

W91640 SERIES



5-MEMORY TONE/PULSE SWITCHABLE DIALER

GENERAL DESCRIPTION

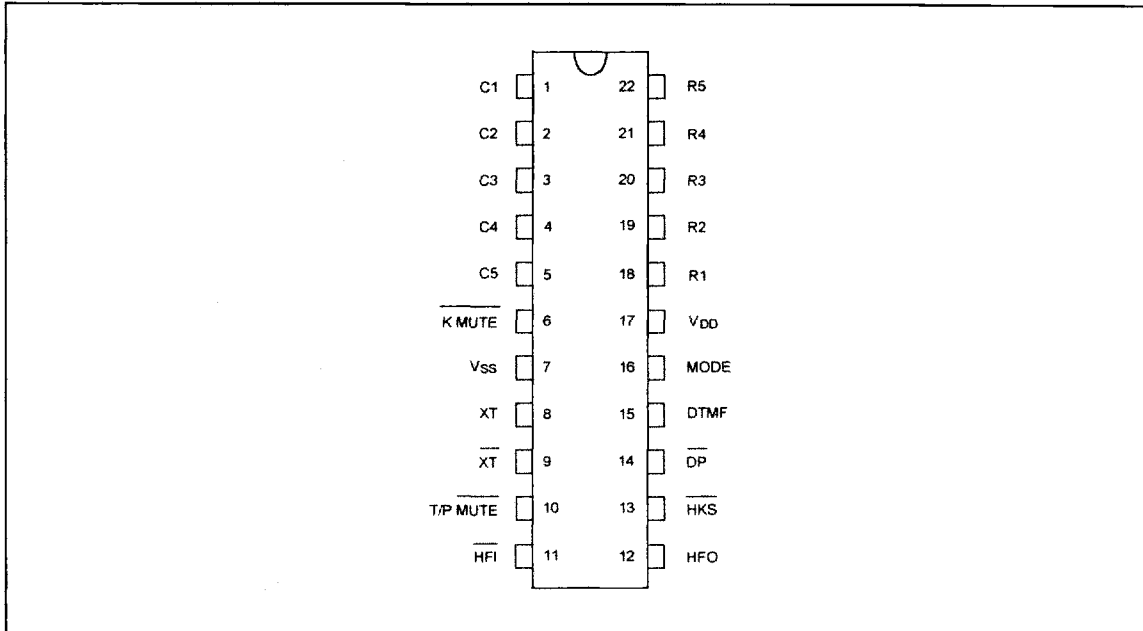
The W91640 series are Si-gate CMOS IC tone/pulse switchable dialers that include a 16-digit \times 5 one-touch memory and a 32-digit save or mercury memory. The dialers also provide key, flash, handfree, and redial functions.

FEATURES

- Tone/pulse switchable dialer
- 32-digit redial memory
- 32-digit save or mercury memory
- 16-digit \times 5 one-touch repertory memory
- Mixed dialing, cascade dialing allowed
- Use 5 \times 5 keyboard
- MUTE key for 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 22-pin plastic DIP
- The different dialers in the W91640 series are described in the following table:

TYPE NO.	PULSE (ppS)	PAUSE (S)	B:M	FLASH (mS)	MERCURY MEMORY
W91640	10	2.5	2:1	98	SAVE
W91641	10	2.5	3:2	98	SAVE
W91640B	10	2.5	2:1	98	YES
W91641B	10	2.5	3:2	98	YES

PIN CONFIGURATION



PIN DESCRIPTION

SYMBOL	PIN	I/O	FUNCTION
Column-Row Inputs	1-5 & 18-22	I	The keyboard input may be used with either the standard 5 × 5 keyboard or the inexpensive single contact (form A) keyboard. Electronic input from a μ C can also be used. A valid key entry is defined by a single row being connected to a single column.
XT, $\overline{\text{XT}}$	8, 9	I, O	A built-in inverter provides oscillation with an inexpensive 3.579545 MHz crystal or ceramic resonator.
T/P $\overline{\text{MUTE}}$	10	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	16	I	Pulling mode pin to Vss places the dialer in tone mode. Pulling mode pin to VDD places the dialer in pulse mode (10 ppS, M/B = 1:2 or 2:3).
$\overline{\text{HKS}}$	13	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 VDD by internal resistor.

