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10-MEMORY TONE/PULSE DIALER WITH SAVE FUNCTION
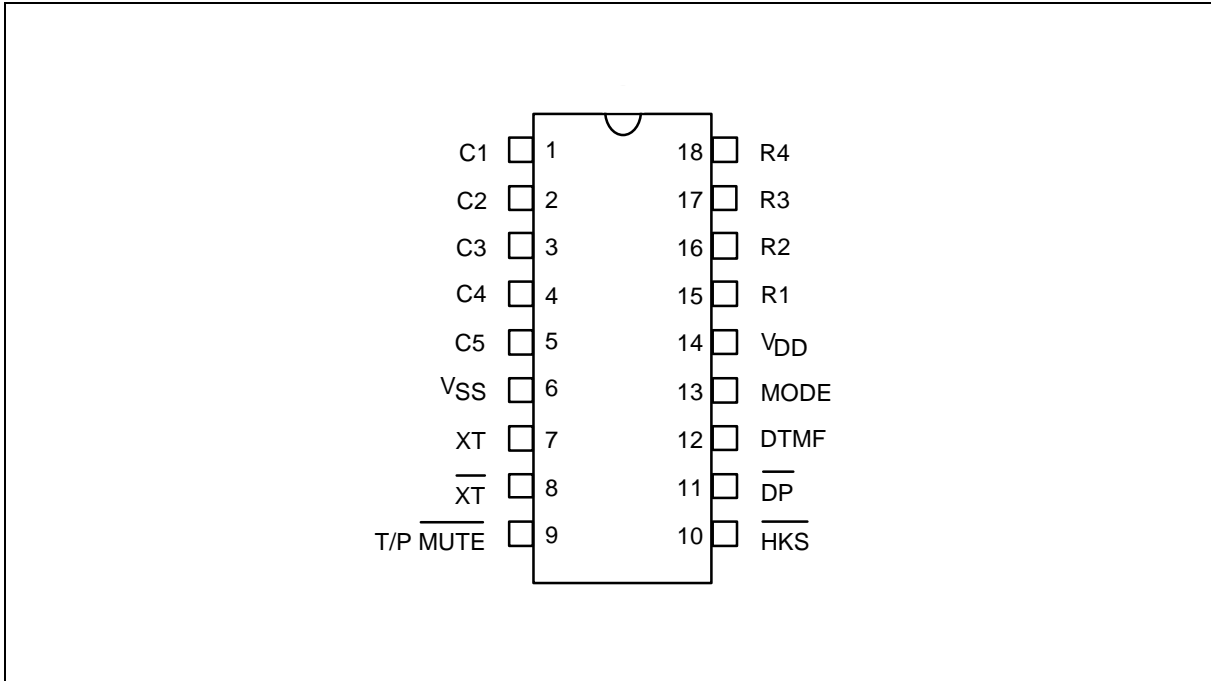
GENERAL DESCRIPTION

The W91440N series are Si-gate CMOS ICs that provide the necessary signals for either tone or pulse dialing. The W91440N series features save memory and a 10 by 16 digit automatic dialing memory.

FEATURES

- DTMF/pulse switchable dialer
- Two by 32 digit redial and save memory
- Ten by 16 digit two-touch direct memory
- Redial memory cascadable with normal dialing; dialing length is unlimited, but if length oversteps 32 digits the redial function is inhibited
- Pulse-to-tone (*/T) keypad for long distance call operation
- Uses 5×5 keyboard
- Easy operation with redial, flash, pause and */T keypads
- Flash, pause, P→T (Pulse-to-tone) can be stored as a digit in memory
- Dialing rate (10, 20 ppS) selected by bonding option
- On-hook debounce time: 150 msec.
- Minimum tone output duration: 93 msec.
- Minimum intertone pause: 93 msec.
- Flash break time (73, 100, 300, 600 msec.) selectable by keypad, and the pause time is 1 sec.
- On-chip power-on reset
- Uses 3.579545 MHz crystal or ceramic resonator
- Packaged in 18-pin plastic DIP
- The different dialers in the W91440N series are shown in the following table:

TYPE NO.	REPLACEMENT TYPE NO.	PULSE (ppS)	FLASH (mS)	PAUSE (S)	M/B
W91442N	W91442	10	600/300/73/100	3.6	Pin
	W91443				
	W91444				
	W91446				
	W91447				
	W91444G				
	W91445G				
W91443N	W91443	20	600/300/73/100	3.6	Pin

