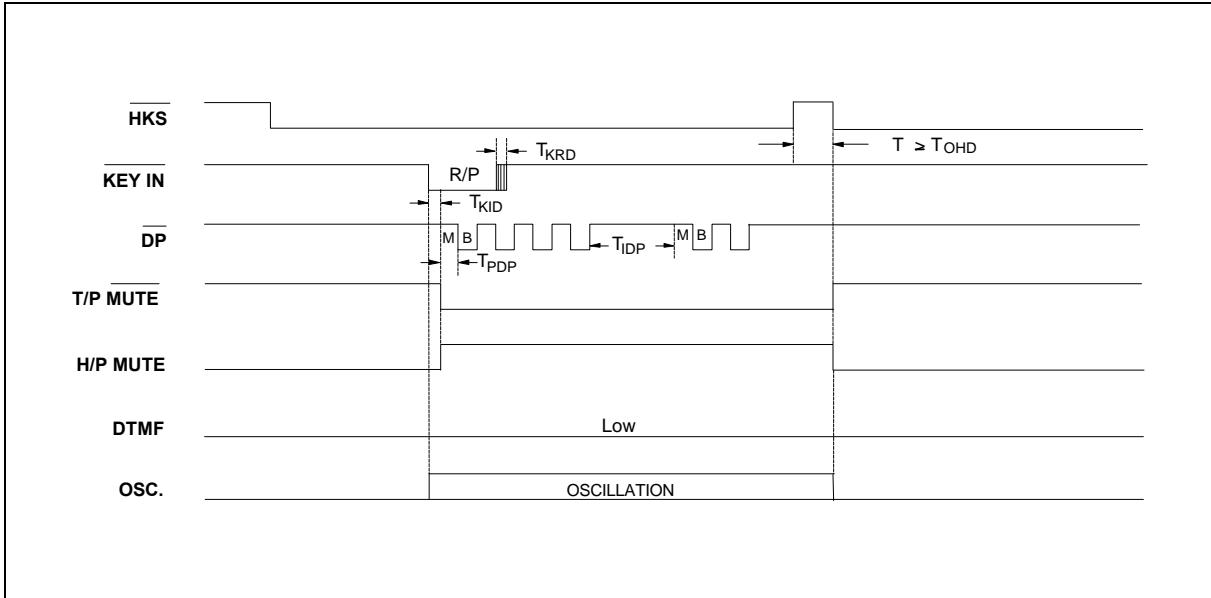
Figure 1(c) Pulse Mode Auto Dialing Timing Diagram
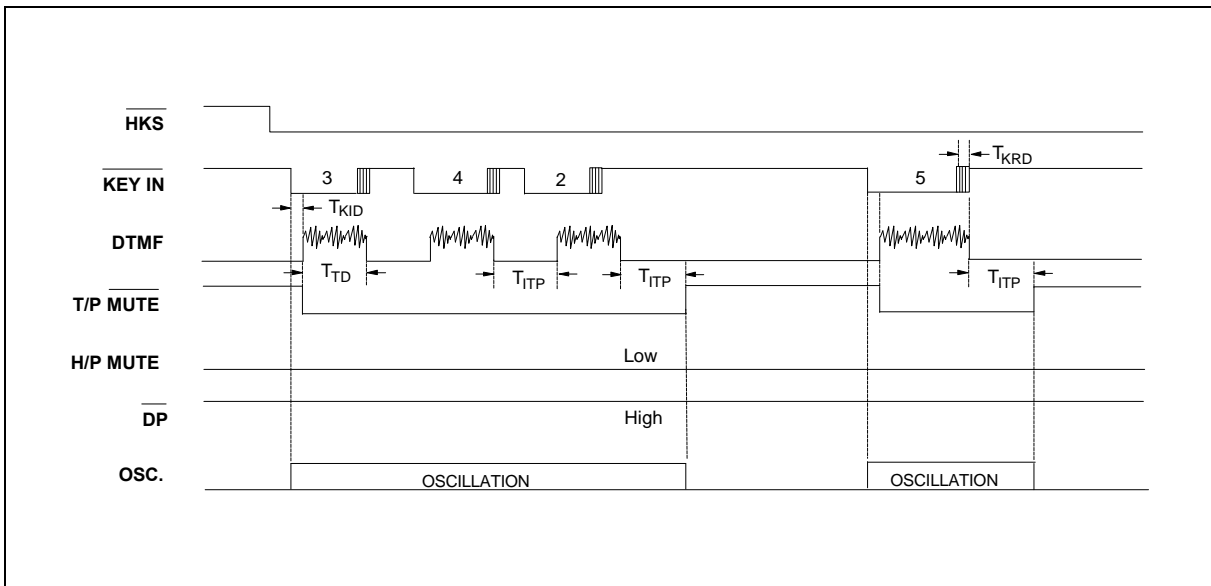
Figure 2(a) Tone Mode Normal Dialing Timing Diagram

