Winbond Electronics Corp.

3-MEMORY TONE/PULSE DIALER WITH SAVE, KEYTONE, LOCK AND HANDFREE FUNCTIONS

GENERAL DESCRIPTION

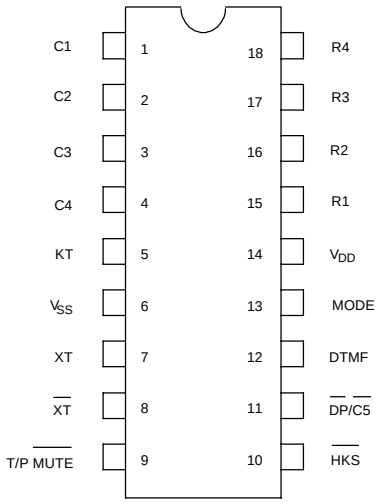
The W91560N series are tone/pulse switchable telephone dialers with three memories, keytone or lock, and handfree dialing control. These chips are fabricated using Winbond's high-performance CMOS technology and thus offer good performance in low-voltage, low-power operations.

FEATURES

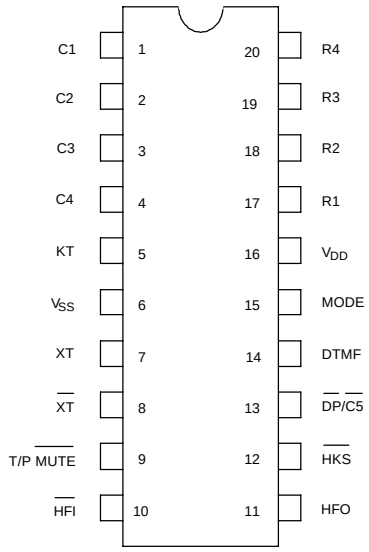
- DTMF/pulse switchable dialer
- Two by 32 digit redial and save memory
- Three by 16 digit one-touch direct repertory memory
- Pulse-to-tone (*/T) keypad for long distance call operation
- Cascaded dialing
- Uses 5 × 5 keyboard
- Easy operation with redial, flash, pause, and */T keypads
- Pause, P→T (pulse-to-tone) can be stored as a digit in memory
- On-hook debounce time: 150 mS (Unlock Mode), 200 mS (Lock Mode)
- 0 or 9 dialing inhibition pin for PABX system or long distance dialing lock out
- Dialing rate (10 ppS or 20 ppS) selectable by bonding option
- Minimum tone output duration: 93 mS
- Minimum intertone pause: 93 mS
- Pause time: 3.6 sec.
- 300 mS off-hook delay in lock mode ($\overline{DP}$ remains low for 300 mS while off hook)
- 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
- Key tone output for valid keypad entry recognition
- 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 W91560N series are shown in the following table:

TYPE NO.	REPLACEMENT TYPE NO.	PULSE (ppS)	FLASH (mS)	KEY TONE	LOCK	HANDFREE DIALING	PACKAGE (PINS)
W91560N	W91560	10	600/300/73/100	Yes	-	-	18
W91560AN	W91560A	10	600/300/73/100	Yes	-	Yes	20
W91560BN	W91560B	20	600/300/73/100	Yes	-	Yes	20
W91561LN	W91561L	10	600/300/73/100	-	Yes	-	18
W91561ALN	W91561ALN	10	600/300/73/100	-	Yes	Yes	20