W91640 SERIES



Pin Description, continued

SYMBOL	PIN	I/O	FUNCTION																																								
\overline{DP}	14	O	N-channel open drain dialing pulse output (Figure 1). Flash key causes \overline{DP} to be active in pulse mode.																																								
DTMF	15	O	In pulse mode, remains in low state at all times. In tone mode, sends a dual or single tone. <table border="1" style="margin-left: auto; margin-right: 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				
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																																								
VDD, VSS	17, 7	I	Power input pins.																																								
\overline{HFI} , HFO	11, 12	I, O	Handfree control pins. A low pulse on the \overline{HFI} input pin toggles the handfree control state. The relationships between the handfree control states are listed in the following table: <table border="1" style="margin-left: auto; margin-right: 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>\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.	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																																							
\overline{KMUTE}	6	O	\overline{KMUTE} is an NMOS open drain output. \overline{KMUTE} is active low when the MUTE key is pressed after OFF HOOK or when HFO is in high state. The \overline{KMUTE} state is toggled by the MUTE key.																																								

W91640 SERIES



FUNCTIONAL DESCRIPTION

Keyboard Operation

C1	C2	C3	C4	C5	
1	2	3	S	M1	R1
4	5	6		M2	R2
7	8	9		M3	R3
*T	0	#	MER	M4	R4
F	P	MUTE	R	M5	R5

Note: **MER** is for the W91640B/641B only. The other type numbers (W91640/641) provide a save function instead.

- 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 (n = 1 to 5): 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 $\overline{\text{KMUTE}}$ output will be toggled.

Note: Dn = 0 to 9, *T, #, Mn = M1 to M5, n = 1 to 5.

Normal Dialing

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

1. D1, D2, ..., Dn will be dialed out.
2. Dialing length is unlimited, but the redial is inhibited if length oversteps 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.

W91640 SERIES



OFF HOOK , D1 , D2 , ..., Dn , Busy, Come ON HOOK , OFF HOOK , (or ON HOOK & $\overline{\text{HFI}}$) R or ON HOOK & $\overline{\text{HFI}}$, D1 , D2 , ..., Dn BUSY, $\overline{\text{HFI}}$, Come $\overline{\text{HFI}}$, R

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

Number Store

1. OFF HOOK (or ON HOOK & $\overline{\text{HFI}}$) 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 & $\overline{\text{HFI}}$) S , Mn (or SAVE) , R , S

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

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

3. OFF HOOK (or ON HOOK & $\overline{\text{HFI}}$) S , Mn , SAVE , S

Save memory is 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 & $\overline{\text{HFI}}$) S , MER , D1 , D2 , ..., Dn , S

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

Memory Clear

1. OFF HOOK (or ON HOOK & $\overline{\text{HFI}}$) , S , Mn (or SAVE) , S

Mn (or save) will be cleared.

2. OFF HOOK (or ON HOOK & $\overline{\text{HFI}}$) , S , Mn

(or SAVE) , S

W91640 SERIES



The Mn (or save) will be cleared.

Repertory Dialing

1. OFF HOOK (or ON HOOK & $\overline{\text{HFI}}$), Mn (or SAVE or R)

Mn (or save) will be dialing out.

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

2. OFF HOOK , Mn

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

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

Access Pause

- OFF HOOK (or ON HOOK & $\overline{\text{HFI}}$), 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 & $\overline{\text{HFI}}$), 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 & $\overline{\text{HFI}}$), F

1. Flash key can be stored as a digit in memory.
2. The flash key function timing diagram is shown in Figure 5.

W91640 SERIES



Mute Key

(or &), , , ..., , ON LINE,
, , , ..., , ON LINE,

1. The \overline{KMUTE} output will go low while 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:

+ + + ...

Example 2:

+ + + ...

Example 3:

+ + + ...

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. , , : 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 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.