Timing Waveforms, continued
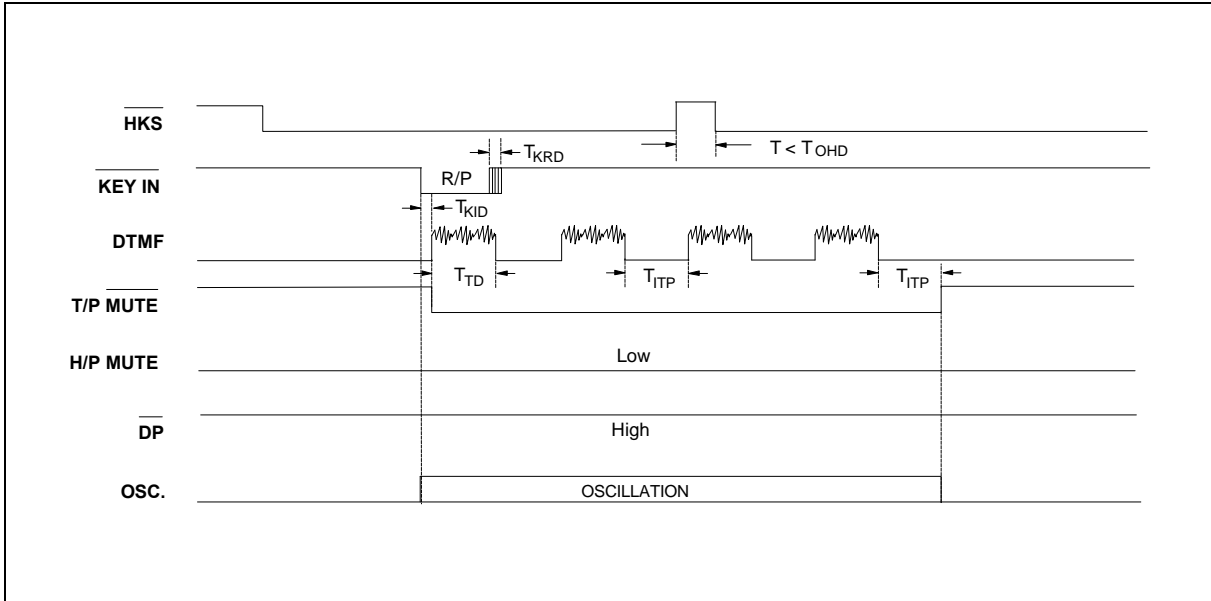
Figure 2(b) Tone Mode Auto Dialing Timing Diagram