PIN CONFIGURATION

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            C1  ▢ 1        18 ▢  R4
            C2  ▢ 2        17 ▢  R3
            C3  ▢ 3        16 ▢  R2
            C4  ▢ 4        15 ▢  R1
            C5  ▢ 5        14 ▢  V_DD
           V_SS ▢ 6        13 ▢  MODE
            XT  ▢ 7        12 ▢  DTMF
           XT̄   ▢ 8        11 ▢  D̄P̄
        T/P MŪTĒ ▢ 9       10 ▢  H̄K̄S̄
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PIN DESCRIPTION

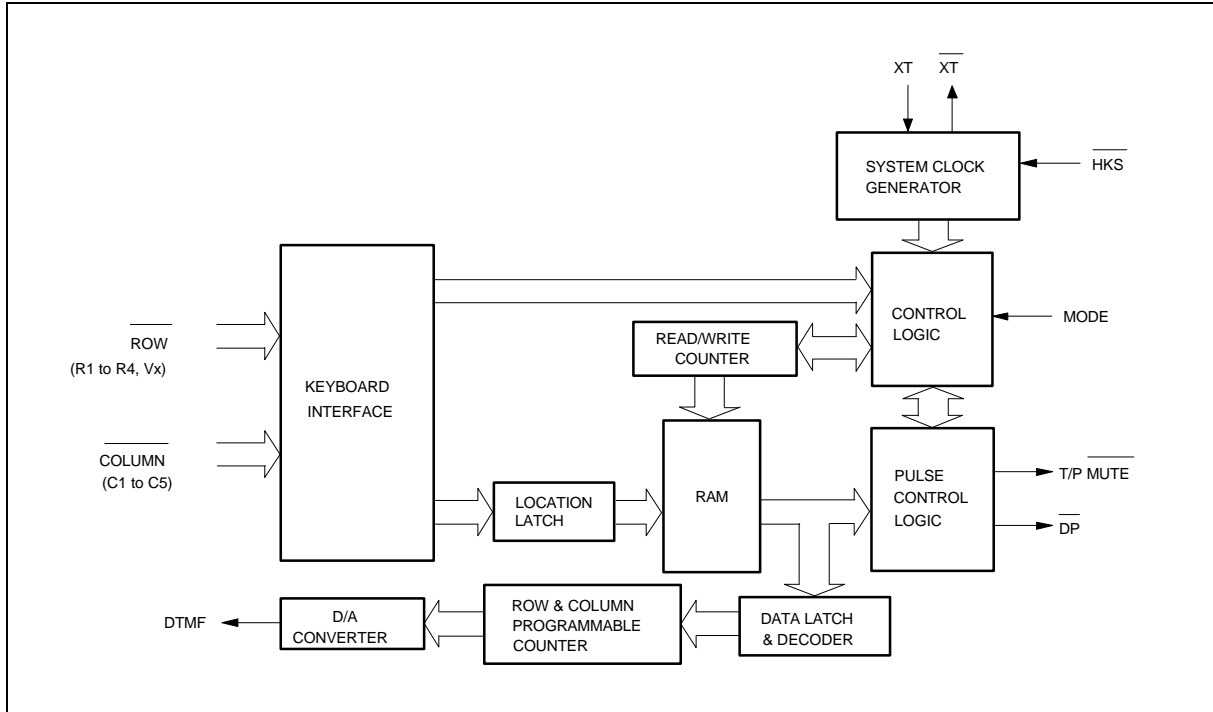| SYMBOL	PIN	I/O	FUNCTION
Column- Row Inputs	1–5 & 15–18	I	The keyboard inputs may be used with either a standard 5×5 keyboard or an inexpensive single contact (Form A) keyboard. Electronic input from a μC can also be used. A valid key in is defined as a single row being connected to a single column.
XT, $\overline{XT}$	7, 8	I, O	A built-in inverter provides oscillation with an inexpensive 3.579545 MHz crystal or ceramic resonator.
T/P $\overline{MUTE}$	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	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 40:60 (10 ppS only for W91442N and 20 ppS for W91443N). Floating mode pin places the dialer in pulse mode with M/B ratio 33:67 (10 ppS only for W91442N and 20 ppS for W91443N).

Pin Description, continued

SYMBOL	PIN	I/O	FUNCTION
$\overline{\text{HKS}}$	10	I	Hook switch input. $\overline{\text{HKS}}$ = V$_{DD}$: On-hook state. Chip in sleeping mode, no operation. $\overline{\text{HKS}}$ = V$_{SS}$: Off-hook state. Chip is enabled for normal operation. $\overline{\text{HKS}}$ pin is pulled to V$_{DD}$ by internal resistor.
$\overline{\text{DP}}$	11	O	N-channel open drain dialing pulse output. Flash key will cause $\overline{\text{DP}}$ to be active in either tone mode or pulse mode. The timing diagram in pulse mode is shown in Figure 1(a, b, c).
V$_{DD}$, V$_{SS}$	14, 6	I	Power input pins.
DTMF	12	O	In pulse mode, this pin remains in low state at all time. In the tone mode, it will output a dual or single tone. Detailed timing diagram for tone mode is shown in Figure 2(a, b, c).

