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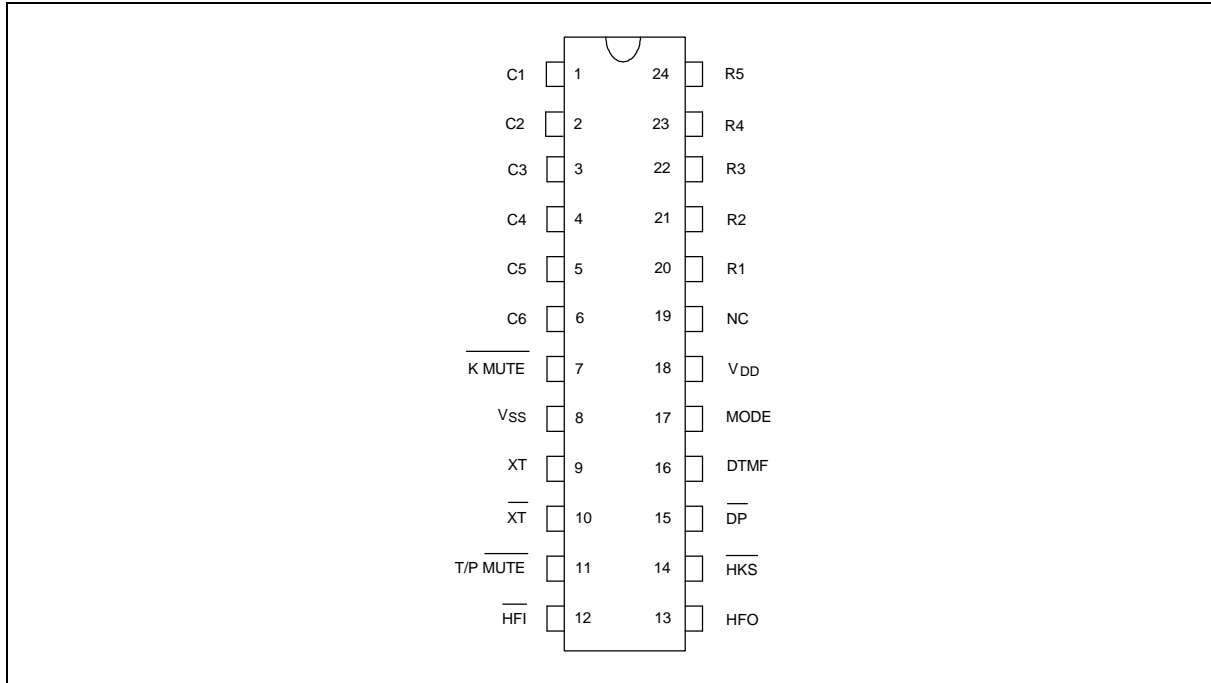# 10-MEMORY TONE/PULSE SWITCHABLE DIALER

GENERAL DESCRIPTION

The W91650 series are Si-gate CMOS IC tone/pulse switchable dialers that include a 16-digit × 10 one-touch memory and a 32-digit save or mercury memory. They also provide secrecy key, flash, handfree and redial functions.

FEATURES

- Tone/pulse switchable dialer
- 32-digit redial memory
- 32-digit save or mercury memory
- 16-digit × 10 one-touch repertory memory
- Mixed dialing, cascade dialing allowed
- Use 5 × 6 keyboard
- MUTE key for secrecy control
- Flash time: 98 mS
- Flash pause time: 1.2 sec.
- Pause time: 2.5 sec.
- Minimum tone output duration: 93 msec.
- Minimum intertone pause: 93 msec.
- Pause, */T (pulse-to-tone), flash can be stored as a digit in memory
- On-chip power-on reset
- Uses 3.579545 MHz crystal or ceramic resonator
- Packaged in 24-pin plastic DIP
- The different dialers in the W91650 series are described in the following table:

TYPE NO.	PULSE (ppS)	PAUSE (S)	B:M	FLASH (mS)	MERCURY MEMORY
W91650	10	2.5	2:1	98	SAVE
W91651	10	2.5	3:2	98	SAVE
W91650B	10	2.5	2:1	98	YES
W91651B	10	2.5	3:2	98	YES

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PIN CONFIGURATION

C1	1	24	R5
C2	2	23	R4
C3	3	22	R3
C4	4	21	R2
C5	5	20	R1
C6	6	19	NC
$\overline{\text{K MUTE}}$	7	18	V_{DD}
V_{SS}	8	17	MODE
XT	9	16	DTMF
$\overline{\text{XT}}$	10	15	$\overline{\text{DP}}$
T/P $\overline{\text{MUTE}}$	11	14	$\overline{\text{HKS}}$
$\overline{\text{HFI}}$	12	13	HFO