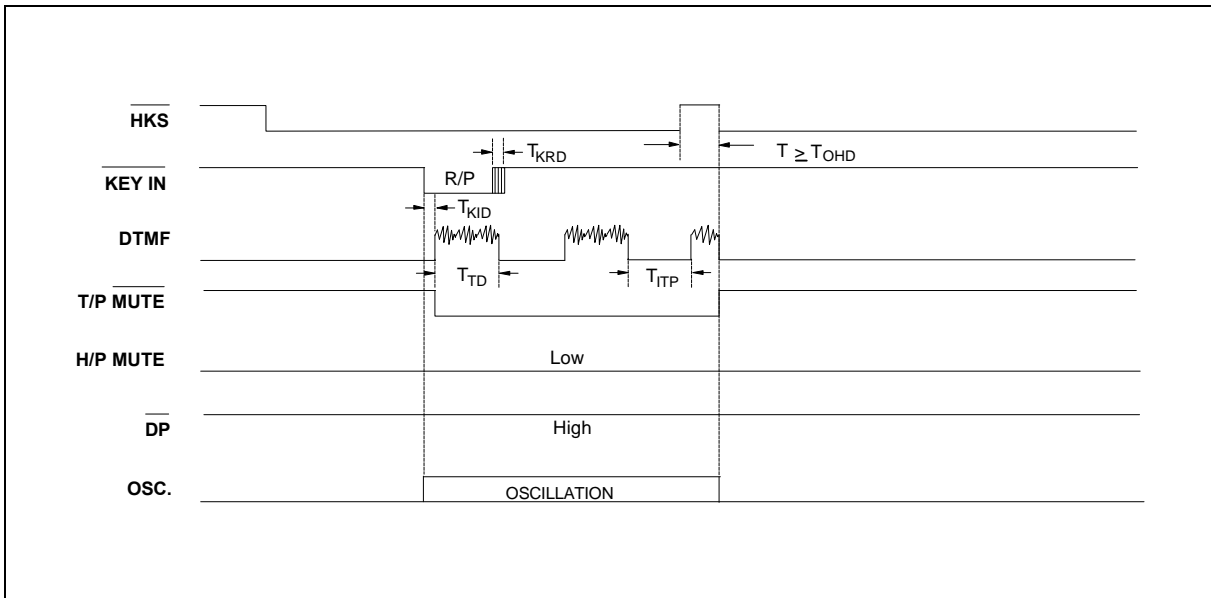
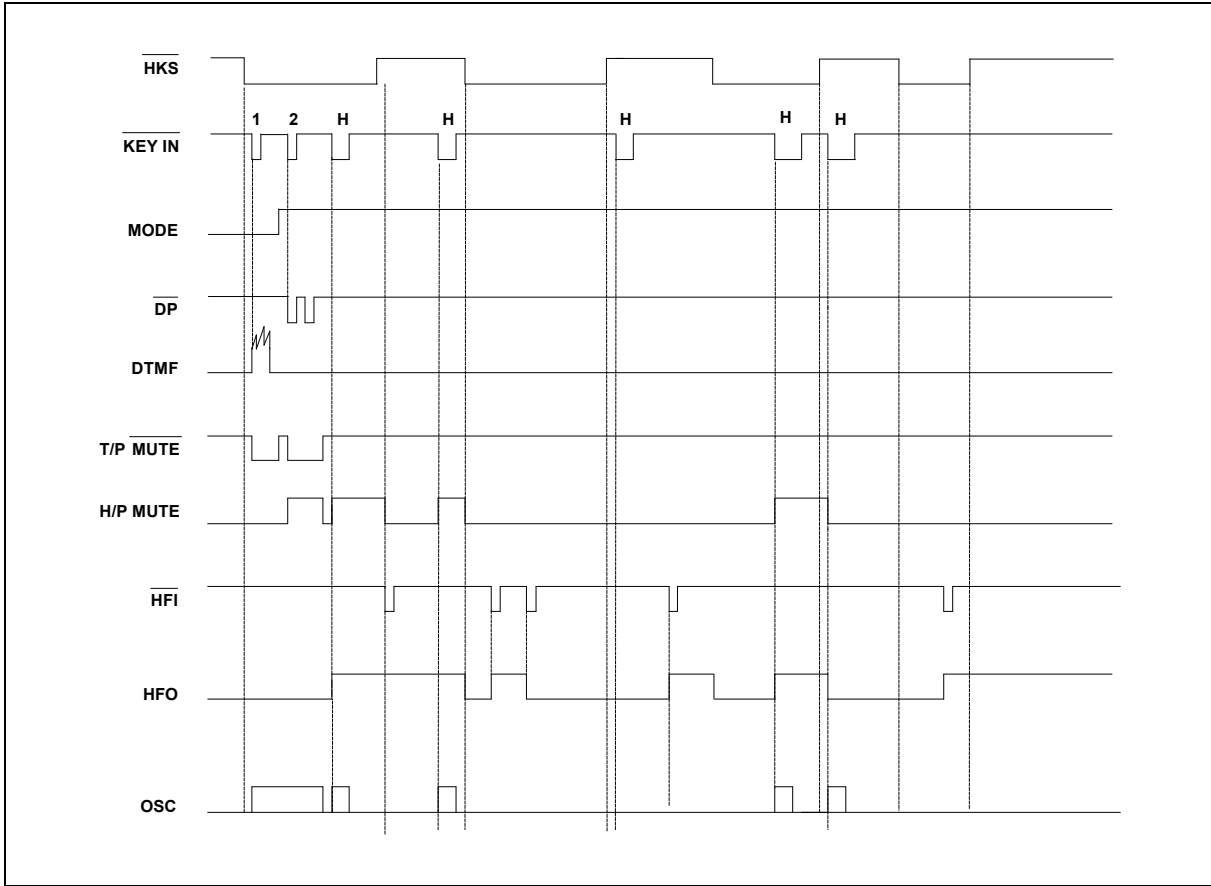Figure 2(c) Tone Mode Auto Dialing Timing Diagram