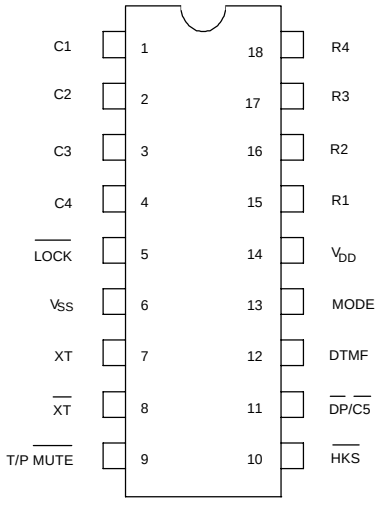
PIN CONFIGURATIONS



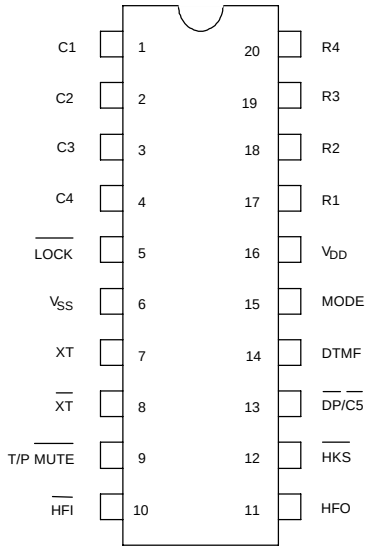
W91560N



W91560AN/BN



W91561LN



W91561ALN

PIN DESCRIPTION

SYMBOL	18-PIN	20-PIN	I/O	FUNCTION
Column-Row Inputs	1–4 & 15–18	1–4 & 17–20	I	The keyboard input is compatible with a standard 5 x 5 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.
MODE	13	15	I	Pulling mode pin to V_{SS} places dialer in tone mode. Pulling mode pin to V_{DD} places dialer in pulse mode with M/B ratio of 40:60 (10 ppS, except for W91560BN, which is 20 ppS). Leaving mode pin floating places dialer in pulse mode with M/B ratio of 33.3:66.7 (10 ppS, except for W91560BN, which is 20 ppS).
$\overline{HKS}$	10	12	I	The $\overline{HKS}$ (hook switch) 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 V_{DD} by internal resistor.
KT	5 (except for W91561LN)	5 (except for W91561ALN)	O	The key tone output is a conventional CMOS inverter. The key tone is generated when any valid key is pressed; the KT pin generates a 1.2 KHz square wave at 35 mS. When no key is pressed, the KT pin remains in low state.

