Winbond Electronics Corp.

6-MEMORY TONE/PULSE DIALER WITH SAVE AND HANDFREE FUNCTIONS

GENERAL DESCRIPTION

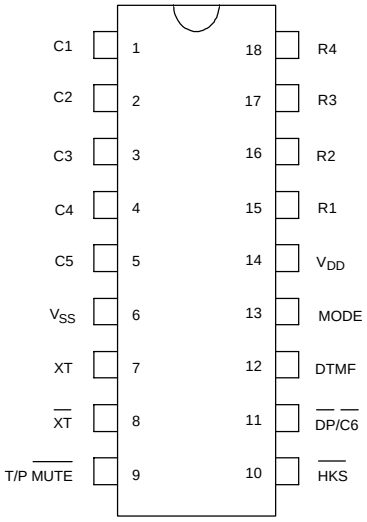
The W91472N series are tone/pulse switchable telephone dialers with five memories, save memory, and handfree dialing control. These chips are fabricated using Winbond's high-performance CMOS technology and thus offer good performance in low-voltage and low-power operations.

FEATURES

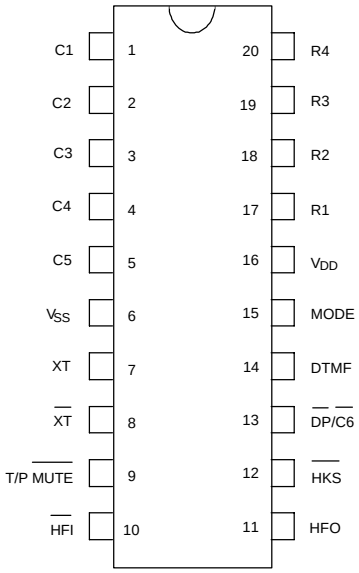
- DTMF/pulse switchable dialer
- Two by 32 digit redial and save memory
- Five by 16 digit one-touch direct repertory memory
- Pulse-to-tone (*/T) keypad for long distance call operation
- Cascaded dialing
- Uses 5 × 6 keyboard
- Easy operation with redial, flash, pause, and */T keypads
- Pause, P→T (pulse-to-tone) can be stored as a digit in memory
- Dialing rate (10 ppS or 20 ppS) selectable by bonding option
- On-hook debounce time: 150 mS
- Minimum tone output duration: 93 mS
- Minimum intertone pause: 93 mS
- Pause time: 3.6 sec.
- Flash break time (73 mS, 100 mS, 300 mS, or 600 mS) selectable by keypad; pause time is 1.0S
- 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
- 18 or 20-pin dual-in-line plastic package
- The different dialers in the W91472N series are shown in the following table:

TYPE NO.	REPLACEMENT TYPE NO.	PULSE (ppS)	FLASH (mS)	M/B	KEY TONE	HANDFREE DIALING	PACKAGE (PINS)
W91472N	W91472	10	600/300/73/100	Pin	-	-	18
W91472AN	W91472A	10	600/300/73/100	Pin	Yes	Yes	20
W91472BN	W91472B	20	600/300/73/100	Pin	-	-	18
W91472CN	W91472C	20	600/300/73/100	Pin	Yes	Yes	20

PIN CONFIGURATIONS



W91472N/472BN



W91472AN/472CN

PIN DESCRIPTION

SYMBOL	18-PIN	20-PIN	I/O	FUNCTION
Column-Row Inputs	1–5 & 15–18	1–5 & 17–20	I	The keyboard input is compatible with a standard 5 x 6 keyboard, an inexpensive single contact (Form A) keyboard, and electronic input. In normal operation, any single button can be pushed to produce dual tone, pulses, or function. Activation of two or more buttons will result in no response except for single tone.
XT	7	7	I	A built-in inverter provides oscillation with an inexpensive 3.579545 MHz crystal. The oscillator ceases when a keypad input is not sensed. The crystal frequency deviation is 0.02%.
$\overline{XT}$	8	8	O	Crystal oscillator output pin.
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 low level during dialing sequence (both pulse and tone mode). Otherwise, it is switched off.