Timing Waveforms, continued

Figure 3. Handfree Function Timing Diagram

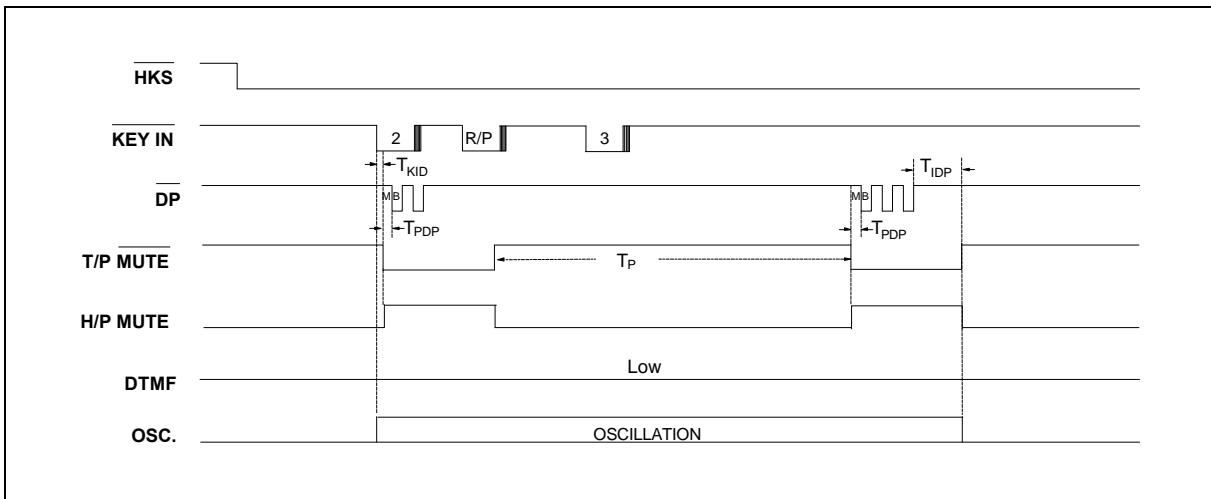Figure 4. Pause Function Timing Diagram
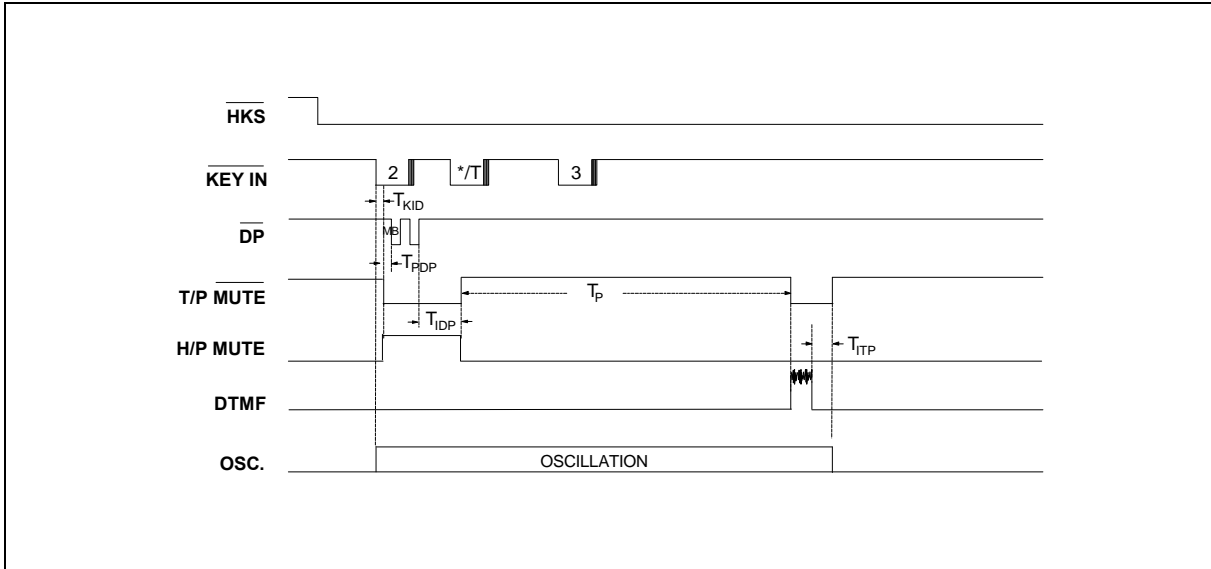
- 13 -