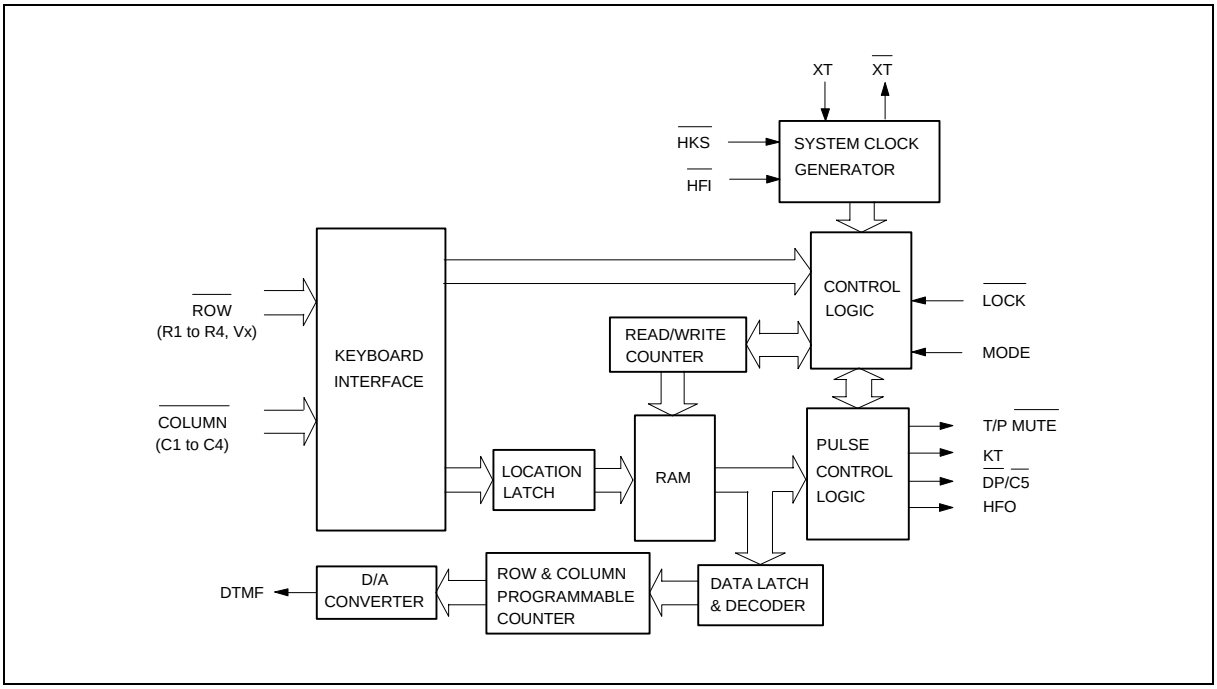
Pin Description, continued

<table>
<tr><th>SYMBOL</th><th>18-PIN</th><th>20-PIN</th><th>I/O</th><th>FUNCTION</th></tr>
<tr><td>$\overline{\text{LOCK}}$</td><td>5
(only for W91561LN)</td><td>5
(only for W91561ALN)</td><td>I</td><td>The function of this terminal is to prevent "0" dialing and "9" dialing under PABX system long distance call control. When the first key input after reset is 0 or 9, all key inputs, including the 0 or 9 key, become invalid and the chip generates no output. The telephone is reinitialized by a reset.
The function of the $\overline{\text{LOCK}}$ pin is shown below:
<table>
<tr><th>$\overline{\text{LOCK}}$ PIN</th><th>FUNCTION</th></tr>
<tr><td>V_{DD}</td><td>"0", "9" dialing inhibited</td></tr>
<tr><td>Floating</td><td>Normal dialing mode</td></tr>
<tr><td>V_{SS}</td><td>"0" dialing inhibited</td></tr>
</table></td></tr>
<tr><td>$\overline{\text{DP}}$ / $\overline{\text{C5}}$</td><td>11</td><td>13</td><td>O</td><td>N-channel open drain dialing pulse output.
Flash key will cause $\overline{\text{DP}}$ to be active in either tone mode or pulse mode.
In lock mode, the $\overline{\text{DP}}$ remains low for 300 mS during off-hook delay time.
The timing diagram for pulse mode is shown in Figure 1 (a, b, c, d).</td></tr>
<tr><td>DTMF</td><td>12</td><td>14</td><td>O</td><td>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).
<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>V_{DD}, V_{SS}</td><td>14, 6</td><td>16, 6</td><td>I</td><td>Power input pins for the dialer chip. V_{DD} is the main power and V_{SS} is the ground.</td></tr>
</table>

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

Keyboard Operation

C1	C2	C3	C4	$\overline{DP}/\overline{C5}$	
1	2	3	S	M1	R1
4	5	6	F4	M2	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 to M3: 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, ..., M3; */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 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), 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), 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 flash 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. 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
4. 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	T_{HD}	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
KT Drive/Sink Current	I_{KTH}	V_{KTH} = 2.0V	0.5	-	-	mA
	I_{KTL}	V_{KTL} = 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	-	-	mA
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}	Lock Mode	-	20	-	mS
		Unlock Mode	-	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	T_{IDP}	10 ppS	-	800	-	mS
(Auto dialing)		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	-	

AC Characteristics, continued

PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Flash Pause Time	TFP		-	1.0	-	S
Pause Time	TP		-	3.6	-	S
Key Tone Frequency	FKT		-	1.2	-	KHz
Key Tone Duration	TKTD		-	35	-	mS
Off-hook Delay	TOFD	Lock Only	-	300	-	mS
First Key-in Delay	TFKP	Lock Only	-	300	-	mS

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, FOSC. = 3.579545 MHz ±0.02%.
2. Crystal oscillator accuracy directly affects these times.

TIMING WAVEFORMS

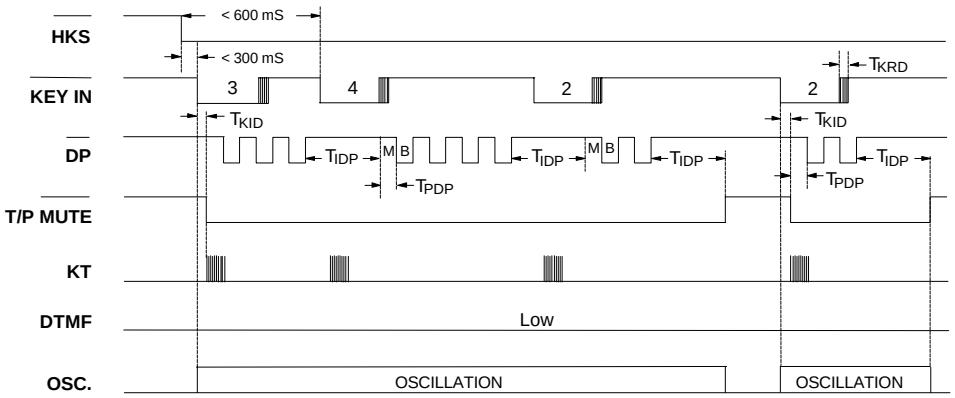


Figure 1a. Normal Dialing Timing Diagram (Pulse Mode Without Lock Function)