W91640 SERIES



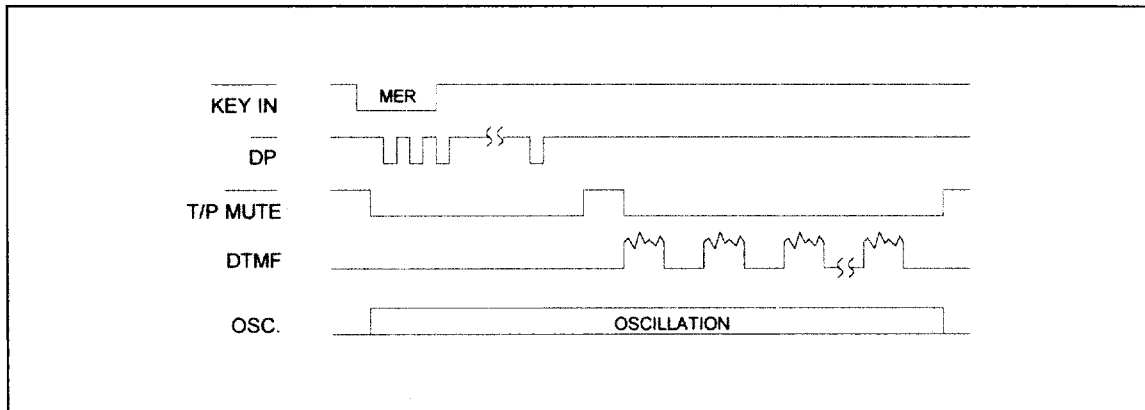
4. **ON HOOK** , **OFF HOOK** , **R** : All the mixed dialing sequences described in the above examples will be dialed out only if there are not more than 32 digits. If the sequence exceeds 32 digits then the redialing is inhibited.

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.



W91640 SERIES



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 Temperature	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}	$\overline{\text{HKS}} = 0$, no load and no key entry	-	-	15	μA
Memory Retention Current	I _{MR}	$\overline{\text{HKS}} = 1$, V _{DD} = 1.0V	-	-	0.2	μA
DTMF Output Voltage	V _{TO}	Row group, R _L = 5 KΩ	130	150	170	V _{rms}
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
$\overline{\text{DP}}$ Sink Current	I _{PL}	V _{PO} = 0.5V	0.5	-	-	mA
$\overline{\text{KMUTE}}$, T/P $\overline{\text{MUTE}}$ Output Sink Current	I _{ML}	V _{MO} = 0.5V	0.5	-	-	mA
$\overline{\text{HKS}}$ I/P Pull High Resistor	R _{KH}		-	500	-	KΩ

W91640 SERIES



DC Characteristics, continued

PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNIT
HFO Drive Current	IHFH	VHFH = 2.0V	0.5	-	-	mA
HFO Sink Current	IHFL	VHFL = 0.5V	0.5	-	-	mA
Keypad Drive Current	IKD	V _I = 0V	30	-	-	μA
Keypad Sink Current	IKS	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	TKID		-	20	-	mS
Key Release Debounce	TKRD		-	20	-	mS
Pre-digit Pause	TPDP	M/B = 1/2	-	33.3	-	mS
		M/B = 2/3	-	40	-	mS
Interdigit Pause (Auto dialing)	TIDP	10 ppS	-	800	-	mS
Make/Break Ratio	M/B	M/B = 1/2	-	33:67	-	%
		M/B = 2/3	-	40:60	-	%
Tone Output Duration	TTD	Auto Dialing	-	93	-	mS
Intertone Pause	TITP	Auto Dialing	-	93	-	mS
Flash Break Time	TFB		-	98	-	mS
Flash Pause Time	TFP		-	1.2	-	S
Pause Time	TP		-	2.5	-	S

Notes:

- Crystal parameters suggested for proper operation are R_s < 10Ω, L_m = 96 mH, C_m = 0.02 pF, C_n = 5 pF, C_l = 18 pF, F_{osc} = 3.579545 MHz ± 0.02%.
- Crystal oscillator accuracy directly affects these times.

