W91660 SERIES

Winbond Electronics Corp.

20-MEMORY TONE/PULSE SWITCHABLE DIALER

GENERAL DESCRIPTION

The W91660 series are Si-gate CMOS IC tone/pulse switchable dialers with 20 automatic dialing memories, a 16-digit × 10 one touch memory, a 16-digit × 10 two touch memory and a 32-digit save or mercury memory. It also provides secrecy key, flash, handfree and redial functions.

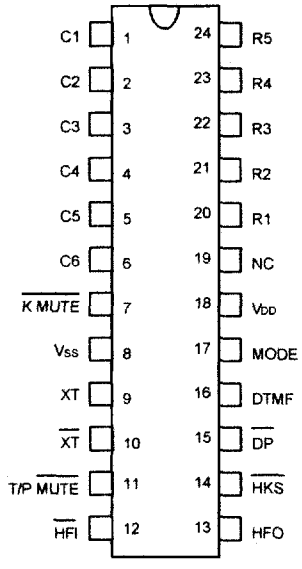
FEATURES

- Tone/Pulse switchable dialer
- 32-digit for redial memory
- 32-digit save memory
- 16-digit × 10 one touch repertory memory
- 16-digit × 10 two 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 W91660 series are described in the following table:

TYPE NO.	PULSE (ppS)	PAUSE (S)	B:M	FLASH (mS)	MERCURY MEMORY
W91660	10	2.5	2:1	98	Save
W91661	10	2.5	3:2	98	Save
W91660B	10	2.5	2:1	98	Yes
W91661B	10	2.5	3:2	98	Yes

Publication Release Date: September 1996
Revision A1

PIN CONFIGURATION



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, $\overline{XT}$	9, 10	I, O	A built-in inverter provides oscillation with an inexpensive 3.579545 MHz crystal or ceramic resonator.
T/P $\overline{MUTE}$	11	O	The T/P $\overline{MUTE}$ 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 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).

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Pin Description, continued

<table>
<tr><th>SYMBOL</th><th>PIN</th><th>I/O</th><th>FUNCTION</th></tr>
<tr><td>$\overline{HKS}$</td><td>14</td><td>I</td><td>Hook switch input.
$\overline{HKS}$ = 1: On-hook state. Chip in sleeping mode, no operation.
$\overline{HKS}$ = 0: Off-hook state. Chip enabled for normal operation.
$\overline{HKS}$ pin is pulled to VDD by internal resistor.</td></tr>
<tr><td>$\overline{DP}$</td><td>15</td><td>O</td><td>N-channel open drain dialing pulse output (Figure 1).
Flash key causes $\overline{DP}$ to be active when in pulse mode.</td></tr>
<tr><td>NC</td><td>19</td><td>-</td><td>No connection.</td></tr>
<tr><td>DTMF</td><td>16</td><td>O</td><td>In pulse mode, remains in low state at all times.
In tone mode, sends a dual or single tone.
<table>
<tr><th colspan="4">OUTPUT FREQUENCY</th></tr>
<tr><td></td><td>Specified</td><td>Actual</td><td>Error %</td></tr>
<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>
</table></td></tr>
<tr><td>VDD, VSS</td><td>18, 8</td><td>I</td><td>Power input pins.</td></tr>
<tr><td>$\overline{HFI}$, HFO</td><td>12, 13</td><td>I, O</td><td>Handfree control pins.
A low pulse on the $\overline{HFI}$ input pin toggles the handfree control state.
Status of the handfree control states are listed in the following table:
<table>
<tr><th colspan="2">CURRENT STATE</th><th colspan="3">NEXT STATE</th></tr>
<tr><td>Hook SW.</td><td>HFO</td><td>Input</td><td>HFO</td><td>Dialing</td></tr>
<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>
</table>
$\overline{HFI}$ pin is pulled to VDD by internal resistor.</td></tr>
</table>

Pin Description, continued

SYMBOL	PIN	I/O	FUNCTION
$\overline{\text{K MUTE}}$	7	O	The $\overline{\text{K MUTE}}$ is NMOS open drain output. The output transistor is switched on only mute function. Otherwise, it is switched off.

FUNCTIONAL DESCRIPTION

Keyboard Operation

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

Note: [MER] is for W91660B/661B only, and the other type numbers (W91660/661) is 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
- A: Two touch memory first 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.
- MUTE: Secrecy control key
  Once the Mute key is pressed, the $\overline{\text{K MUTE}}$ output will be toggled.