PIN DESCRIPTION

SYMBOL	PIN	I/O	FUNCTION
Column-Row Inputs	1–6 & 20–24	I	The keyboard input may be used with either the standard 5×6 keyboard or the inexpensive single contact (form A) keyboard. Electronic input with µC can also be used. A valid key entry is defined by a single row being connected to a single column.
XT, $\overline{\text{XT}}$	9, 10	I, O	A built-in inverter provides oscillation with an inexpensive 3.579545 MHz crystal or ceramic resonator.
T/P $\overline{\text{MUTE}}$	11	O	The T/P $\overline{\text{MUTE}}$ is a conventional CMOS N-channel open drain output. The output transistor is switched on during pulse and tone mode dialing sequence and flash break. Otherwise, it is switched off.
MODE	17	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 (10 ppS, M/B = 1:2 or 2:3).
$\overline{\text{HKS}}$	14	I	Hook switch input. $\overline{\text{HKS}}$ = 1: On-hook state. Chip in sleeping mode, no operation. $\overline{\text{HKS}}$ = 0: Off- hook state. Chip enabled for normal operation. $\overline{\text{HKS}}$ pin is pulled to V_{DD} by internal resistor.

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Pin Description, continued

SYMBOL	PIN	I/O	FUNCTION
$\overline{DP}$	15	O	N-channel open drain dialing pulse output (Figure 1). Flash key causes $\overline{DP}$ to be active when in pulse mode.
NC	19	-	No connection.
DTMF	16	O	In pulse mode, remains in low state at all times. In tone mode, sends a dual or single tone.
V_{DD}, V_{SS}	18, 8	I	Power input pins.
$\overline{HFI}$, HFO	12, 13	I, O	Handfree control pins. A low pulse on the $\overline{HFI}$ input pin toggles the handfree control state. Status of the handfree control states is described in the following table:
$\overline{K\,MUTE}$	7	O	The $\overline{K\,MUTE}$ is NMOS open drain output. $\overline{K\,MUTE}$ is active low when MUTE key is pressed after OFF HOOK or when HFO is in high state. The $\overline{K\,MUTE}$ state is toggled by the MUTE key.

DTMF output frequency 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

Handfree control states table:

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 internal resistor.

FUNCTIONAL DESCRIPTION

Keyboard Operation

C1	C2	C3	C4	C5	C6	
1	2	3	S	M1	M6	R1
4	5	6		M2	M7	R2
7	8	9		M3	M8	R3
∗/T	0	#	MER	M4	M9	R4
F	P	MUTE	R	M5	M10	R5

Note: The [MER] key is for the W91650B/651B only. In the other type numbers (W91650/651) this key activates the save function.

- S: Memory store function key
- F: Flash key with 98 mS break time and 1.2 sec pause time
- R: Redial function key
- P: Pause function key
- Mn: one-touch direct memory
- ∗/T: Pulse-to-tone switch function key in pulse mode, * key in tone mode
- SAVE: One-touch memory for save dialing

  Save dialing can be executed after off-hook or handfree dialing is activated.
- MER: One-touch memory for mercury code dialing
- MUTE: Secrecy control key

  Once the MUTE key is pressed, the $\overline{K\,MUTE}$ output will be toggled.

Note: Dn = 0 to 9, ∗/T, #, Mn = M1 to M10.

Normal Dialing

| OFF HOOK | (or | ON HOOK | & | $\overline{HFI}$ ı̆ŏ̱ |), | 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.

Redialing

1. Redialing is valid any time after off-hook or handfree dialing is activated.
2. The redial function timing diagram is shown in Figure 1.

| OFF HOOK | , | D1 | , | D2 | , ..., | Dn | , Busy, Come | ON HOOK | , | OFF HOOK | , (or |

| ON HOOK | & | HFI iŏ |) | R | or | ON HOOK | & | HFI iŏ | , | D1 | , | D2 | , ..., | Dn |

BUSY, | HFI iŏ | , Come | HFI iŏ | , | R |

D1, D2, ..., Dn will be dialed out.

Number Store

1. | OFF HOOK | (or | ON HOOK | & | HFI iŏ |) | S | , | Mn | (or | SAVE |)

   | D1 | , | D2 | , ..., | Dn | , | S |

   a. D1, D2, ..., Dn will be stored in memory Mn (or save) location but will not be dialed out.

   b. | P | , | F | , and | */T | keys can be stored as a digit in memory. The store mode is released after the store function is executed or the state of the hook switch is changed.

2. | OFF HOOK | (or | ON HOOK | & | HFI iŏ |) | S | , | Mn | (or | SAVE |), | R | , | S |

   a. Redial buffer is transferred to Mn (or save memory).

   b. If content of the redial buffer exceeds 16 digits, the content is not transferred to Mn.

3. | OFF HOOK | (or | ON HOOK | & | HFI iŏ |) | S | , | Mn | , | SAVE | , | S |

   a. Save memory is transferred to Mn.

   b. If content of the save buffer exceeds 16 digits, the content is not transferred to Mn.

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

   D1, D2, …, Dn will be stored to save memory.

Mercury Store

| OFF HOOK | (or | ON HOOK | & | HFI iŏ |) | S | , | MER | , | D1 | , | D2 | , ..., | Dn | , | S |

D1, D2, ..., Dn will be stored in mercury memory but will not be dialed out.