W91640 SERIES



TIMING WAVEFORMS

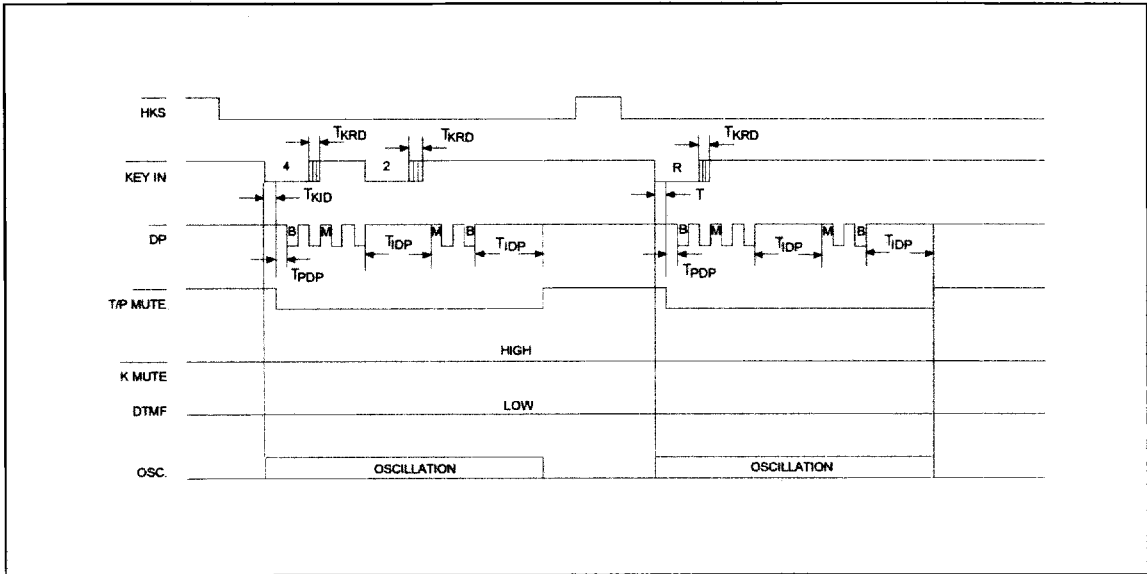


Figure 1. Pulse Mode Timing Diagram

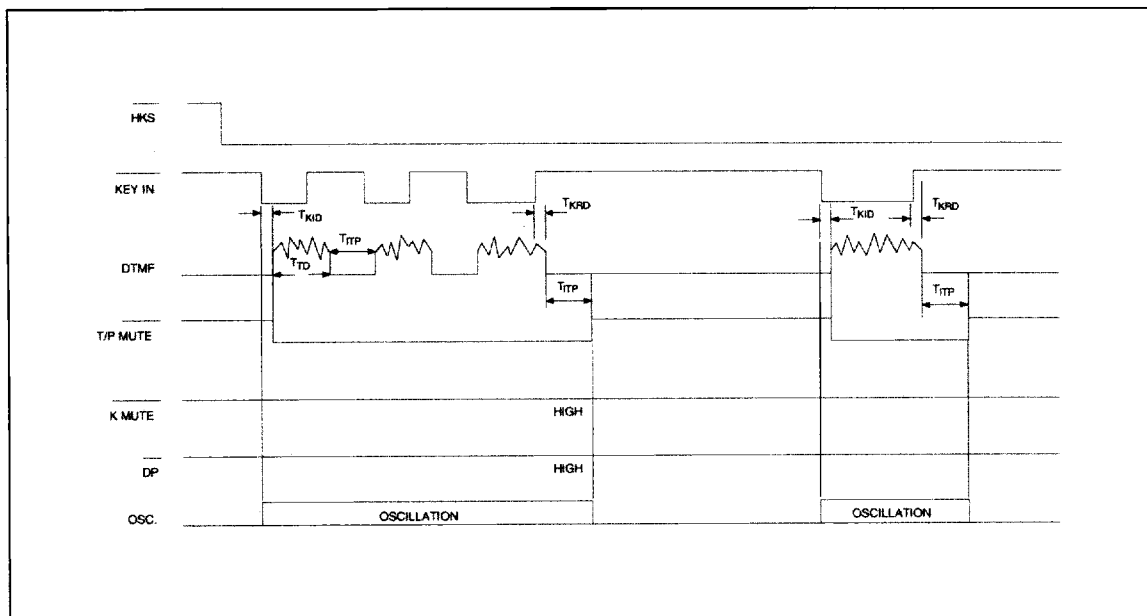


Figure 2(a). Tone Mode Normal Dialing Timing Diagram

W91640 SERIES