Notes:

1. Dn = 0 to 9,*/T, #, Mn = M1 to M10
2. Ln = [A] + N = [A] + Mn. The memory address of Ln is same as M11 to M20.

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.

[OFF HOOK] , [D1] , [D2] , ..., [Dn] Busy, Come [ON HOOK] , [OFF HOOK] , (or [ON HOOK] & [HFI]), [R]

or [ON HOOK] & [HFI] , [D1] , [D2] , ..., [Dn] BUSY, [HFI] , Come [HFI] , [R]

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

Number Store

1. [OFF HOOK] (or [ON HOOK] & [HFI]) [S] , [Mn] (or [Ln]), [SAVE] [D1] , [D2] , ..., [Dn] , [S]

   a. D1, D2, ..., Dn will be stored in memory Mn (or save) or Ln 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]), [S] , [Mn] (or [Ln] , [SAVE]) [R] , [S]

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

   b. If redial buffer is over 16-digit, the content isn't transferred to Mn or Ln.

3. [OFF HOOK] (or [ON HOOK] & [HFI]), [S] , [Mn] (or [Ln]), [SAVE] , [S]

   Save memory is transferred to Mn or Ln.

4. [OFF HOOK] , [D1] , [D2] , ..., [Dn] , [SAVE]

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

Mercury Store

[OFF HOOK] (or [ON HOOK] & [HFI]) [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), S , Mn (or Ln , SAVE), S

The Mn (or Ln, save) will be cleared .

Repertory Dialing

1. OFF HOOK (or ON HOOK & HFI), Mn (or Ln , SAVE)
   Mn (or Ln, save) will be dialing out.

2. OFF HOOK , Mn (or Ln , SAVE)
   a. Mn or Ln, save content = D1, D2, */T, D3, D4
   b. D1, D2, P→T, D3, D4 will be dialed out
   c. Redail register is changed to D1, D2, P→T, D3, D4.

Access Pause

OFF HOOK (or ON HOOK & 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 & 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 remain 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), 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 & $\overline{\text{HFI}}$), D1 , D2 , ..., Dn , ON LINE MUTE , D1' , D2' , ..., Dn' , ON LINE, MUTE

1. The $\overline{\text{K MUTE}}$ output will go low while first MUTE key is pressed.
2. The operation timing diagram is shown in Figure 6(a), 6(b).

Cascade Dialing

Cascade Dialing

1. Definition of cascade dialing:

   The next sequence may be pressed before the former sequence is set out completely.

   The examples of cascade dialing could be like (but not limited to):

   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 rectangled above is treated as one sequence.
3. There are at most 32 digits allowed in the cascade dialing, and no limitation of the numbers of sequences.
4. The content of cascade dialing could be the combination of normal dialing, redialing, repertory dialing.
5. ON HOOK , OFF HOOK , R , then all the cascade-dialed sequences described in the above examples will be dialed out only if they are not more than 32 digits. If it is over 32 digits then the redialing is inhibited. (The R key can be used any time after off-hook or handfree activity.)

Mix Dialing

1. Definition of cascade dialing:

   As in the described 3 examples above, if we dialed every sequence only if its former sequence is dialed out completely, then this is Mix dialing.

2. There is no limitation on the number of digits and sequences in the Mix dialing.
3. The contents of Mix dialing, could be the combination of normal dialing, redialing, and repertory dialing.

4. [ON HOOK] , [OFF HOOK] , [R] , then all the Mix dialing sequences described in the above examples will be dialed out only if they are not more than 32 digits. If it is over 32 digits then the redialing is inhibited.