Memory Clear

| OFF HOOK | (or | ON HOOK | & | HFI iŏ |), | S | , | Mn | (or | SAVE |), | S |

Mn (or save) will be cleared.

Repertory Dialing

1. OFF HOOK (or ON HOOK & HFI i̅õ̲), Mn (or SAVE or R)

   Mn (or save) will be dialing out.

   Mn content = D1, D2, */T, D3, D4

2. OFF HOOK , Mn

   a. D1, D2, P→T, D3, D4 will be dialed out.

   b. Redail register is changed to D1, D2, P→T, D3, D4.

Access Pause

OFF HOOK (or ON HOOK & HFI i̅õ̲), D1 , D2 , P , D3 , ..., Dn

1. The pause function can be stored in memory.

2. The pause function is executed in normal dialing, redialing, or memory dialing.

3. The pause function timing diagram is shown in Figure 3.

Pulse-to-tone (*/ T)

OFF HOOK (or ON HOOK & HFI i̅õ̲), 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 (2.5s), D1', D2', …, Dn'

        (Pulse)   (Tone)

2. If the mode switch is set to tone mode, then the output signal

   will be: D1, D2, …, Dn, $*$, D1', D2', …, Dn'

        (Tone)   (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 */T function timing diagram is shown in Figure 4.

Flash Key

OFF HOOK (or ON HOOK & HFI i̅õ̲), F

1. Flash key can be stored as a digit in memory.

2. The flash key function timing diagram is shown in Figure 5.

Mute Key

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

MUTE , D1' , D2' , ..., Dn' , ON LINE, MUTE

1. The $\overline{K\,MUTE}$ output will go low when the first MUTE key is pressed.

2. The operation timing diagram is shown in Figure 6(a, b).

Cascade Dialing

Cascade Dialing

1. Definition of cascade dialing:

The next sequence may be pressed before the former sequence is sent out completely. Examples of cascade dialing are shown below:

Example 1:

Normal dialing + Repertory dialing 1 + Repertory dialing 2 + ...

Example 2:

Repertory dialing 1 + Normal dialing + Repertory dialing 2 + ...

Example 3:

Redialing + Normal dialing + Repertory dialing 2 + ...

2. Normal dialing, redialing, or repertory dialing as depicted above is treated as one sequence.

3. A most 32 digits are allowed in cascade dialing, with no limitation on the number of sequences.

4. The content of cascade dialing can be a combination of normal dialing, redialing, repertory dialing.

5. ON HOOK , OFF HOOK , R : All the cascade-dialing sequences described in the

above examples will be dialed out only if there are not more than 32 digits. If the sequence exceeds

32 digits then redialing is inhibited. (The R key can be used any time after off-hook or handfree

activity.)

Mixed Dialing

1. Definition of mixed dialing:

In the examples above, if each sequence is dialed only after the preceding sequence is dialed out completely, then this is mixed dialing.

2. There is no limitation on the number of digits and sequences in mixed dialing.

3. The content of mixed dialing can be a combination of normal dialing, redialing, and repertory dialing.

4. ☐ ON HOOK ☐ , ☐ OFF HOOK ☐ , ☐ R ☐ : All the mixed dialing sequences described in the above examples will be dialed out only if there are not more than 32 digits. If the sequence exceeds 32 digits then the redialing is inhibited.

Combination(s) of Cascade and Mixed Dialing

1. Cascade dialing and mixed dialing can be combined, and each follows the rules described above.

2. To apply redial to a combination of cascade and mixed dialing:

☐ ON HOOK ☐ , ☐ OFF HOOK ☐ , ☐ R ☐ . Redialing will be executed only if the total number of digits does not exceed 32 digits. If it exceeds 32 digits, then redialing is inhibited.

3. If n cascaded sequences have been dialed, with a total of 30 digits, then for the (n+1)th cascade sequence, you can dial one 2-digit normal dialing sequence or one complete repertory dialing number (length up to 32 digits). The (n+2)th sequence is not accepted for cascade dialing.