Timing Waveforms, continued

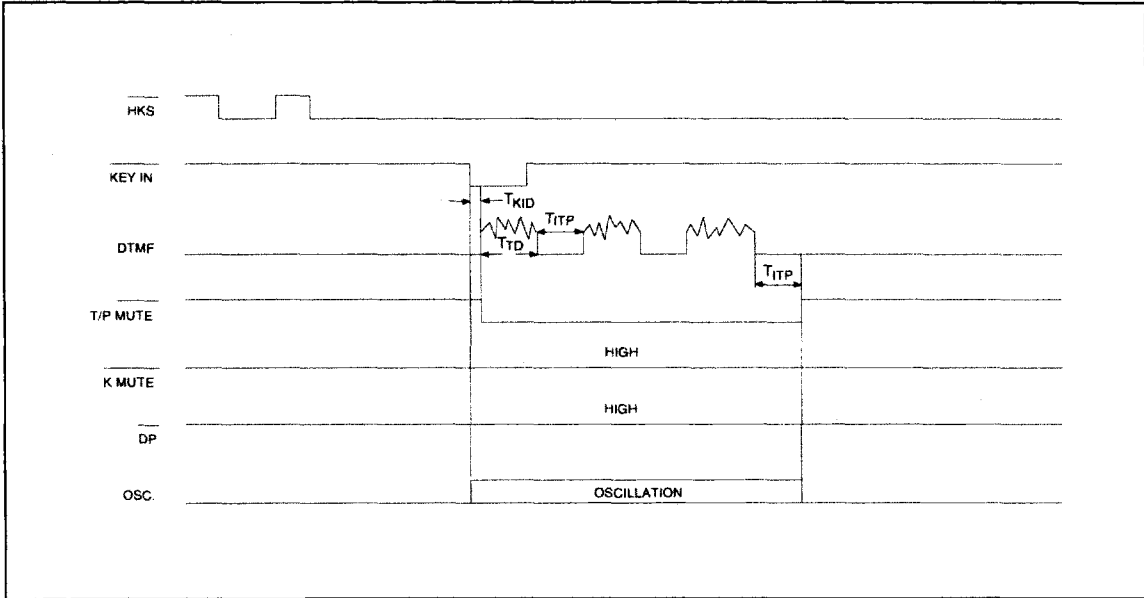


Figure 2(b). Tone Mode Auto Dialing Timing Diagram

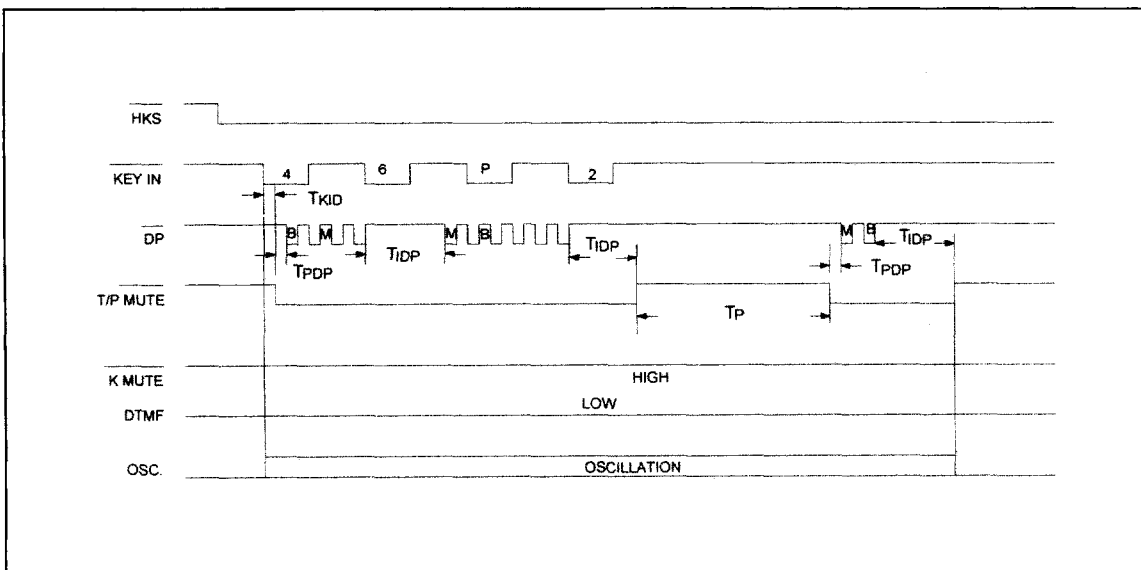


Figure 3. Pause Function Timing Diagram

W91640 SERIES