Timing Waveforms, continued

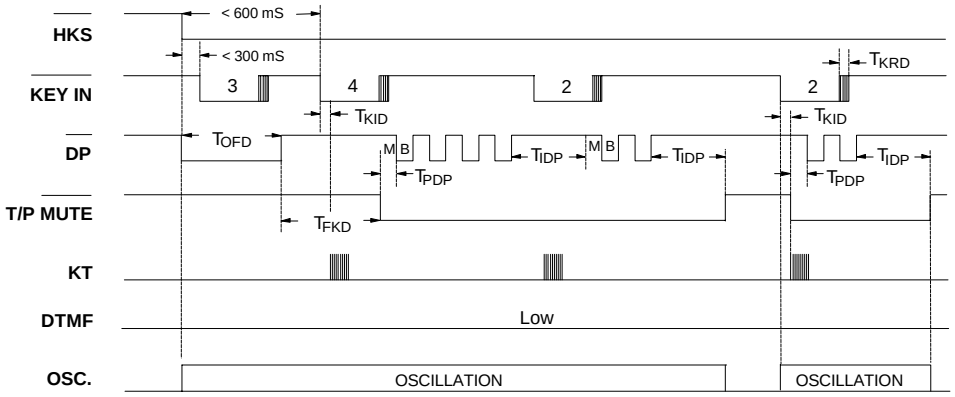


Figure 1b. Normal Dialing Timing Diagram (Pulse Mode with Lock Function)

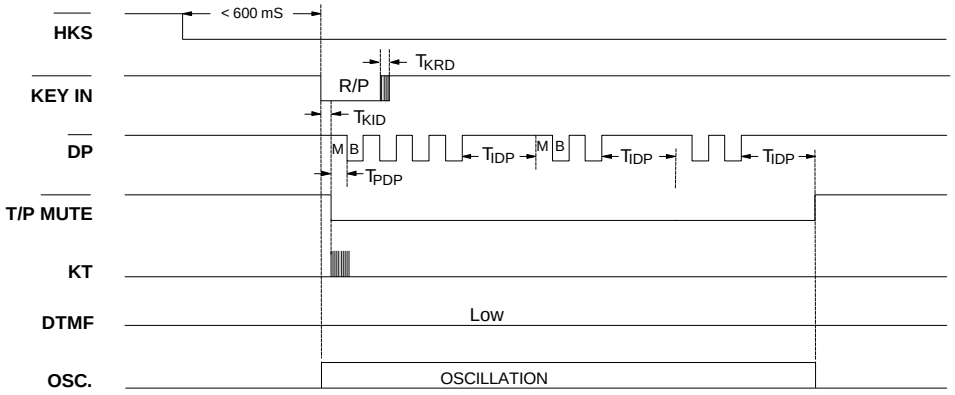


Figure 1c. Auto Dialing Timing Diagram (Pulse Mode Without Lock Function)

Timing Waveforms, continued

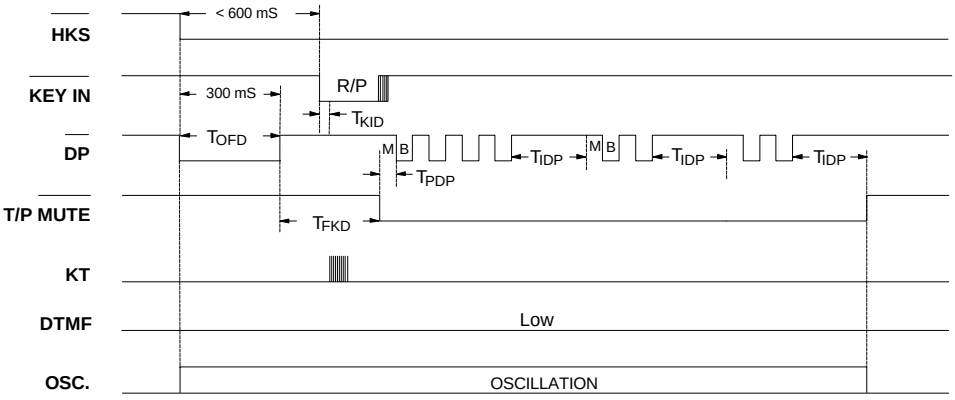


Figure 1d. Auto Dialing Timing Diagram (Pulse Mode with Lock Function)