Timing Waveforms, continued

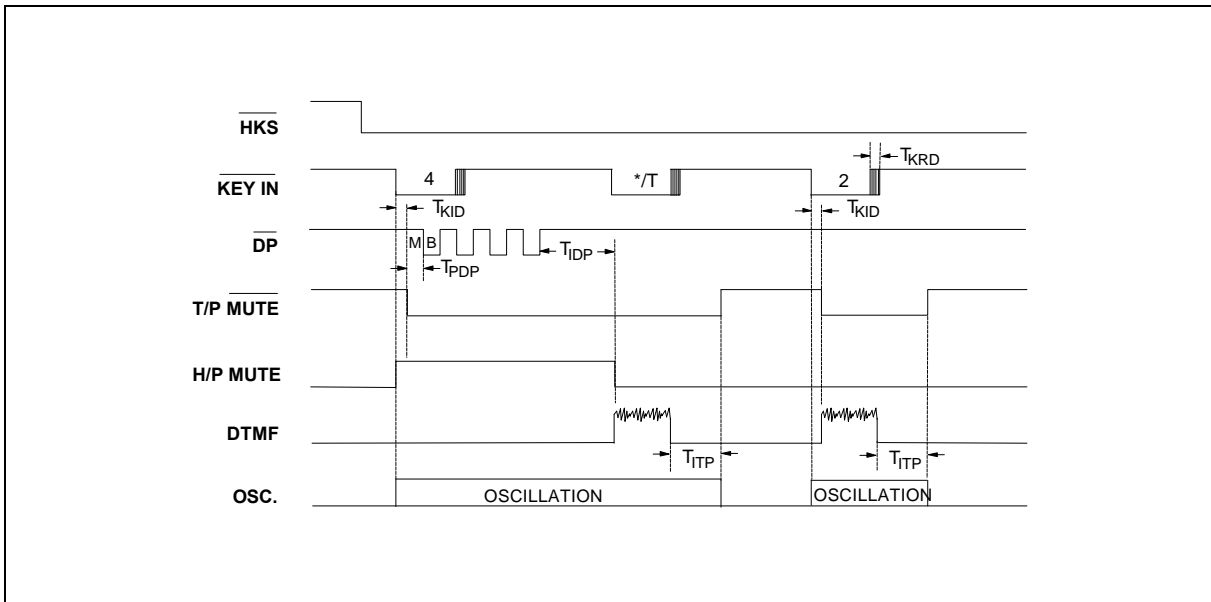Figure 5(a). Pulse-to-tone Timing Diagram (All Versions Except W91354AN)