Timing Waveforms, continued

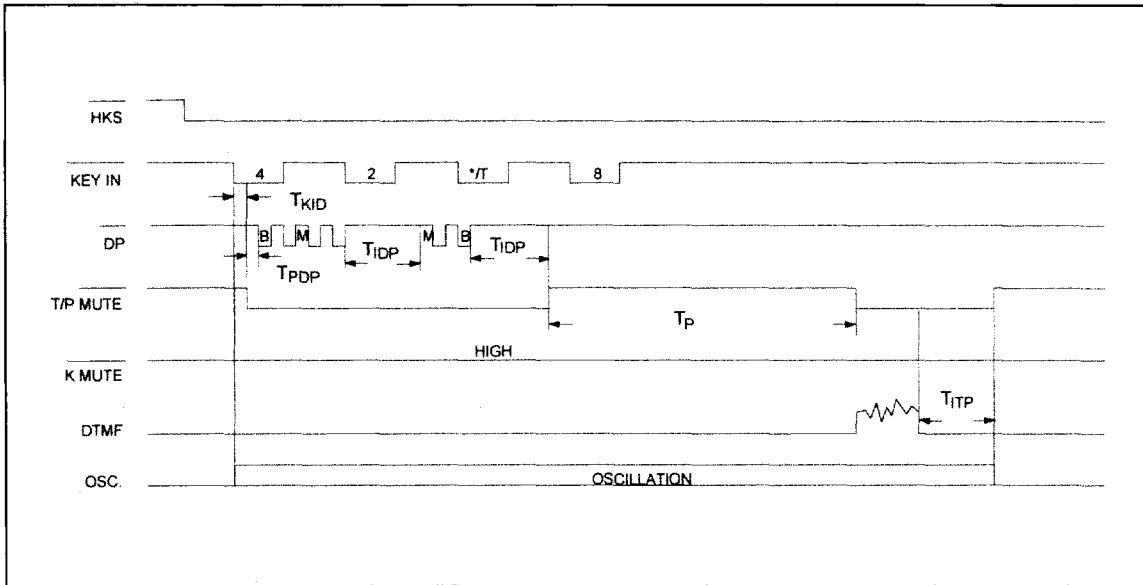


Figure 4. Pulse-to-tone Operation Timing Diagram

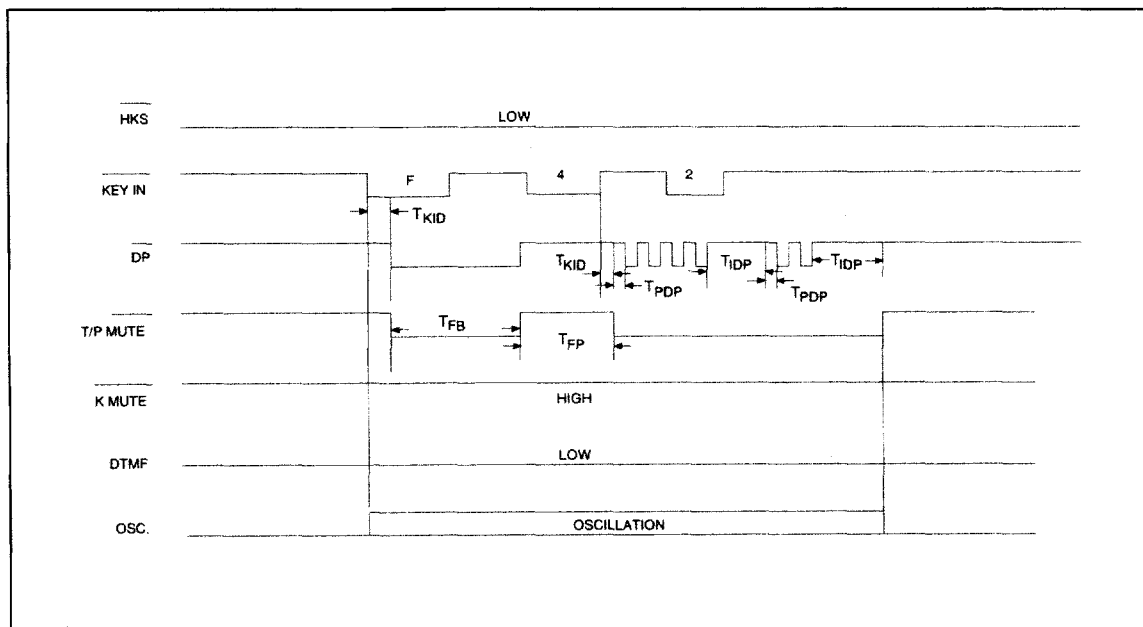


Figure 5. Flash Operation Timing Diagram

W91640 SERIES