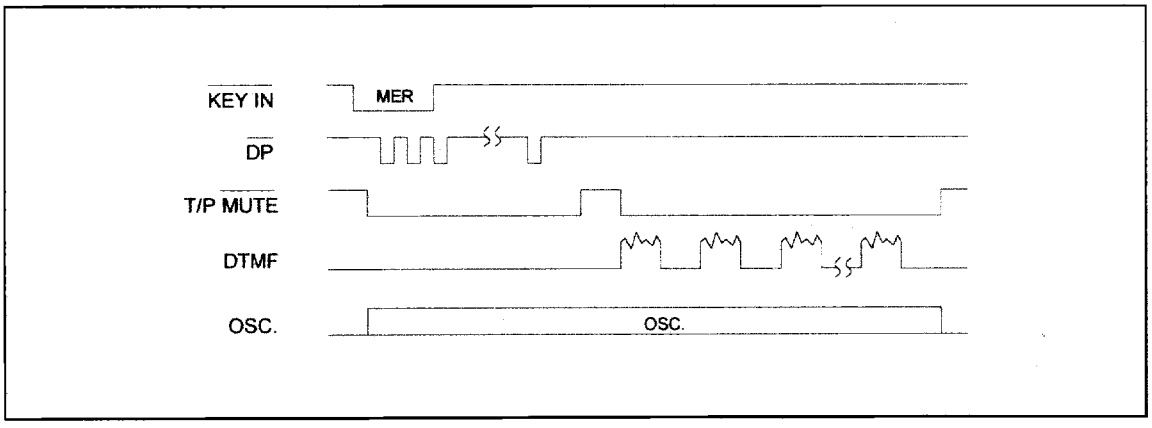
Combination(s) of Cascade and Mix Dialing

1. Cascade dialing and Mix dialing could be combined, and each follows the rules described above.
2. To apply redial to the combination of Cascade and Mix dialing:

   [ON HOOK] , [OFF HOOK] , [R] , and then the redialing will be executed only if the total number of digits in the combination are not over 32 digits. If it is over 32 digits, then this redial is inhibited.
3. If there had been n Cascaded sequences, accumulatively 30 digits dialed, then for the (n+1)th Cascade sequence, you can dial one 2-digit Normal dialing or one complete repertory dialing (length up to 32 digits). The (n+2)th sequence is not accepted for Cascade dialing.
4. After an accumulative 32-digits Cascade dialing is completed, Mix dialing can be added.

Mercury Dialing

1. Up to 32 digits may be stored.
2. Mercury dialing is activated 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	PD	120	mW
Operating Temperature	TOPR	-20 to 70	°C
Storage Temprature	TSTG	-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} = 2.5 V, $F_{OSC.}$ = 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} = 2.0–5.5V	1	2	3	dB
DTMF Distortion	THD	R_L = 5 KΩ, V_{DD} = 2.0–5.5V	-	-30	-23	dB
DTMF Output DC Level	V_{TDC}	R_L = 5 KΩ, V_{DD} = 2.0–5.5V	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

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}	W91660/660B	-	33.3	-	mS
		W91661/661B	-	40	-	
Interdigit Pause (Auto dialing)	T_{IDP}	10 ppS	-	800	-	mS
Make/Break Ratio	M/B	W91660/660B	-	33:67	-	%
		W91661/661B	-	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 < 100Ω, 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