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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BLOCK DIAGRAM

FUNCTIONAL DESCRIPTION

Keyboard Operation

	C1	C2	C3	C4	C5	
	1	2	3	S		R1
	4	5	6	F4		R2
	7	8	9	A		R3
	∗/T	0	#	R/P	SAVE	R4
	F1	F2	F3			VX

- S: Store function key

- A: Indirect repertory dialing function key

- R/P: Redial and pause function key

- SAVE: Save function key

- ∗/T: ∗ in tone mode and P→T in pulse mode

- F1, ..., F4: Flash keys, F1 = 600 mS, F2 = 300 mS, F3 = 73 mS, F4 = 100 mS

Note: D1, ..., Dn, D1', ..., Dn': 0, ..., 9, */T, #;Ln: 0, ..., 9; Fn: F1, ..., F4

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Normal Dialing

| OFF HOOK | , | 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 | , | D1 | , | D2 | , ..., | Dn | Busy, Come | ON HOOK | , | OFF HOOK | , | 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 oversteps 32 digits, the redialing function will be inhibited.

Number Store

| OFF HOOK | , | D1 | , | D2 | , ..., | Dn | , | S | , | S | , | 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 stored in memory location and dialed out.

| OFF HOOK | , | S | , | D1 | , | D2 | , ..., | Dn | , | S | , | 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; | */T | is the pulse to tone function key.

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

Repertory Dialing

| OFF HOOK | , | A | , | Ln |

Access Pause

| OFF HOOK | , | 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 3.

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Pulse-to-tone (*/T)

| OFF HOOK | , | D1 | , | D2 | , ..., | Dn | , | */T | , | D1' | , | D2' | , ..., | Dn' |

1. If the mode switch is set in pulse mode, then the output signal will be:

D1, D2, …, Dn, Pause (3.6 sec.), D1', D2', …, Dn'

(Pulse)　　　　　　　　　　　(Tone)

2. If the mode switch is set in tone mode, then the output signal will be the form as follow:

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 by going on-hook.

4. The pulse-to-tone function timing diagram is shown in Figure 4.

Flash

| OFF HOOK | , | Fn |

1. Fn = F1, …, F4

2. The dialer will execute flash break time of 600 mS (F1), 300 mS (F2), 73 mS (F3), or 100 mS (F4) and all the flash pause time is 1.0 sec. before the next digit is dialed out.

3. Flash key can be stored as a digit in memory; however, only one flash will be released to users.

4. The system will return to the initial state after the flash pause time is finished.

5. The timing diagram of flash function is shown in Figure 5.

Save

| OFF HOOK | , | D1 | , | D2 | , ..., | Dn | , | SAVE |

1. 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.

| OFF HOOK | , | SAVE |

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

Cascaded Dialing

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

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

3. | Redialing | + | Normal Dialing | + | Repertory Dialing |

4. Redialing is valid as first key-in only.

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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	0.60	mA
		Pulse, Unloaded	-	0.2	0.40	
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

DC Characteristics, continued

PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$\overline{DP}$ 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
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	-	-	-	5.0	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
Pulse Mute Delay	T_{MD}	Mode = V_{DD}	-	40	-	mS
		Mode = Floating	-	33.3	-	
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	-	
Make/Break Ratio	M:B	Mode = V_{DD}	-	40:60	-	%
		Mode = Floating	-	33:67	-	
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	-	300	-	
		F3		73		
		F4	-	100	-	

AC Characteristics, continued

PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Flash Pause Time	T_{FP}	F1, F2, F3, F4	-	1.0	-	S
Pause Time	T_P		-	3.6	-	S
On-hook Debounce Time	T_{OHD}		-	150	-	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, $F_{OSC.}$ = 3.579545 MHz ±0.02%.