4. After an a total of 32 digit of cascaded mixed dialing is completed, mixed dialing can be added.

Mercury Dialing

1. Up to 32 digits may be stored.

2. Mercury dialing is active only as the first key-in after off-hook or handfree dialing is activated.

3. The timing diagram for the mercury memory function is given below.
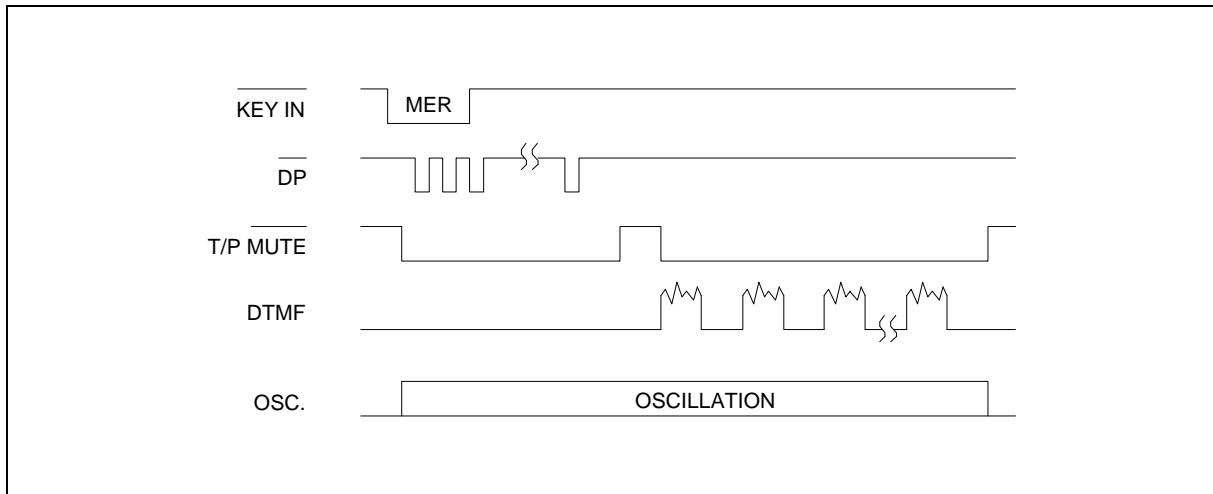
ABSOLUTE MAXIMUM RATINGS

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
Operating Temperature	T_{OPR}	-20 to 70	°C
Storage Temprature	T_{STG}	-55 to 125	°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. = 3.58 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 mode	-	0.5	1.0	mA
		Pulse mode	-	0.3	0.5	
Standby Current	I_{SB}	$\overline{HKS}$ = 0, no load and no key entry	-	-	15	μA
Memory Retention Current	I_{MR}	$\overline{HKS}$ = 1, V_{DD} = 1.0V	-	-	0.2	μA
DTMF Output Voltage	V_{TO}	Row group, R_L = 5 KΩ	130	150	170	Vrms
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 Sink Current	I_{TL}	V_{TO} = 0.5V	0.2	-	-	mA
$\overline{DP}$ Sink Current	I_{PL}	V_{PO} = 0.5V	0.5	-	-	mA
$\overline{K\,MUTE}$, T/P $\overline{MUTE}$ Output Sink Current	I_{ML}	V_{MO} = 0.5V	0.5	-	-	mA

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DC Characteristics, continued

PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$\overline{HKS}$ I/P Pull High Resistor	R_{KH}		-	500	-	KΩ
HFO Drive Current	I_{HFH}	$V_{HFH} = 2.0V$	0.5	-	-	mA
HFO Sink Current	I_{HFL}	$V_{HFL} = 0.5V$	0.5	-	-	mA
Keypad Drive Current	I_{KD}	$V_I = 0V$	30	-	-	μA
Keypad Sink Current	I_{KS}	$V_I = 2.5V$	200	400	-	μA
Keypad Resistance			-	-	5.0	KΩ