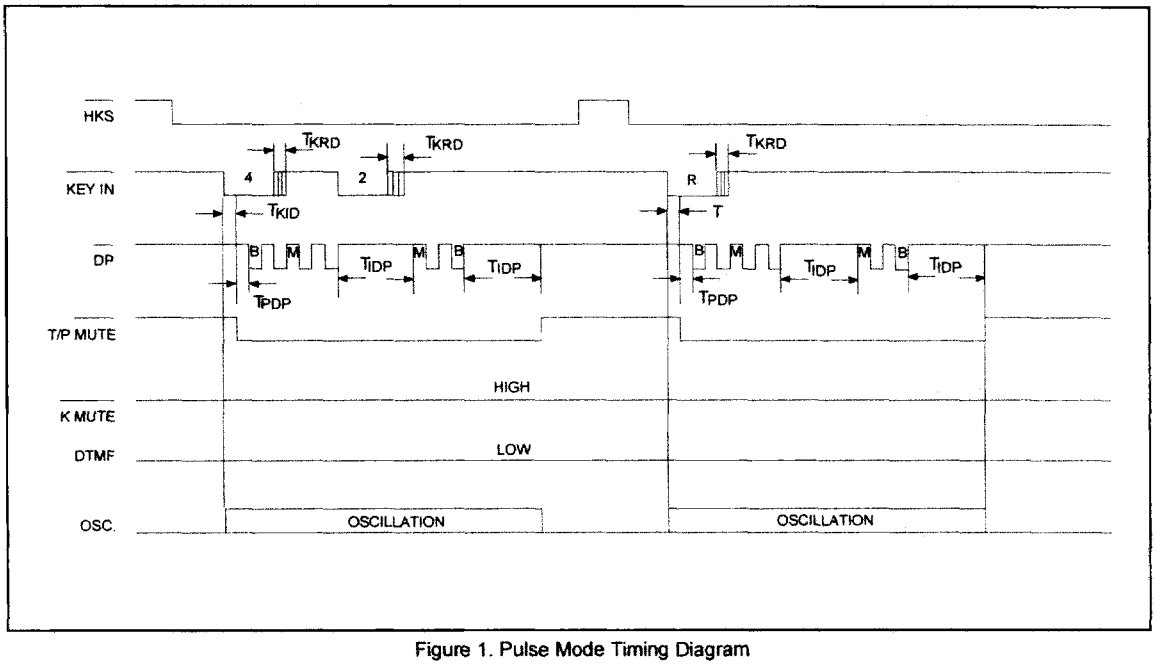


Figure 1. Pulse Mode Timing Diagram

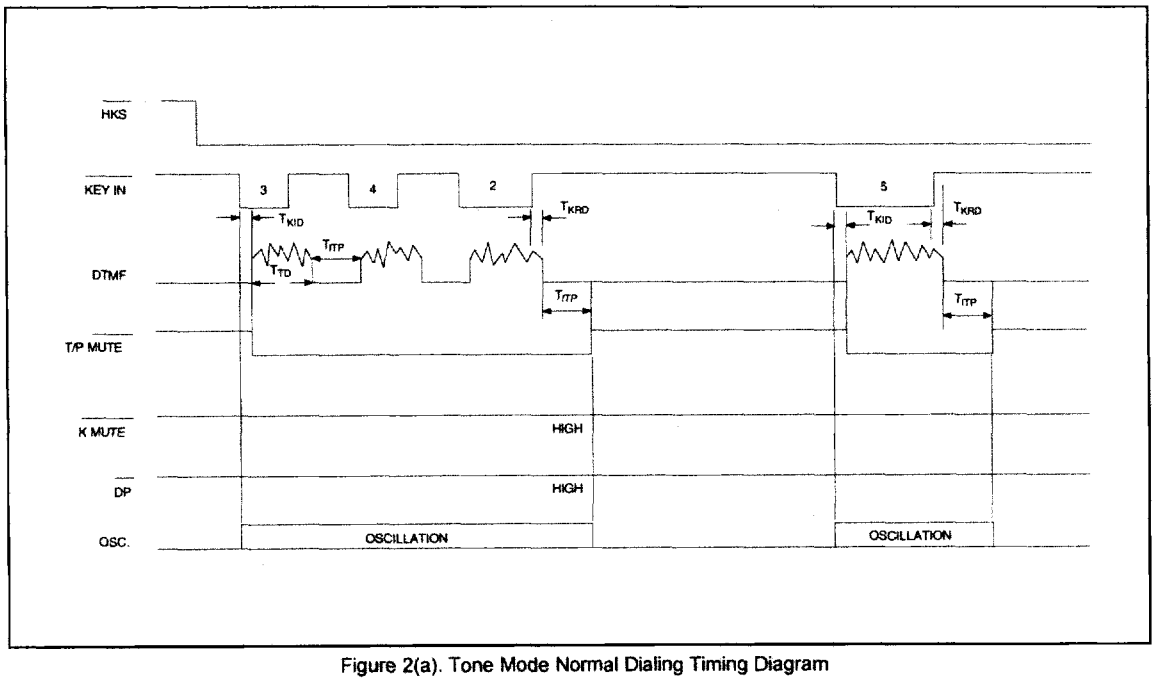


Figure 2(a). Tone Mode Normal Dialing Timing Diagram

Timing Waveforms, continued