2. Crystal oscillator accuracy directly affects these times.

TIMING WAVEFORMS
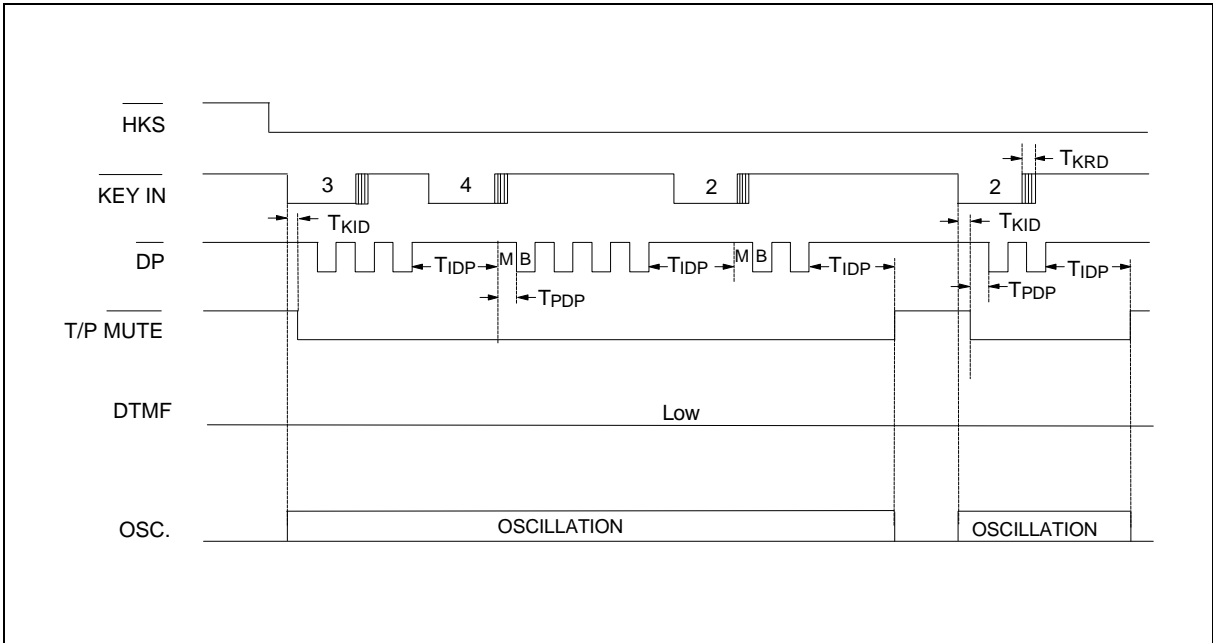
Figure 1(a) Normal Dialing Timing Diagram