Timing Waveforms, continued

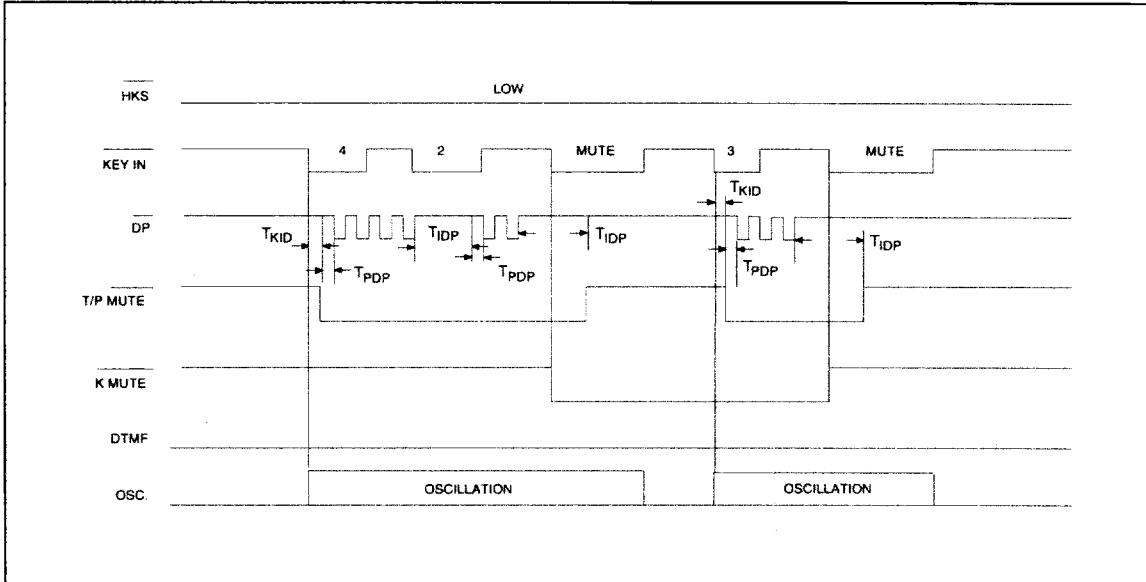


Figure 6(a). Mute Key Timing Diagram

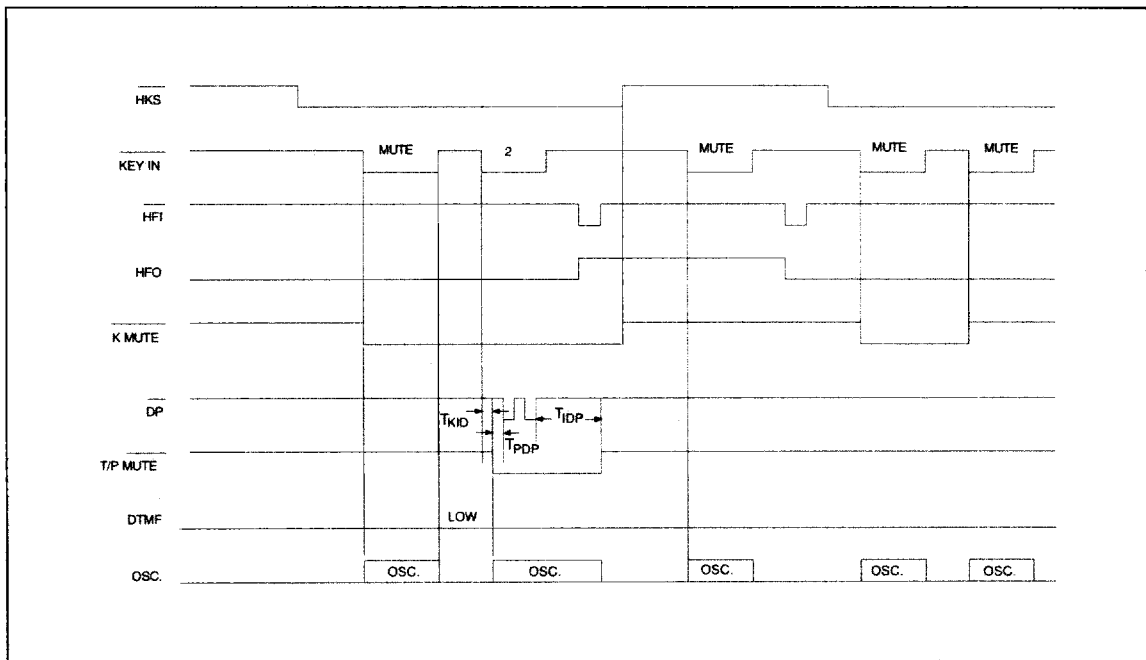


Figure 6(b). Mute Key Operation with HFI/HFO Timing Diagram (IA5264001 Only)