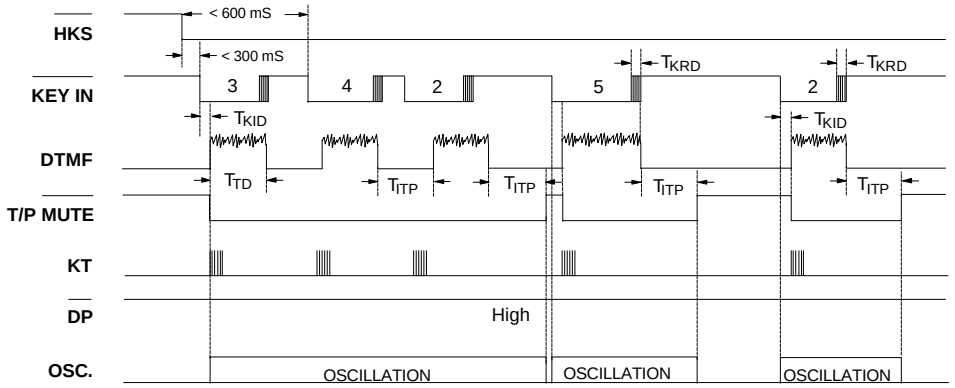


Figure 2a. Normal Dialing Timing Diagram (Tone Mode Without Lock Function)

Timing Waveforms, continued

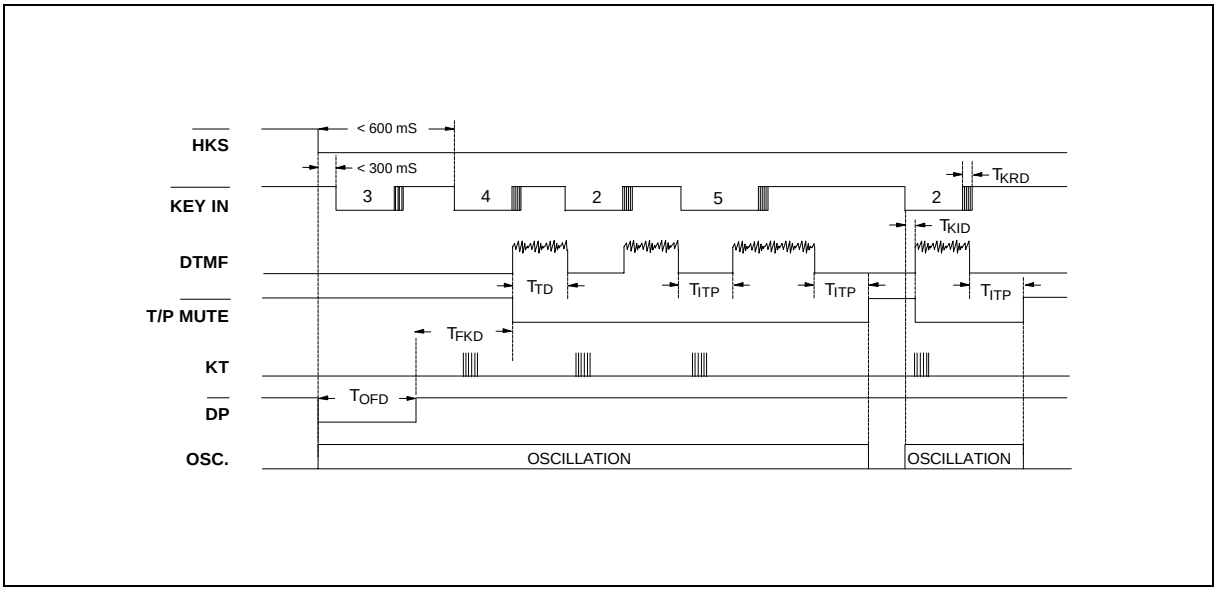


Figure 2b. Normal Dialing Timing Diagram (Tone Mode with Lock Function)