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Timing Waveforms, continued
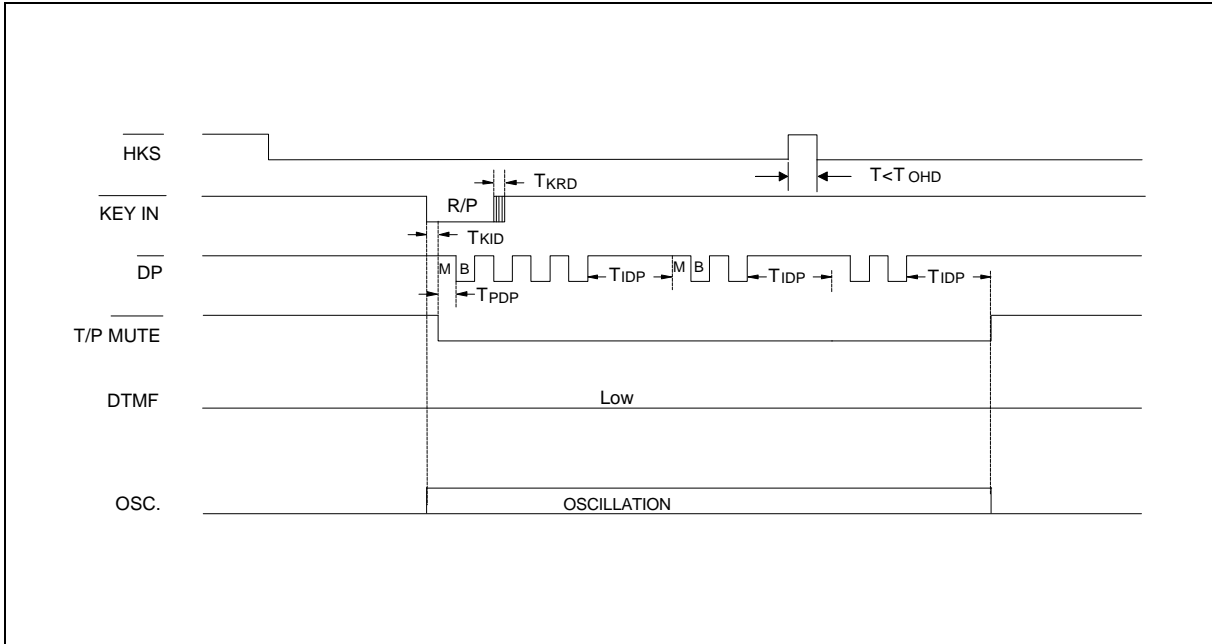
Figure 1(b) Pulse Mode Auto Dialing Timing Diagram
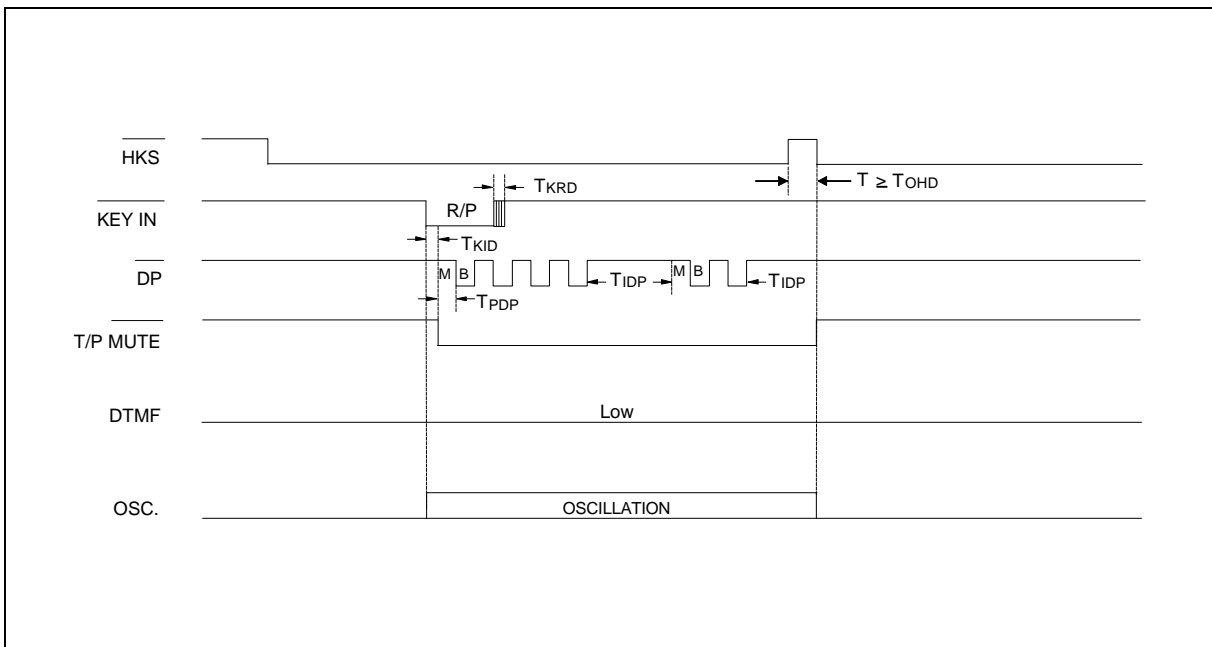
Figure 1(c) Pulse Mode Auto Dialing Timing Diagram