W91640 SERIES



Timing Waveforms, continued

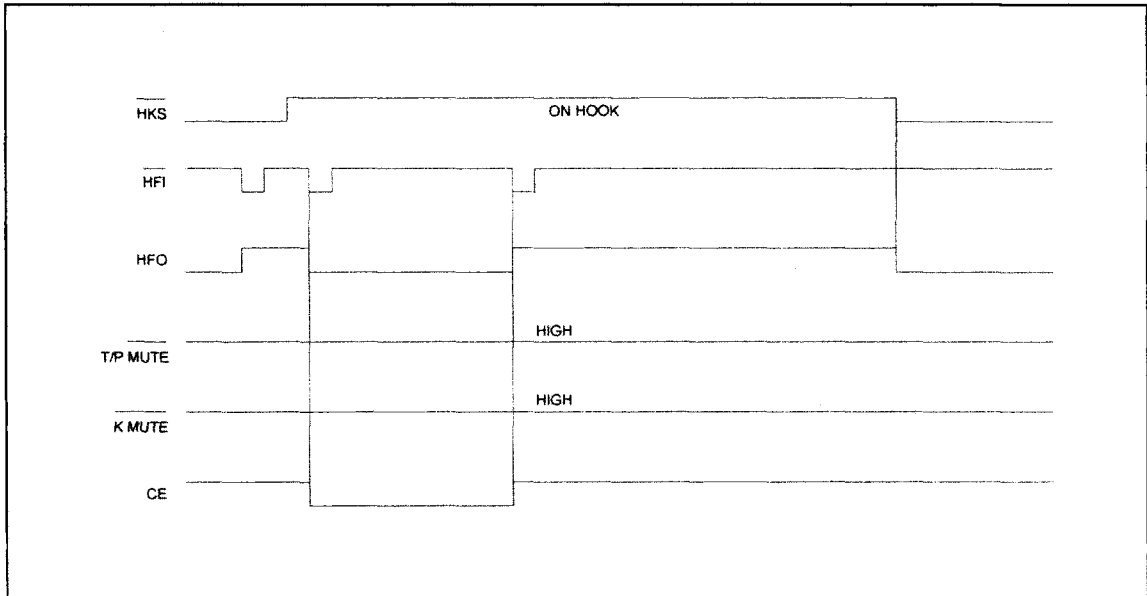


Figure 7. Handfree Reset by $\overline{\text{HKS}}$ Falling Edge

W91640 SERIES



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.