Pin Description, continued

SYMBOL	18-PIN	20-PIN	I/O	FUNCTION
MODE	13	15	I	Pulling mode pin to VSS places dialer in tone mode. Pulling mode pin to VDD places dialer in pulse mode with M/B ratio of 40:60 (10 ppS, except for 91472BN/472CN = 20 ppS). Leaving mode pin floating places dialer in pulse mode with M/B ratio of 33.3:66.7 (10 ppS, except for W91472BN/472CN = 20 ppS).
$\overline{HKS}$	10	12	I	The $\overline{HKS}$ input is used to sense whether the handset is on-hook or off-hook. In on-hook state, $\overline{HKS}$ = 1: chip is in sleeping mode, no operation. In off-hook state, $\overline{HKS}$ = 0: chip is enabled for normal operation. $\overline{HKS}$ pin is pulled to VDD by internal resistor.
$\overline{DP}$ / $\overline{C6}$	11	13	O	N-channel open drain dialing pulse output. Flash key will cause $\overline{DP}$ to be active in either tone mode or pulse mode. The timing diagram for pulse mode is shown in Figure 1 (a, b, c, d).
DTMF	12	14	O	During pulse dialing, this pin remains in low state regardless of keypad input. In the tone mode, it will output a dual or single tone. A detailed timing diagram for tone mode is shown in Figure 2 (a, b, c, d).
VDD, VSS	14, 6	16, 6	I	Power input pins for the dialer chip. VDD is the main power and VSS is the ground.

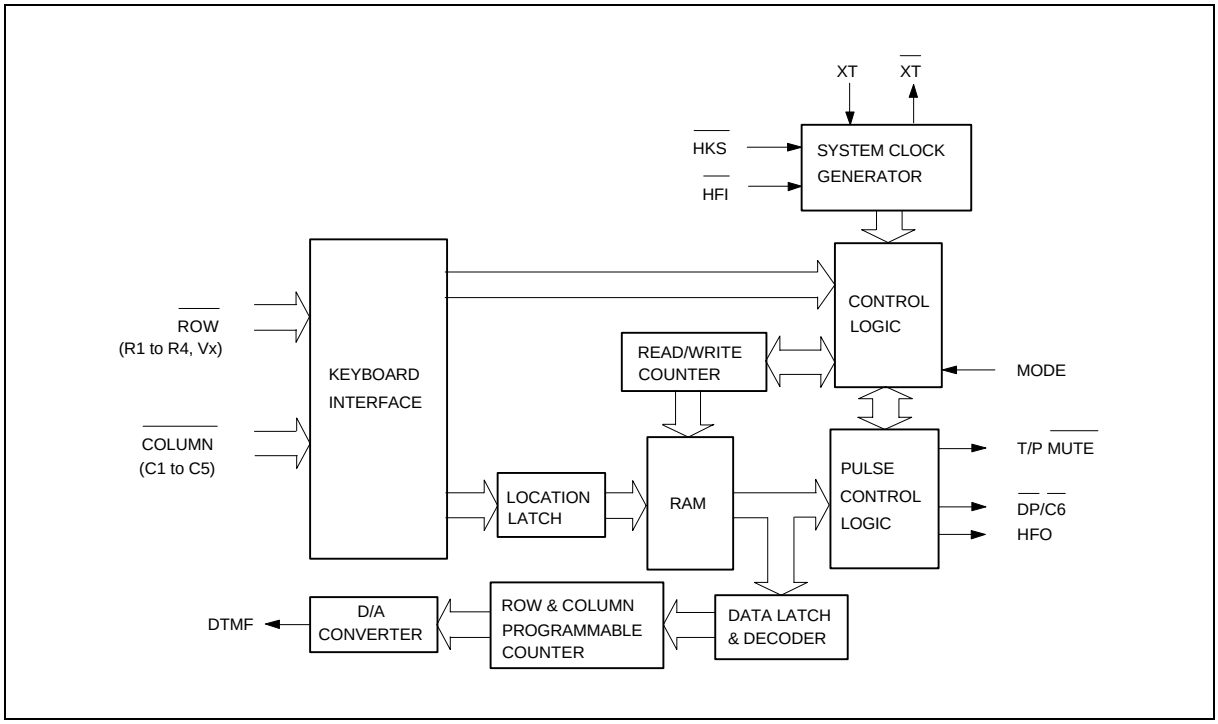
OUTPUT FREQUENCY

	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

Pin Description, continued

<table>
<tr><th>SYMBOL</th><th>18-PIN</th><th>20-PIN</th><th>I/O</th><th>FUNCTION</th></tr>
<tr><td>$\overline{HFI}$,
HFO</td><td>-</td><td>10, 11</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 state is 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 V_{DD} by an internal resistor.
Detailed timing diagram is shown in Figure 3.</td></tr>
</table>

BLOCK DIAGRAM



FUNCTIONAL DESCRIPTION

C1	C2	C3	C4	$\overline{DP}/\overline{C6}$	C5	
1	2	3	S	M1	M4	R1
4	5	6	F4	M2	M5	R2
7	8	9		M3		R3
*/T	0	#	R/P	SAVE		R4
F1	F2	F3				Vx

- S: Store function key
- R/P: Redial and pause function key
- */T: * in tone mode and P→T key in pulse mode
- SAVE: Save function key for one-touch 32-digit memory
- M1, ..., M5: One-touch memory
- F1, ..., F4: Flash function keys: F1 = 600 mS, F2 = 300 mS, F3 = 73 mS, F4 = 100 mS, and all flash pause time is 1.0 mS

Note: Mn = M1 , ..., M5; Dn = 0, ..., 9, */T, #, Pause.