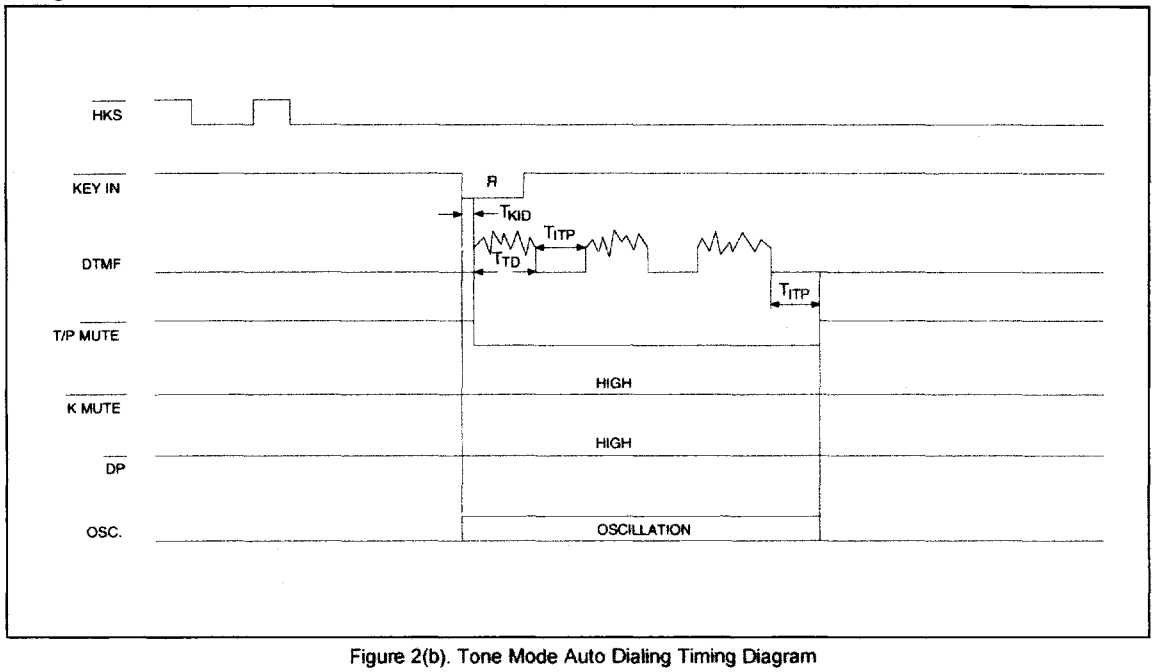


Figure 2(b). Tone Mode Auto Dialing Timing Diagram

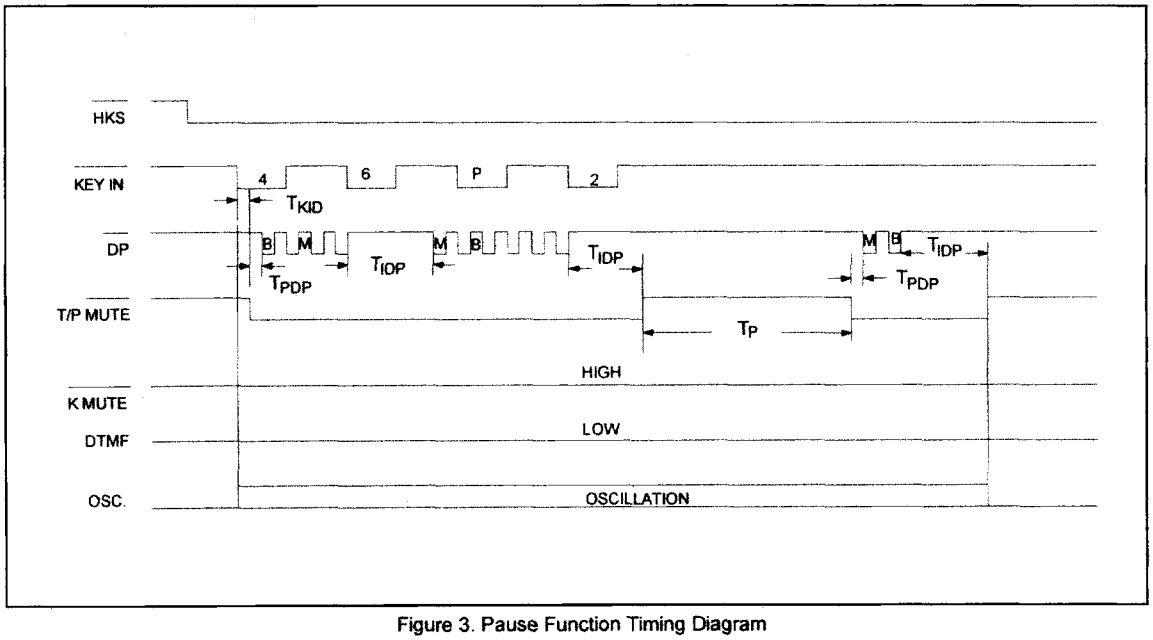


Figure 3. Pause Function Timing Diagram

Timing Waveforms, continued