AC CHARACTERISTICS

PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Keypad Active in Debounce	T_{KID}		-	20	-	mS
Key Release Debounce	T_{KRD}		-	20	-	mS
Pre-digit Pause	T_{PDP}	M/B = 1/2	-	33.3	-	mS
		M/B = 2/3	-	40	-	mS
Interdigit Pause (Auto dialing)	T_{IDP}	10 ppS	-	800	-	mS
Make/Break Ratio	M/B	W91650/650B	-	33:67	-	%
		W91651/651B	-	40:60	-	%
Tone Output Duration	T_{TD}	Auto Dialing	-	93	-	mS
Intertone Pause	T_{ITP}	Auto Dialing	-	93	-	mS
Flash Break Time	T_{FB}		-	98	-	mS
Flash Pause Time	T_{FP}		-	1.2	-	S
Pause Time	T_P		-	2.5	-	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
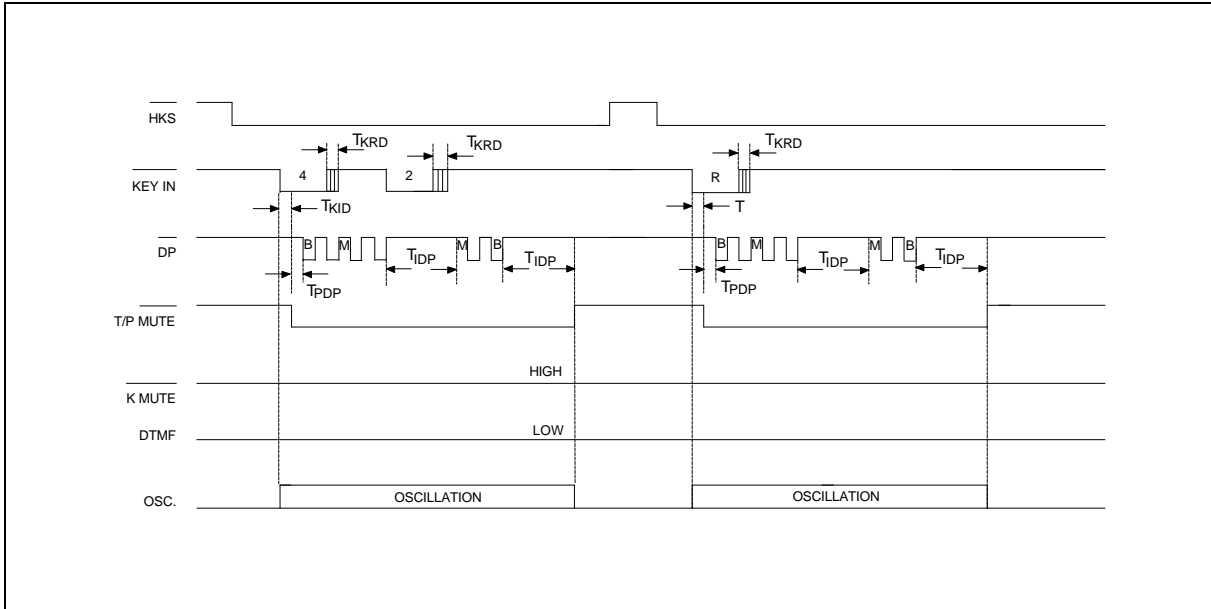
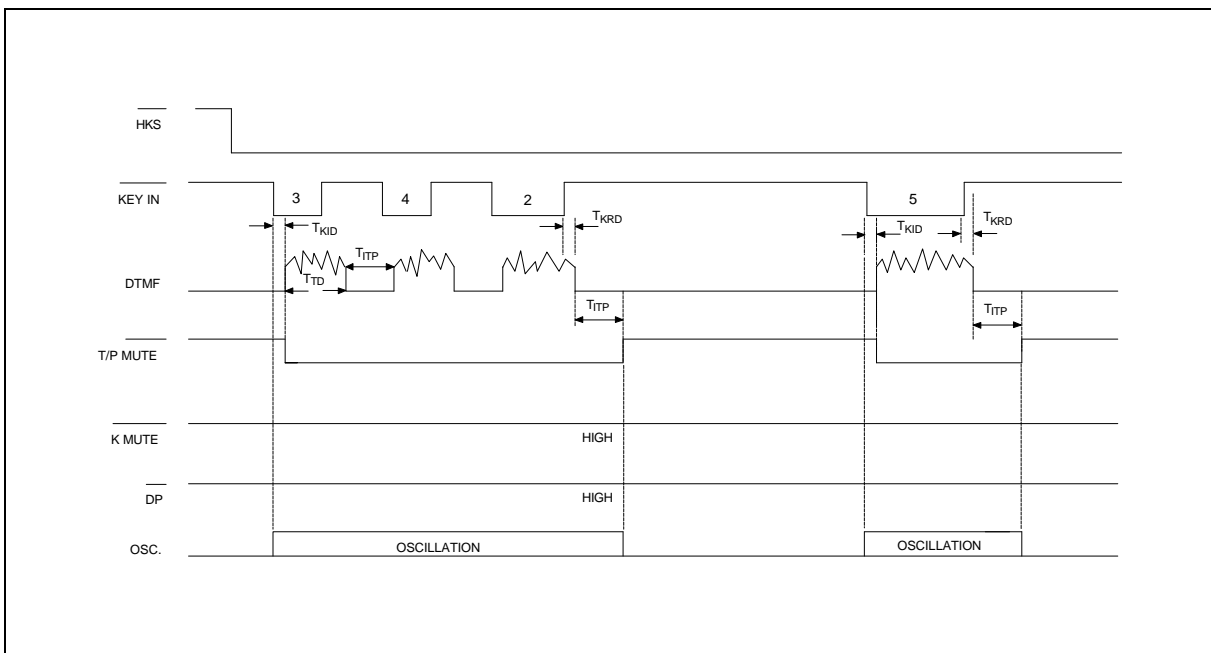Figure 1. Pulse Mode Timing Diagram