Normal Dialing

OFF HOOK (or ON HOOK & $\overline{HFI}$ i), 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 nomal dialing.

Redialing

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

ON HOOK , OFF HOOK (or ON HOOK & $\overline{HFI}$ i), R/P

1. The redial memory content will be D1, D2, ..., Dn.
2. The R/P key can execute the redial function only as first key-in after off-hook. Otherwise, it will execute the pause function.

Number Store

1. [OFF HOOK] (or [ON HOOK] & [$\overline{\text{HFI}}$ i]), [D1] , [D2] , ..., [Dn] , [S] , [S] , [Mn]

a. If the sequence of the dialed digits D1, D2, ..., Dn has not finished, [S] will be ignored.

b. D1, D2, ..., Dn will be dialed out and stored in memory location Mn.

2. [OFF HOOK] (or [ON HOOK] & [$\overline{\text{HFI}}$ i]), [S] , [D1] , [D2] , ..., [Dn] , [S] , [Mn]

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

b. [R/P] and [*/T] keys can be stored as a digit in memory, but [R/P] key cannot be the first digit. In store mode, [R/P] is the pause function key.

c. The store mode is released after the store function is executed or when the state of the hook switch changes or the flash function is executed.

Save

1. [OFF HOOK] (or [ON HOOK] & [$\overline{\text{HFI}}$ i]), [D1] , [D2] , ..., [Dn] , [SAVE]

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

b. If the dialing of [D1] to [Dn] is finished, pressing [SAVE] will cause D1 to Dn to be duplicated to save memory.

2. [ON HOOK] , [OFF HOOK] (or [$\overline{\text{HFI}}$ i]), [SAVE]

D1 to Dn will be dialed out after the [SAVE] key is pressed.

Repertory Dialing

[OFF HOOK] (or [ON HOOK] & [$\overline{\text{HFI}}$ i]), [Mn] (or [SAVE])

The content of memory location Mn (or save) will be dialed out.

Access Pause

[OFF HOOK] (or [ON HOOK] & [$\overline{\text{HFI}}$ i]), [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 or redialing or memory dialing.
3. The pause function timing diagram is shown in Figure 4.

Pulse-to-Tone (*/T)

OFF HOOK (or ON HOOK & $\overline{\text{HFI}}$ i 1), 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, 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)
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 function timing diagram is shown in Figure 5.

Flash

OFF HOOK (or ON HOOK & $\overline{\text{HFI}}$ i 1), Fn

1. Fn = F1, ..., F4.
2. If Fn is pressed, the dialer will execute flash break time of 600 mS (F1), 300 mS (F2), 73 mS (F3), or 100 mS (F4). The pause time is 1.0 second.
3. Flash key cannot be stored as a digit in memory. The flash key 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.

Cascaded Dialing

OFF HOOK (or ON HOOK & $\overline{\text{HFI}}$ i 1),

1. Normal dialing (1st sequence) + Repertory dialing (2nd sequence) + Normal dialing
2. Repertory dialing (1st sequence) + Normal dialing (2nd sequence) + Repertory dialing
3. Redialing (1st sequence) + Normal dialing (2nd sequence) + Repertory dialing

Redialing and save dialing is valid only as the first key-in.

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 +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, 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	-	0.40	0.60	mA
		Pulse	-	0.20	0.40	mA
Standby Current	I_{SB}	$\overline{HKS}$ = 0, No load & No key entry	-	-	15	µA
Memory Retention Current	I_{MR}	$\overline{HKS}$ = 1, V_{DD} = 1.0V	-	-	0.2	µA
Tone 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