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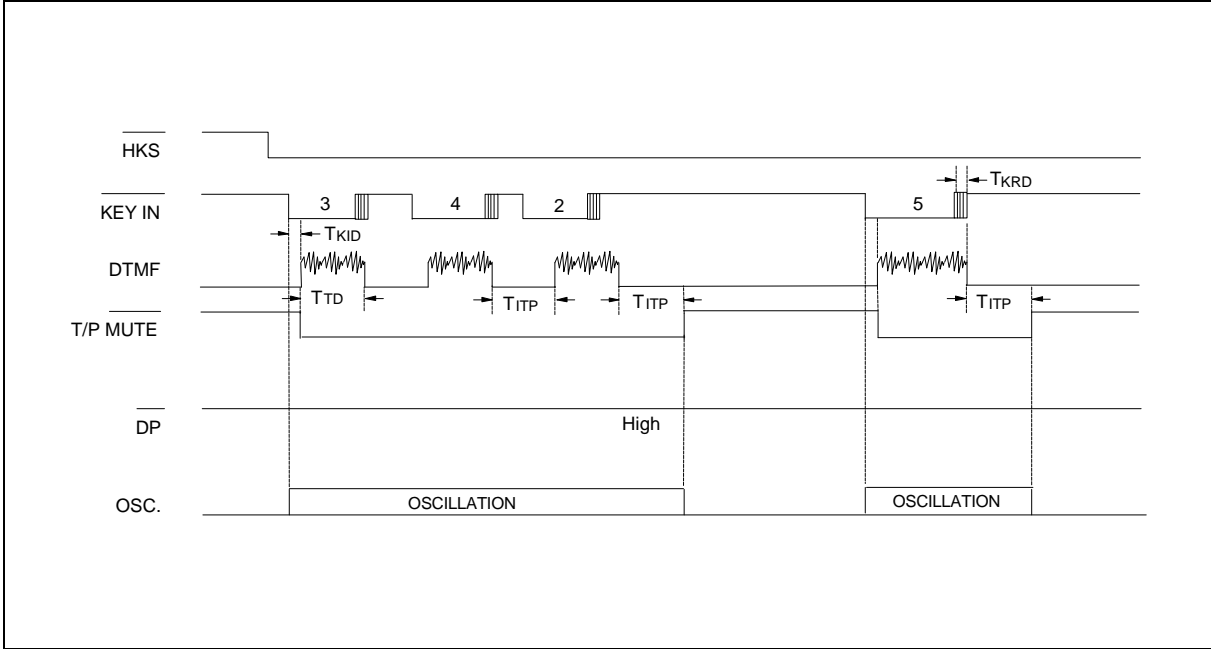
Figure 2(a) Tone Mode Normal Dialing Timing Diagram
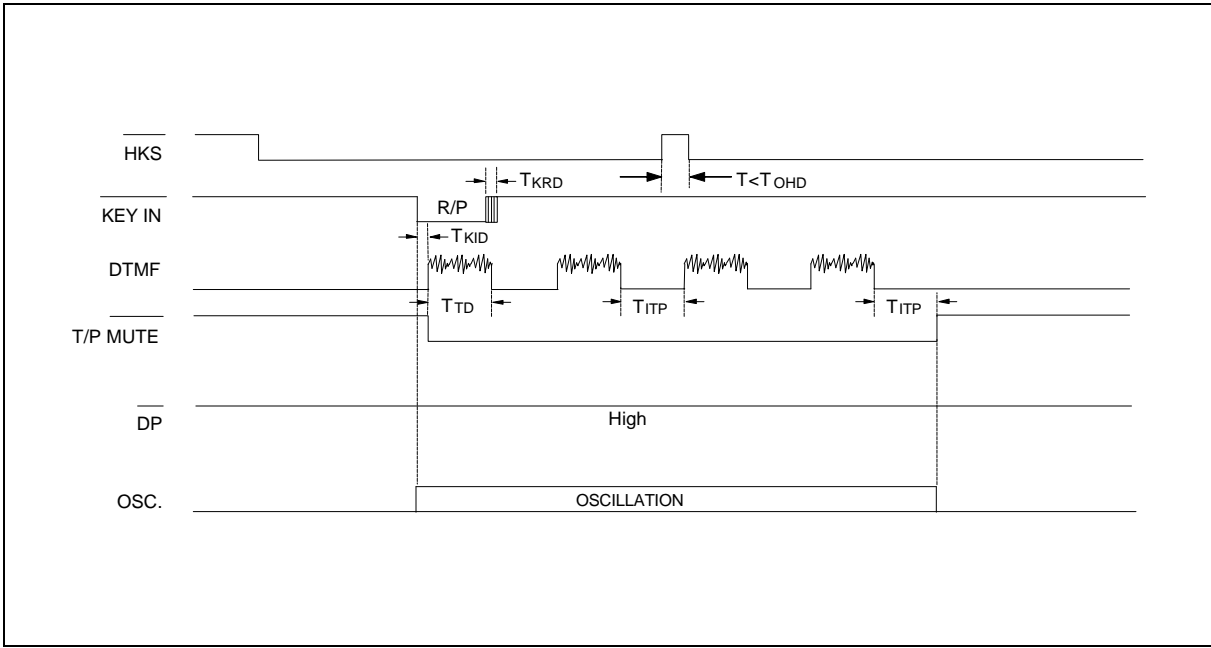
Figure 2(b) Tone Mode Auto Dialing Timing Diagram