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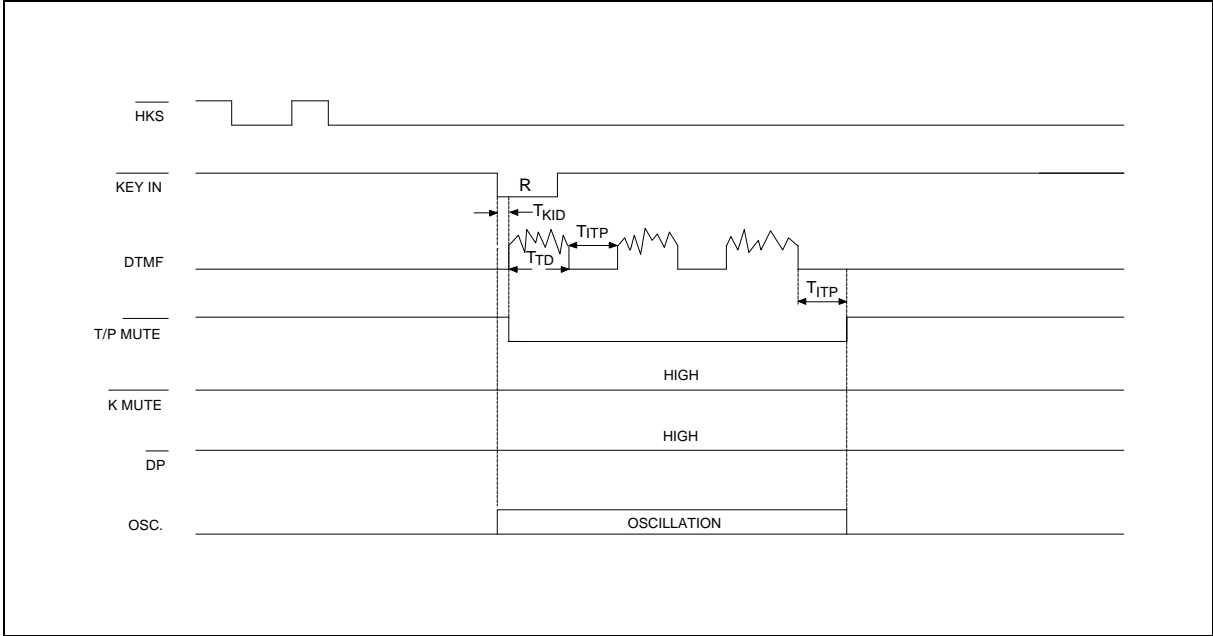
Timing Waveforms, continued

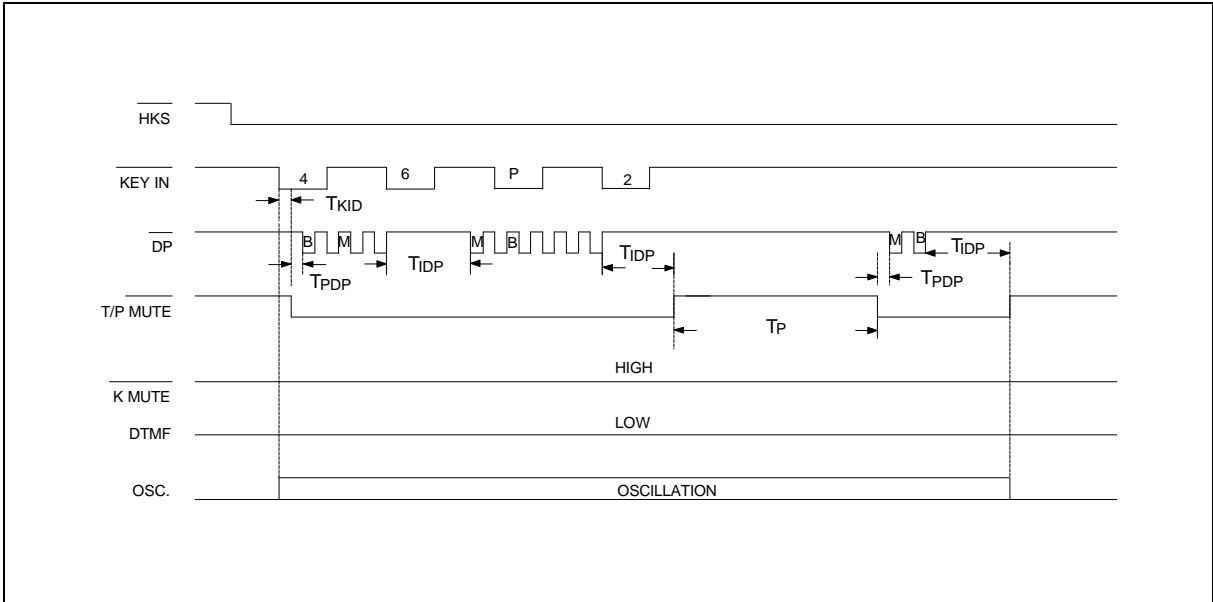Figure 2(b). Tone Mode Auto Dialing Timing Diagram