DC Characteristics, continued

PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNIT
T/P $\overline{\text{MUTE}}$ Output Sink Current	I_{ML}	V_{MO} = 0.5V	0.5	-	-	mA
HFO Drive/Sink Current	I_{HFH}	V_{HFH} = 2.0V	0.5	-	-	mA
	I_{HFL}	V_{HFL} = 0.5V	0.5	-	-	
Keypad Input Drive Current	I_{KD}	V_I = 0V	4	-	-	µA
Keypad Input 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
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 Pin = V_{DD}	-	40	-	mS
10 ppS		Mode Pin = Floating	-	33.3	-	mS
Pre-digit Pause[2]	T_{PDP2}	Mode Pin = V_{DD}	-	20	-	mS
20 ppS		Mode Pin = Floating	-	16.7	-	mS
Interdigit Pause (Auto dialing)	T_{IDP}	10 ppS	-	800	-	mS
		20 ppS	-	500	-	mS
Make/Break Ratio	M:B	Mode Pin = V_{DD}	-	40:60	-	%
		Mode Pin = Floating	-	33.3:66.7	-	%
Tone Output Duration	T_{TD}		-	93	-	mS
Intertone Pause	T_{ITP}		-	93	-	mS
Flash Break Time	T_{FB}	F1	-	600	-	mS
		F2	-	300	-	
		F3	-	73	-	
		F4	-	100	-	
Flash Pause Time	T_{FP}		-	1.0	-	S
Pause Time	T_P		-	3.6	-	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