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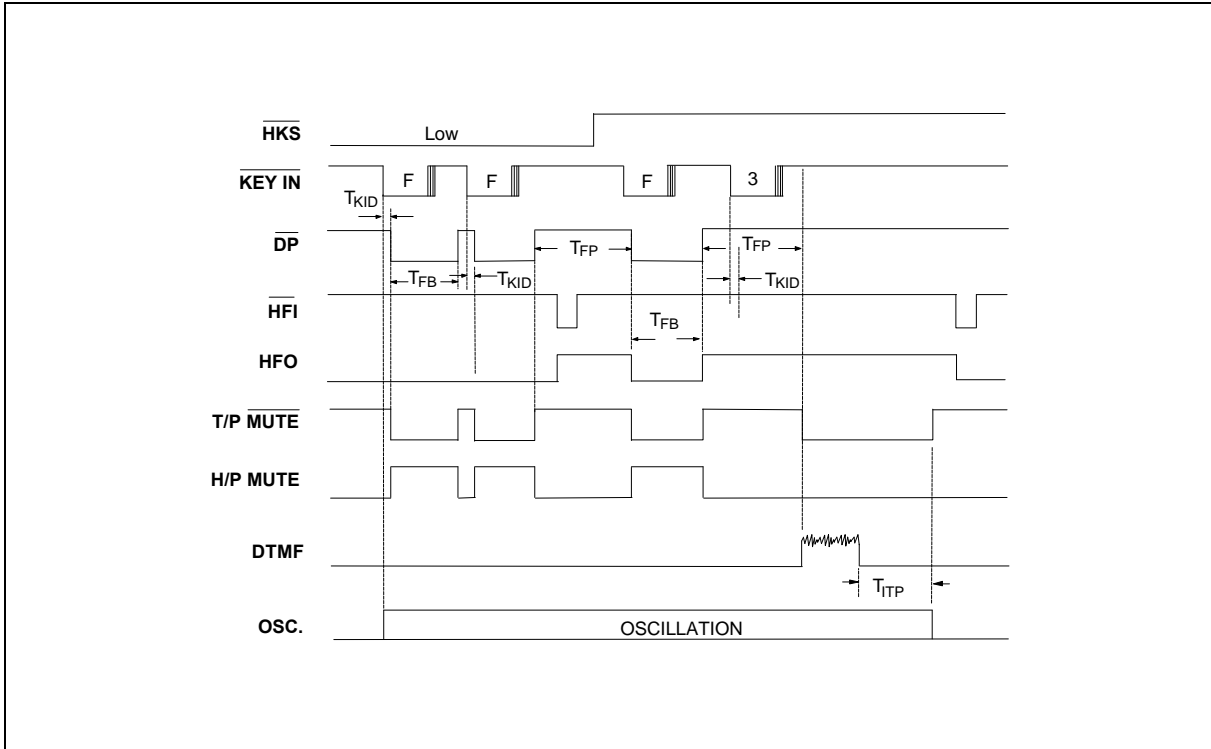
Timing Waveforms, continued

Figure 6. Flash Timing Diagram

Winbond
Electronics Corp.

Headquarters

No. 4, Creation Rd. III,
Science-Based Industrial Park,
Hsinchu, Taiwan
TEL: 886-3-5770066
FAX: 886-3-5792697
http://www.winbond.com.tw/
Voice & Fax-on-demand: 886-2-7197006

Taipei Office

11F, No. 115, Sec. 3, Min-Sheng East Rd.,
Taipei, Taiwan
TEL: 886-2-7190505
FAX: 886-2-7197502

Winbond Electronics (H.K.) Ltd.

Rm. 803, World Trade Square, Tower II,
123 Hoi Bun Rd., Kwun Tong,
Kowloon, Hong Kong
TEL: 852-27516023
FAX: 852-27552064

Winbond Electronics North America Corp.
Winbond Memory Lab.
Winbond Microelectronics Corp.
Winbond Systems Lab.

2730 Orchard Parkway, San Jose,
CA 95134, U.S.A.
TEL: 1-408-9436666
FAX: 1-408-9436668

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