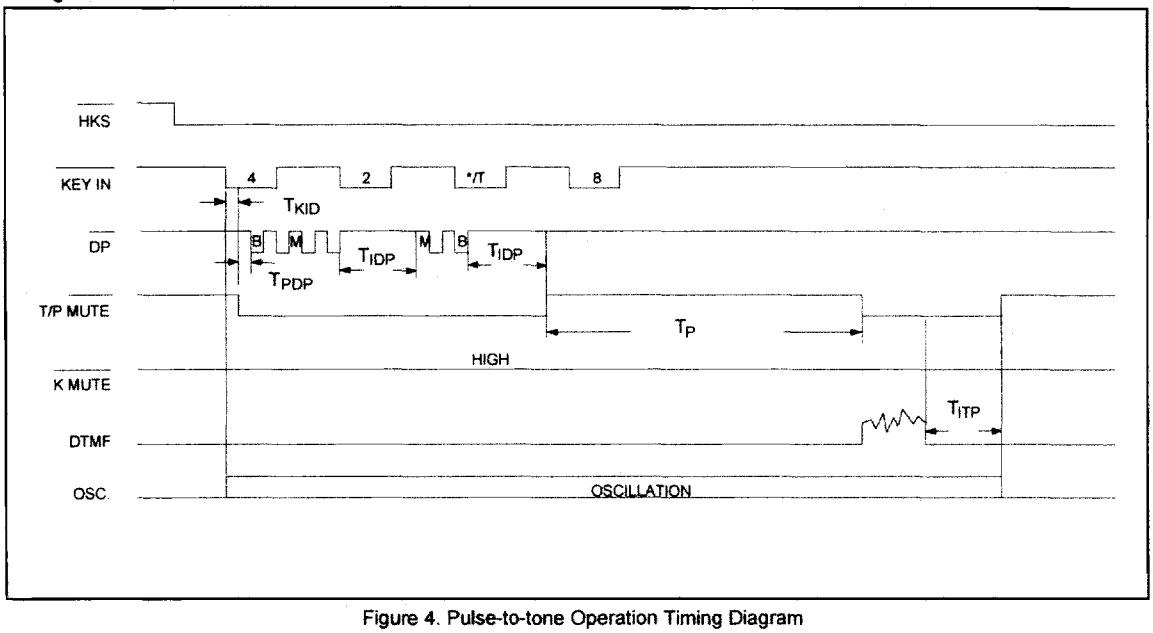


Figure 4. Pulse-to-tone Operation Timing Diagram

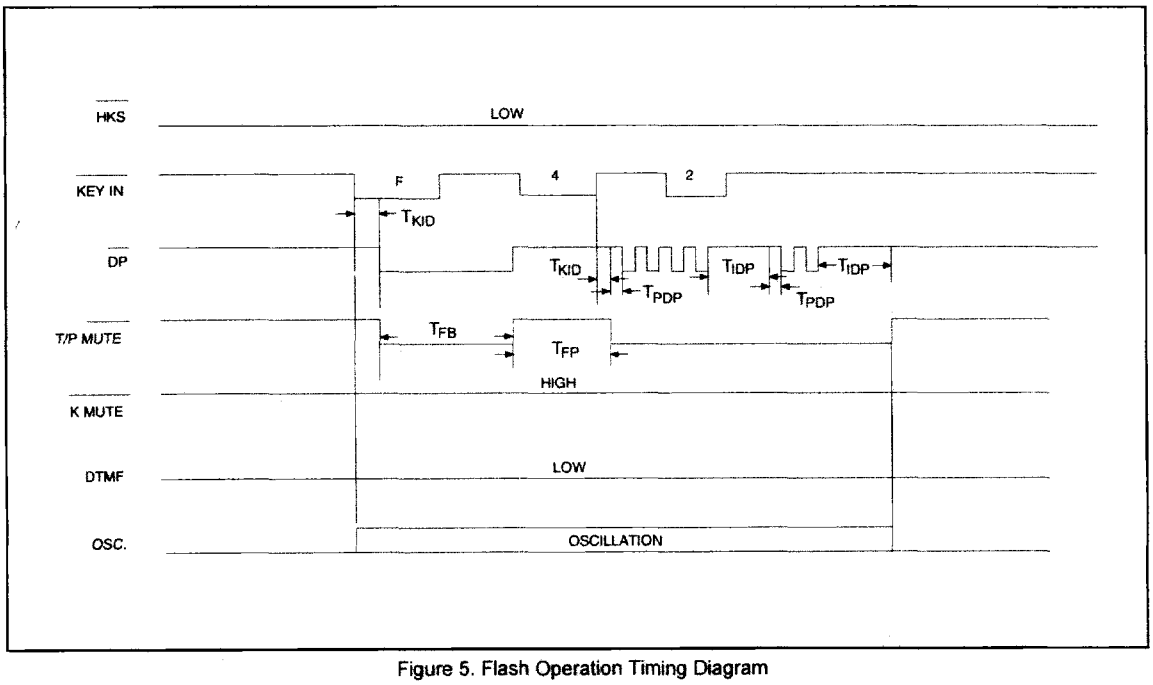


Figure 5. Flash Operation Timing Diagram

Timing Waveforms, continued