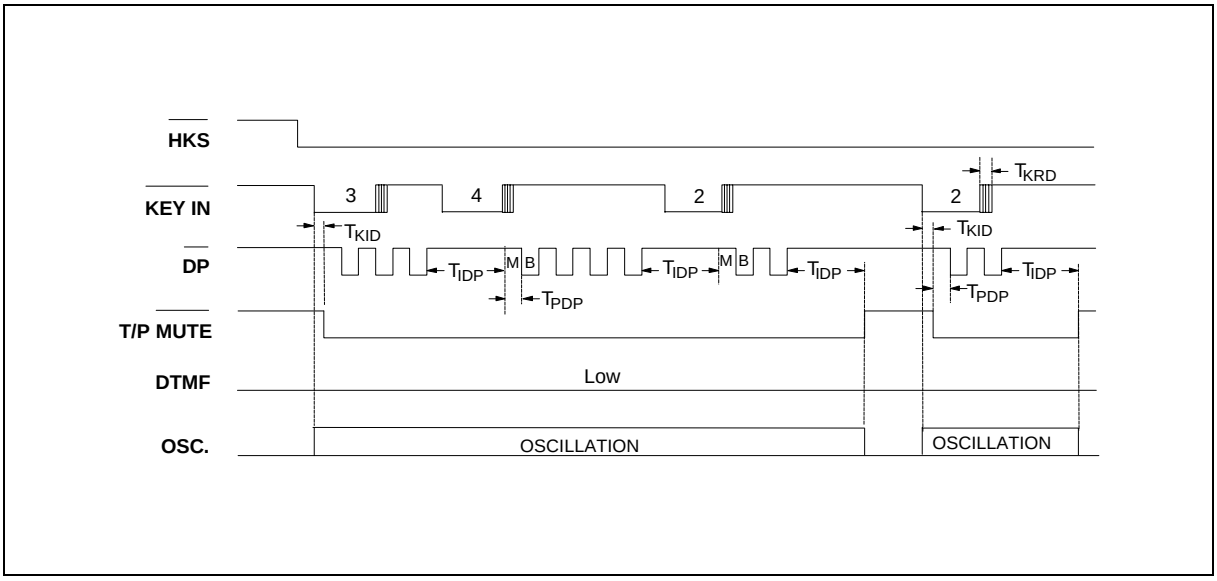


Figure 1(a). Normal Dialing Timing Diagram

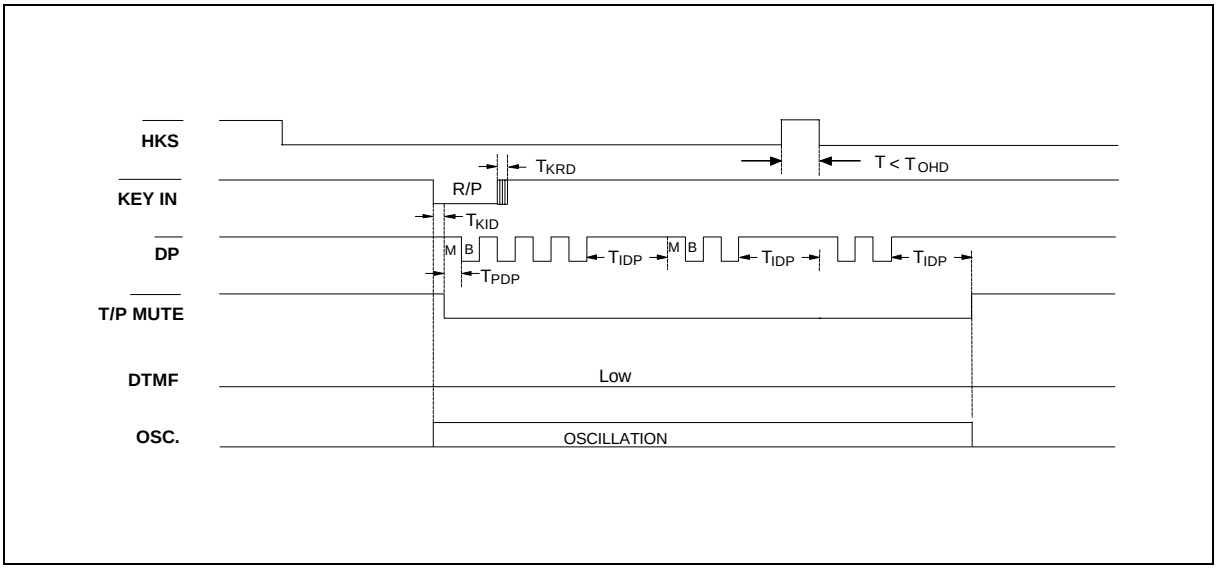


Figure 1(b). Pulse Mode Auto Dialing Timing Diagram

Timing Waveforms, continued

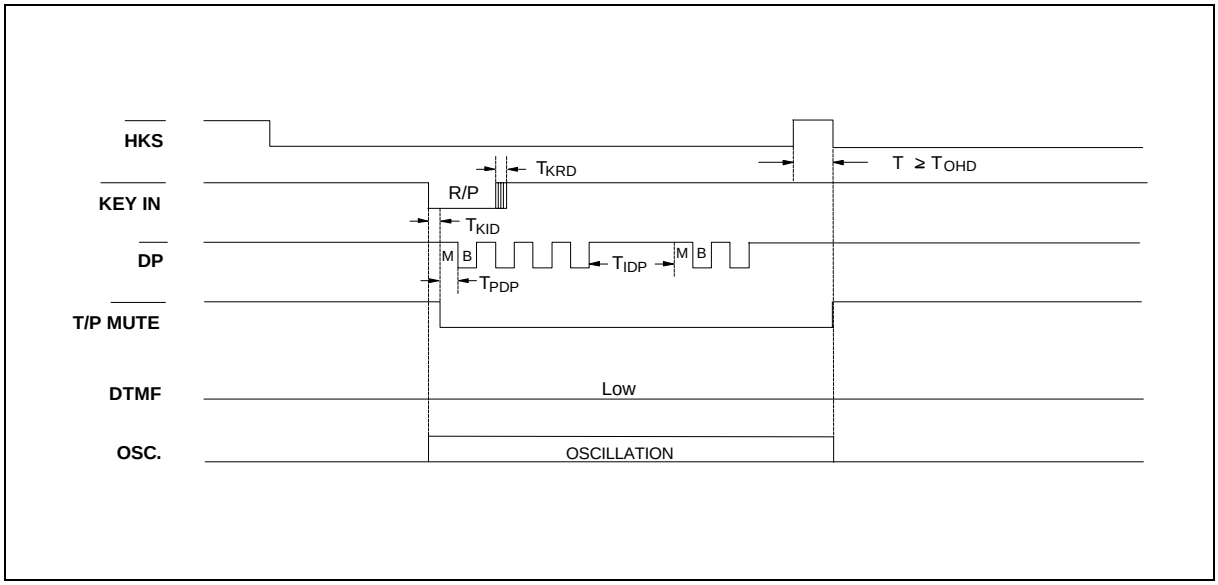