Figure 3. Pause Function Timing Diagram

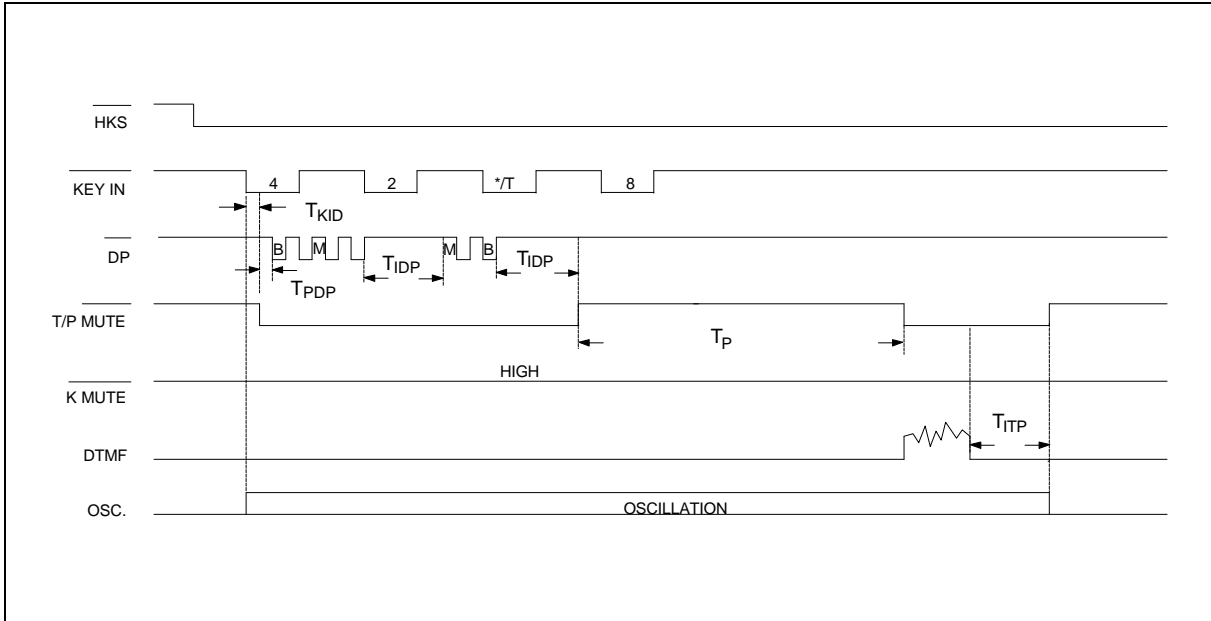# W91650 SERIES

Timing Waveforms, continued
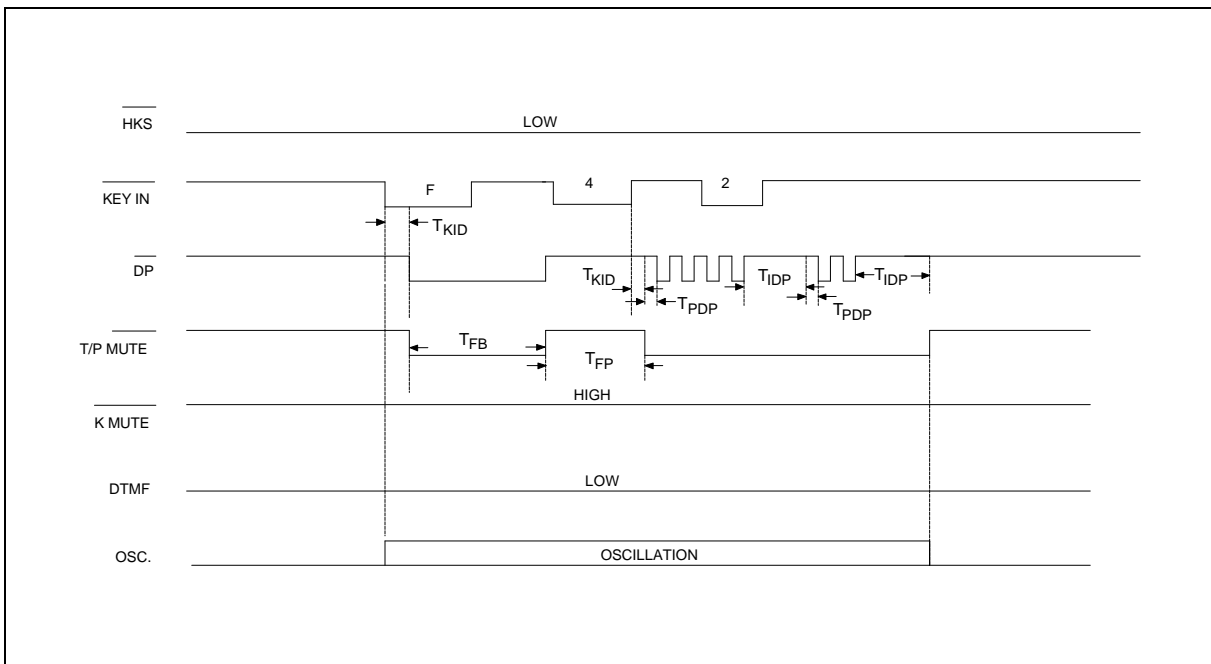

Figure 4. Pulse-to-tone Operation Timing Diagram

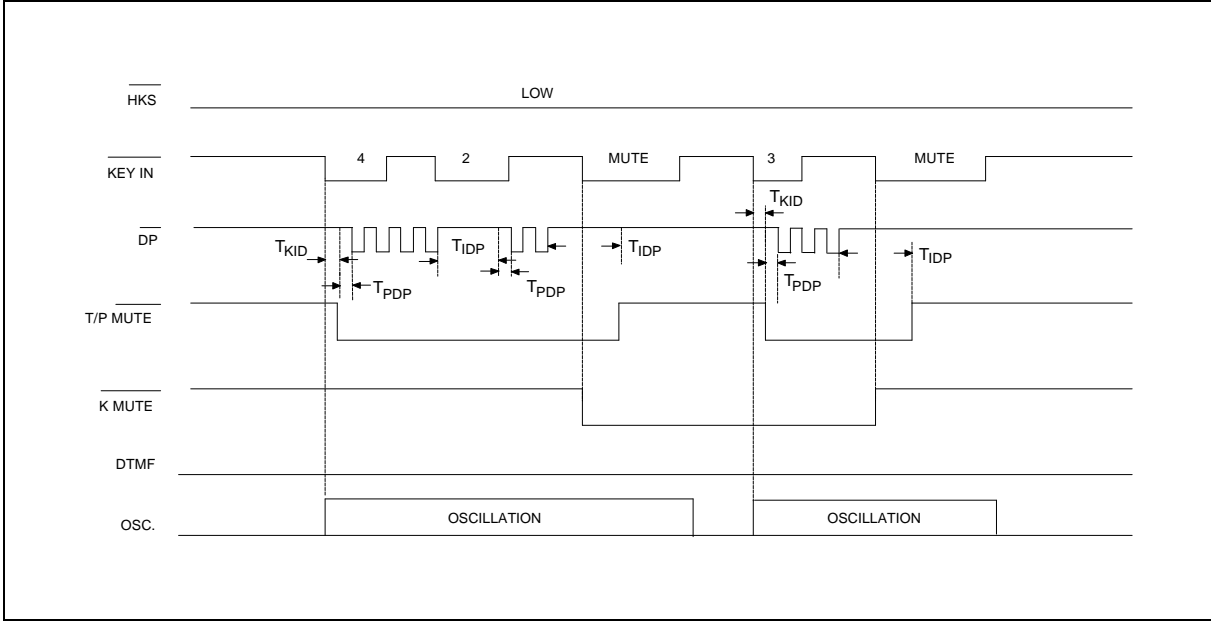Figure 5. Flash Operation Timing Diagram