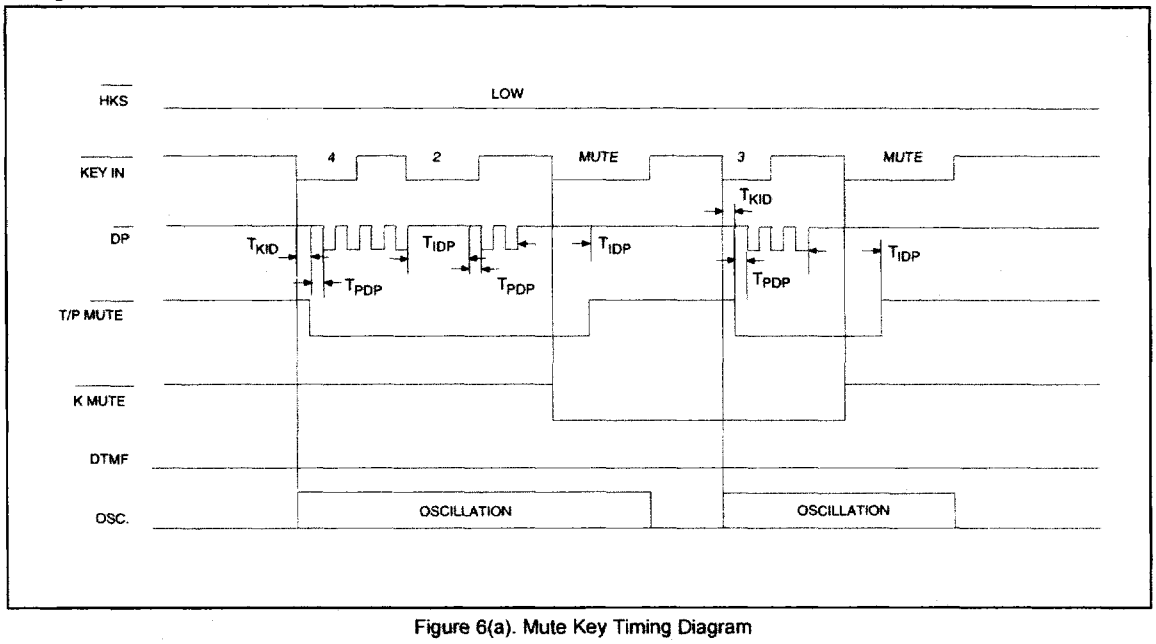


Figure 6(a). Mute Key Timing Diagram

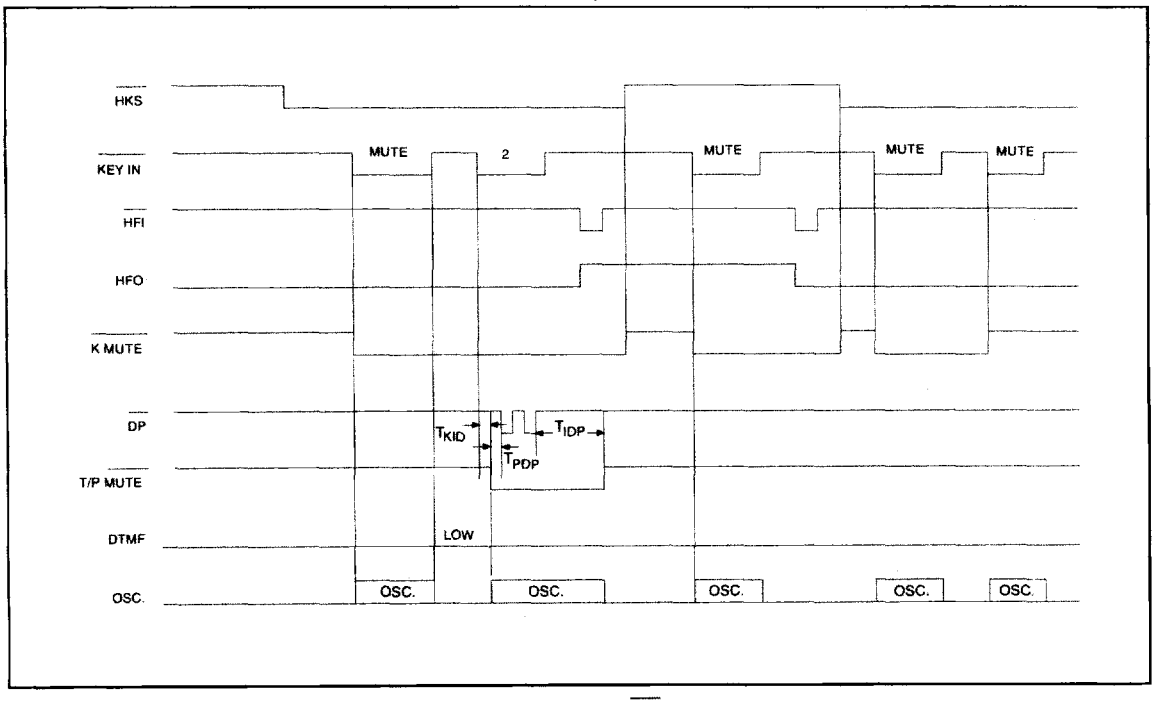


Figure 6(b). Mute Key Operation with $\overline{HFI}$ /HFO Timing Diagram