Figure 1(c). Pulse Mode Auto Dialing Timing Diagram

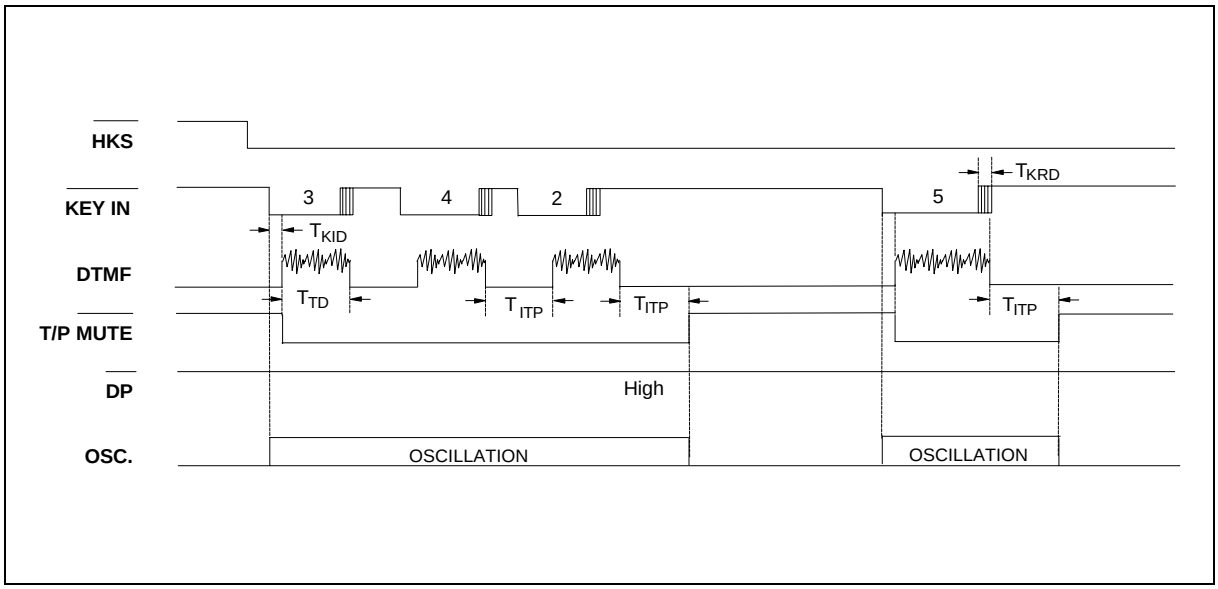


Figure 2(a). Tone Mode Normal Dialing Timing Diagram

Timing Waveforms, continued

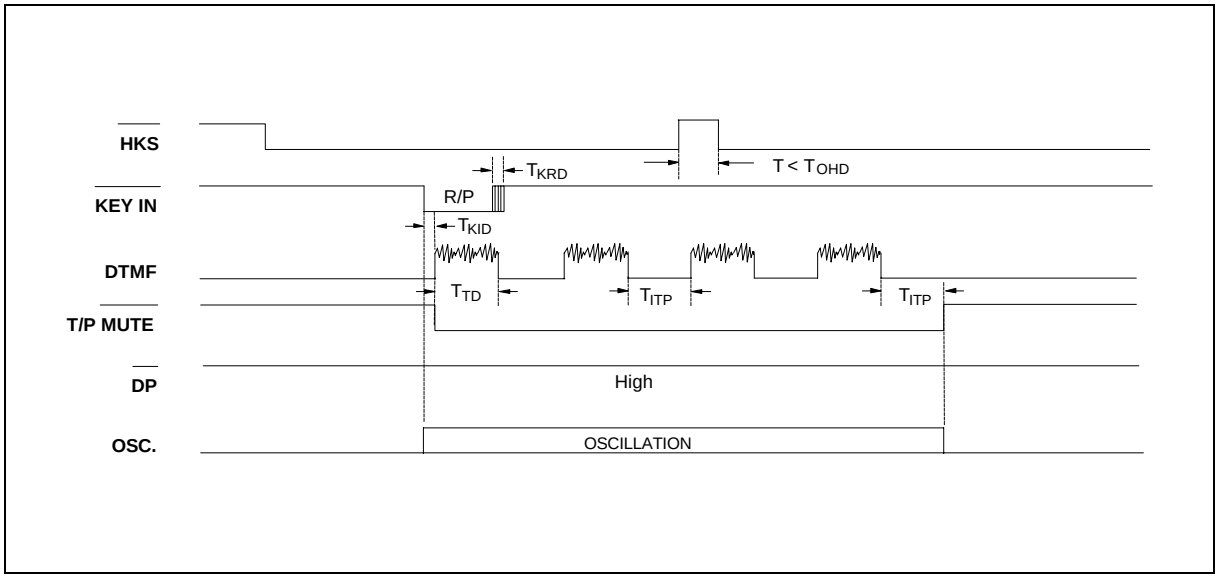


Figure 2(b). Tone Mode Auto Dialing Timing Diagram