Timing Waveforms, continued
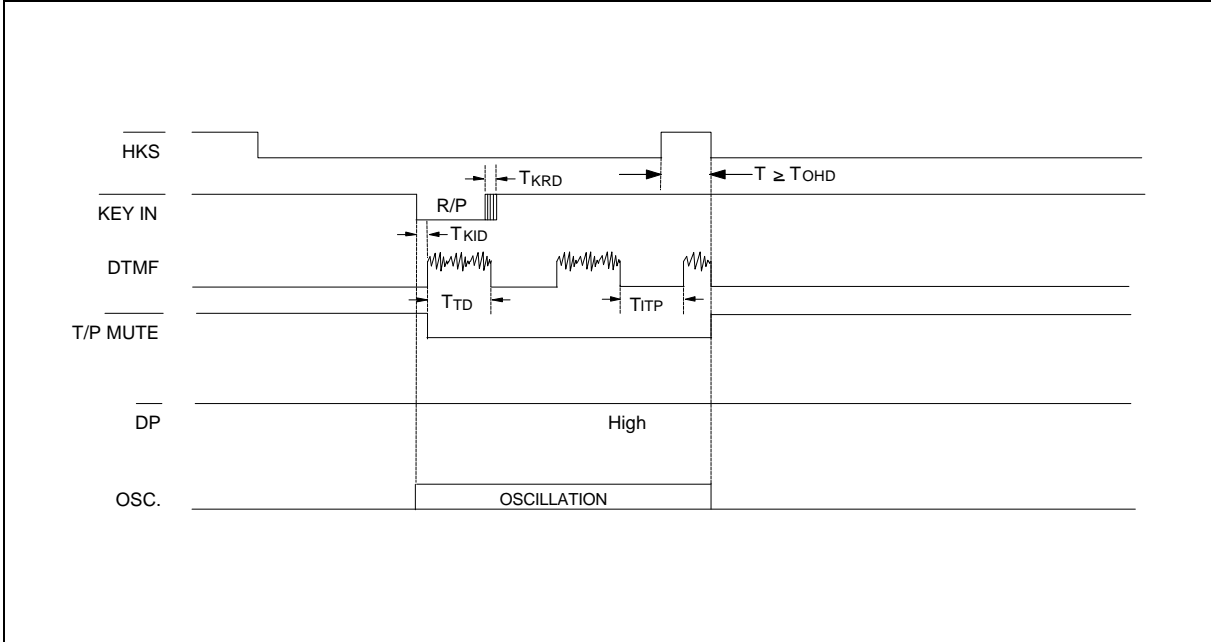
Figure 2(c) Tone Mode Auto Dialing Timing Diagram
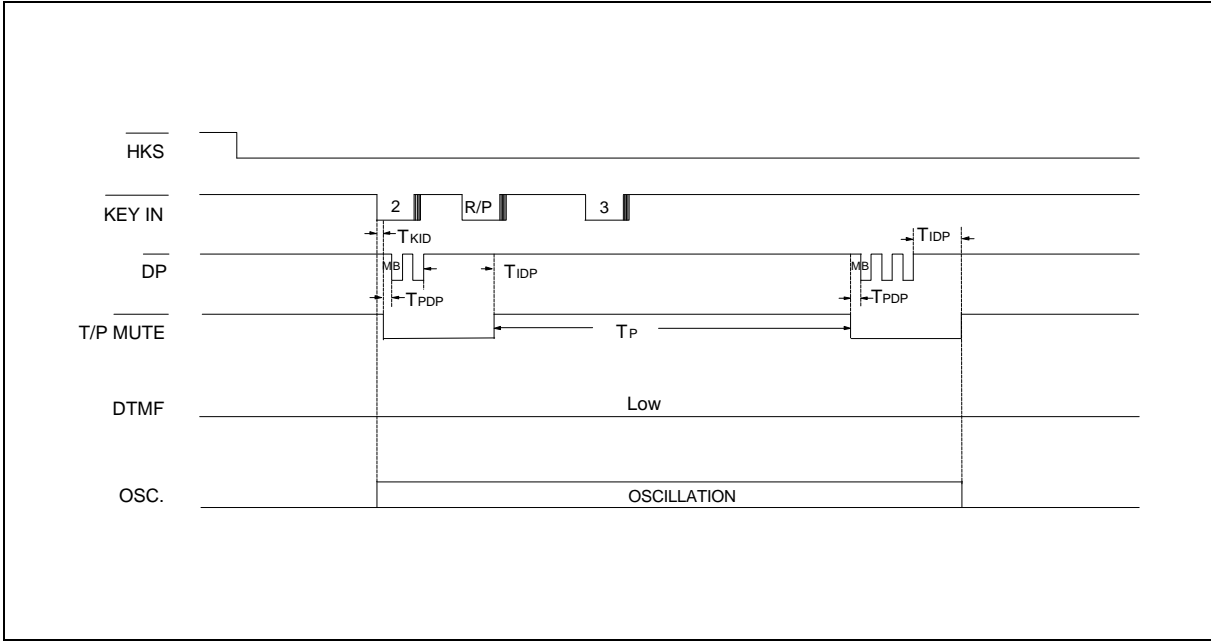
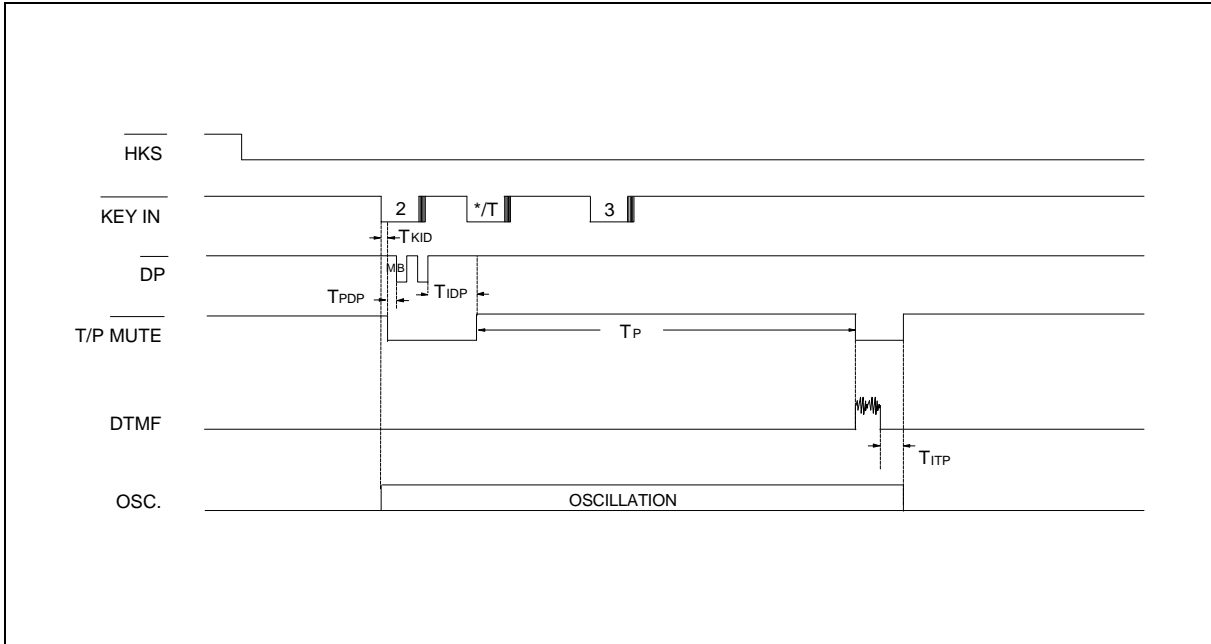Figure 3. Pause Function Timing Diagram