Timing Waveforms, continued

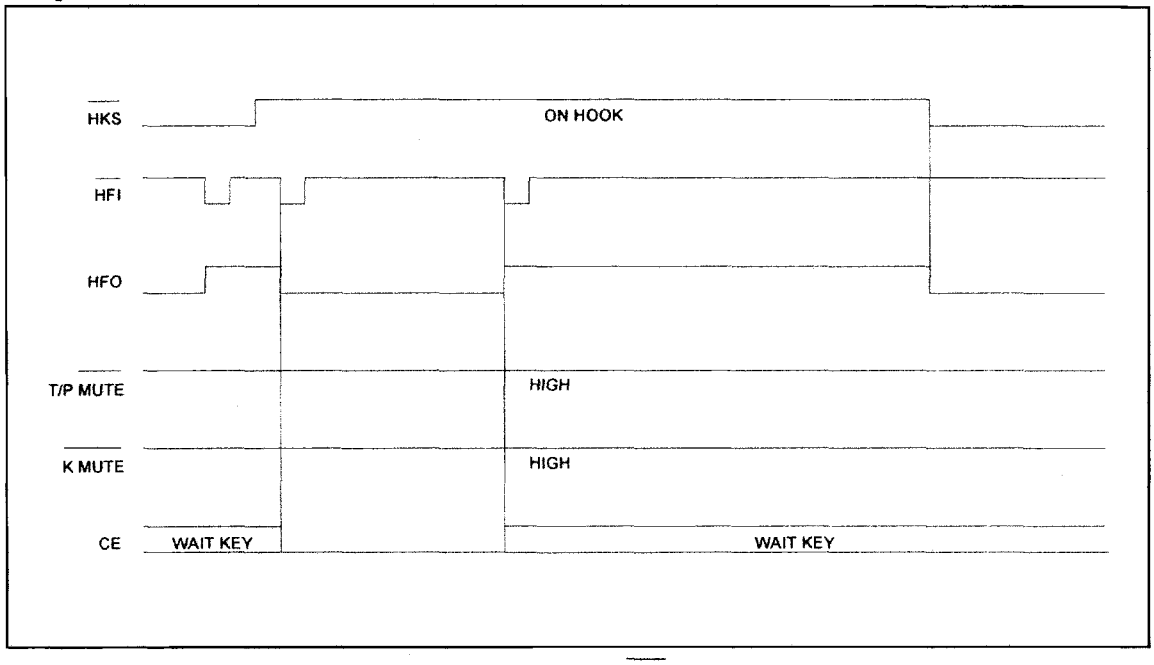


Figure 7. Handfree Reset by $\overline{\text{HKS}}$ Falling Edge

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