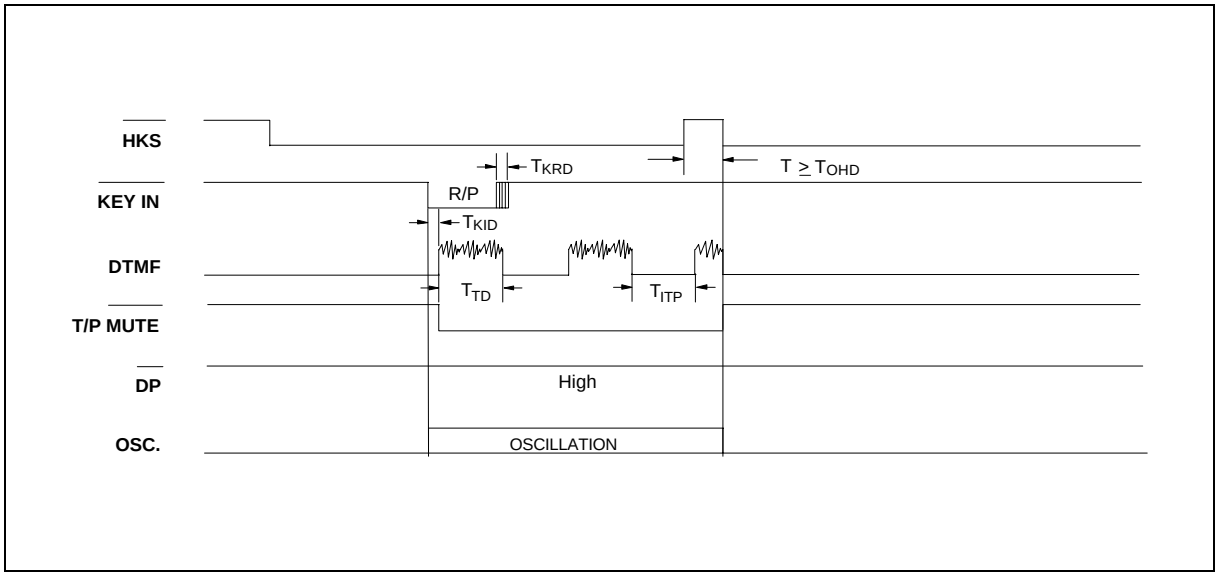


Figure 2(c). Tone Mode Auto Dialing Timing Diagram

Timing Waveforms, continued

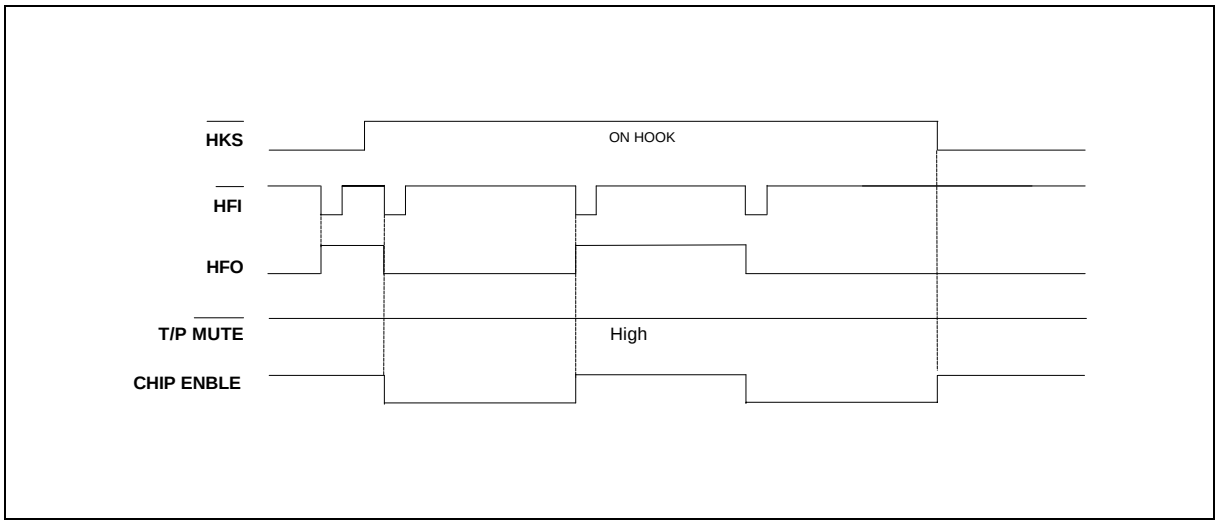


Figure 3. Handfree Timing diagram

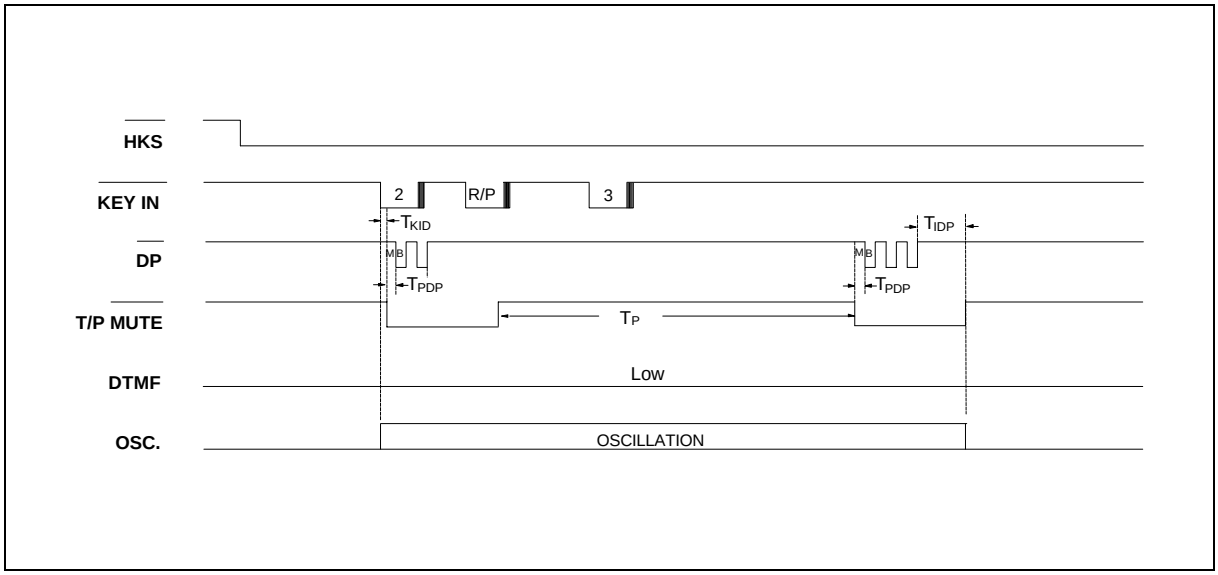