Timing Waveforms, continued
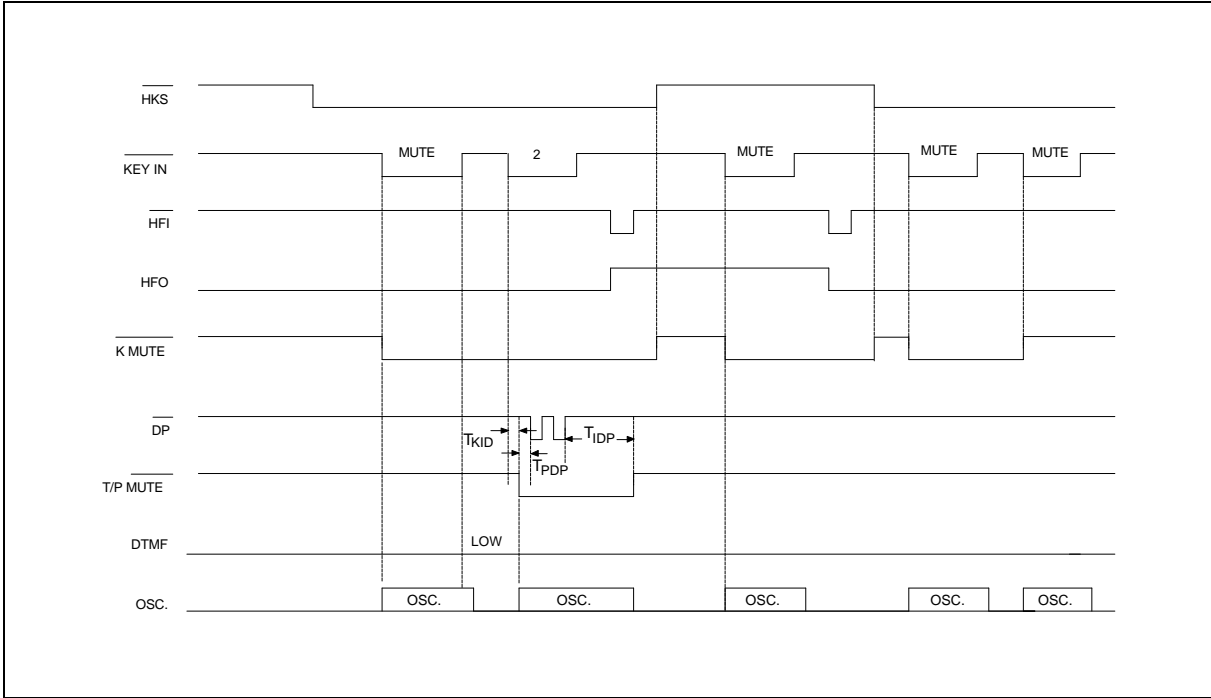

Figure 6(a). Mute Key Timing Diagram

Figure 6(b). Mute Key Operation with $\overline{HFI}$ /HFO Timing Diagram

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