Timing Waveforms, continued

Figure 4. Pulse-to-tone Timing Diagram
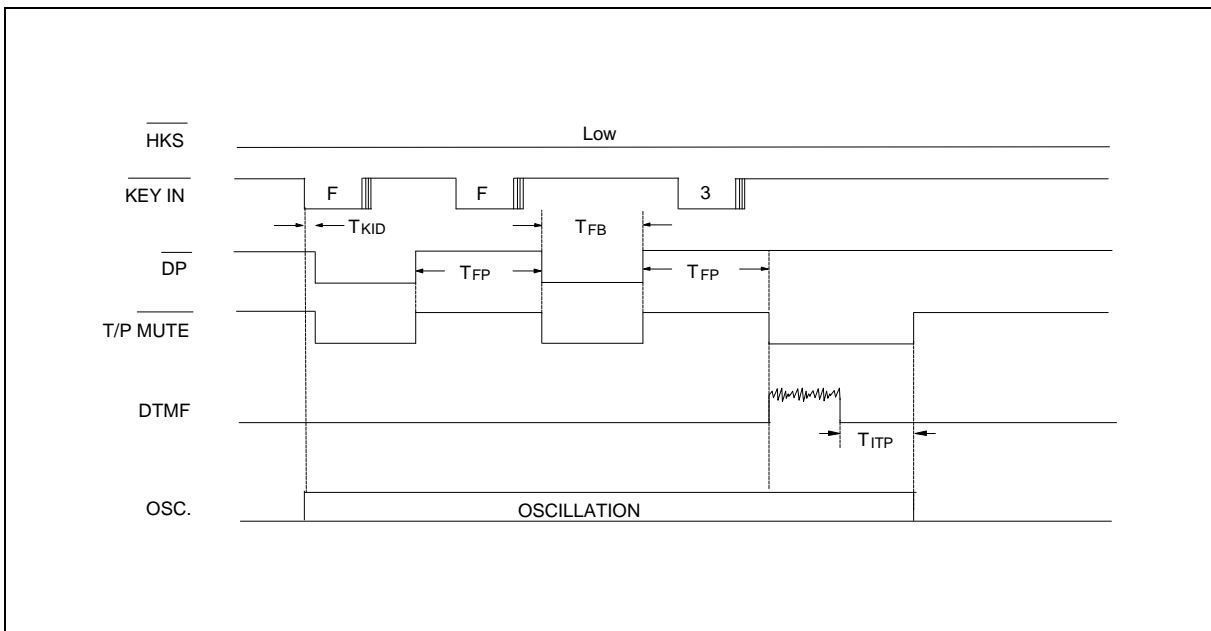
Figure 5. Flash Timing Diagram