Figure 4. Pause Function Timing Diagram

Timing Waveforms, continued

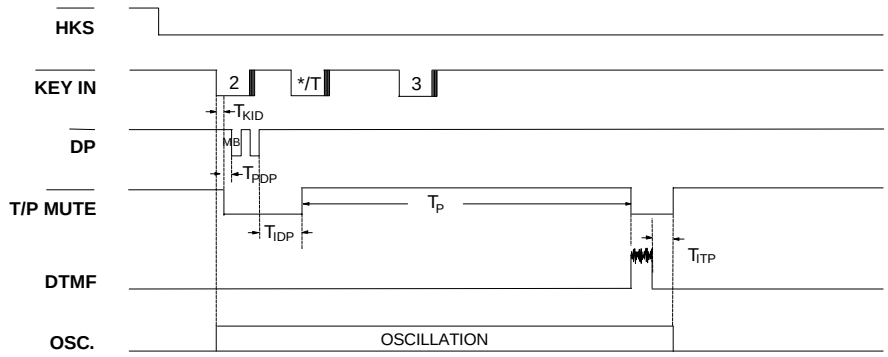


Figure 5. Pulse-to-Tone Timing Diagram

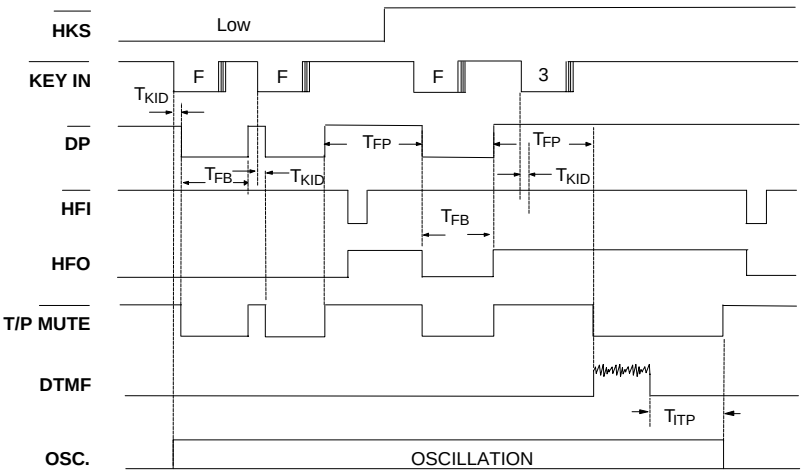


Figure 6. Flash Timing Diagram

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