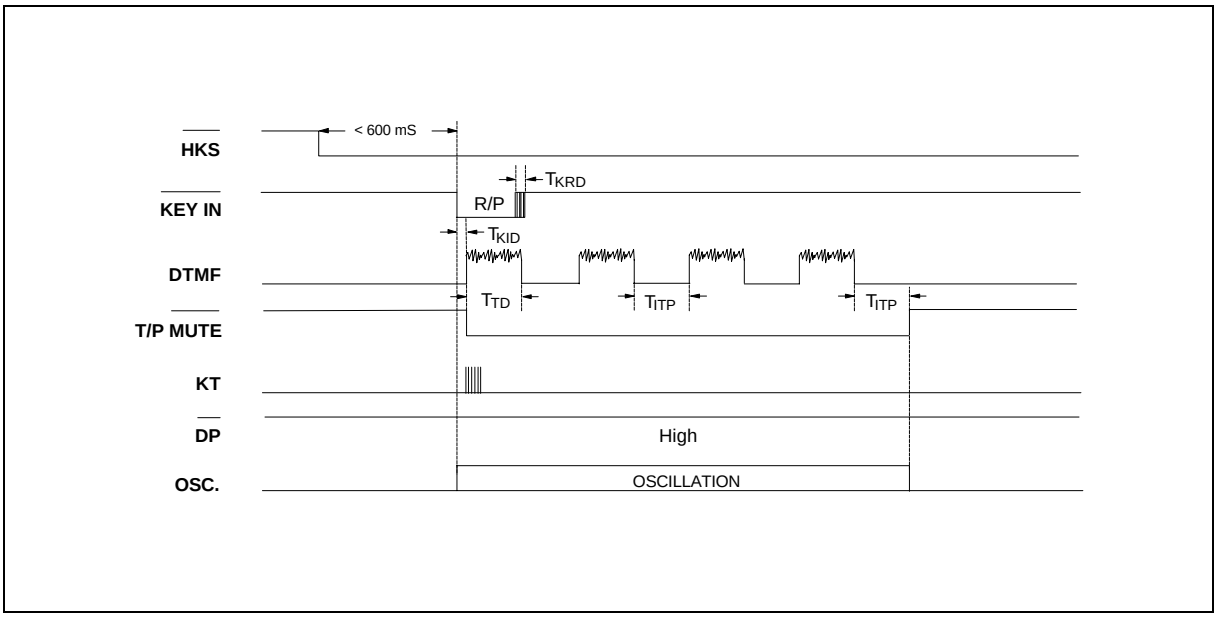


Figure 2c. Auto Dialing Timing Diagram (Tone Mode Without Lock Function)

Timing Waveforms, continued

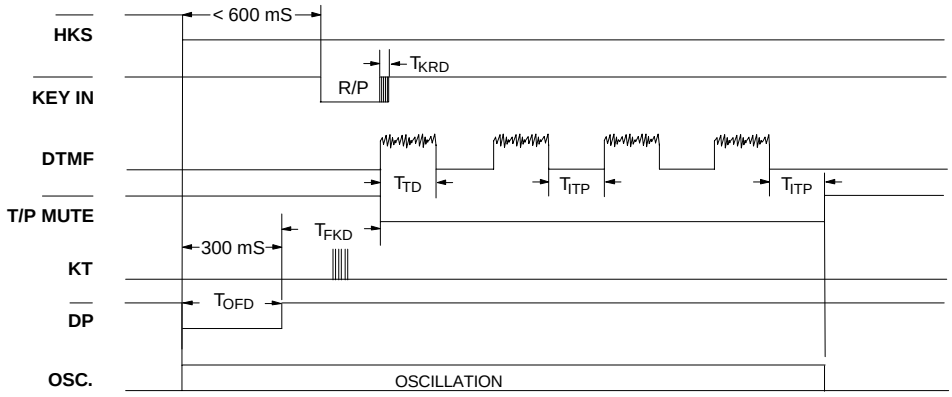


Figure 2(d) Auto Dialing Timing Diagram (Tone Mode with Lock Function)

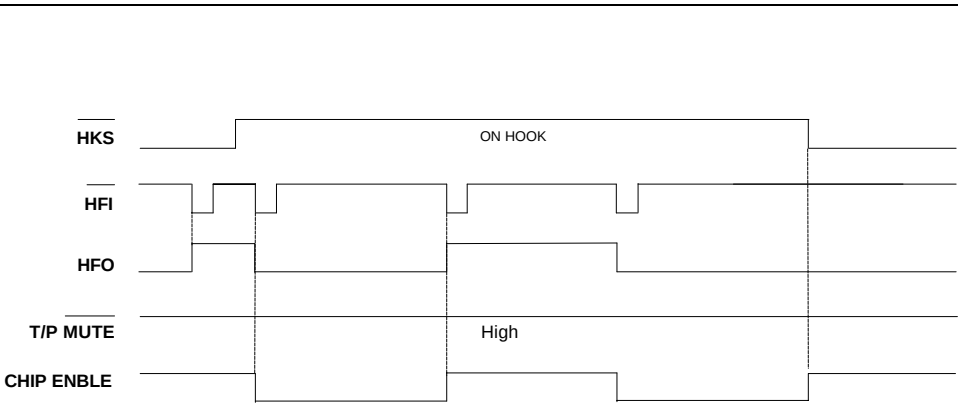


Figure 3. Handfree Timing diagram

Timing Waveforms, continued

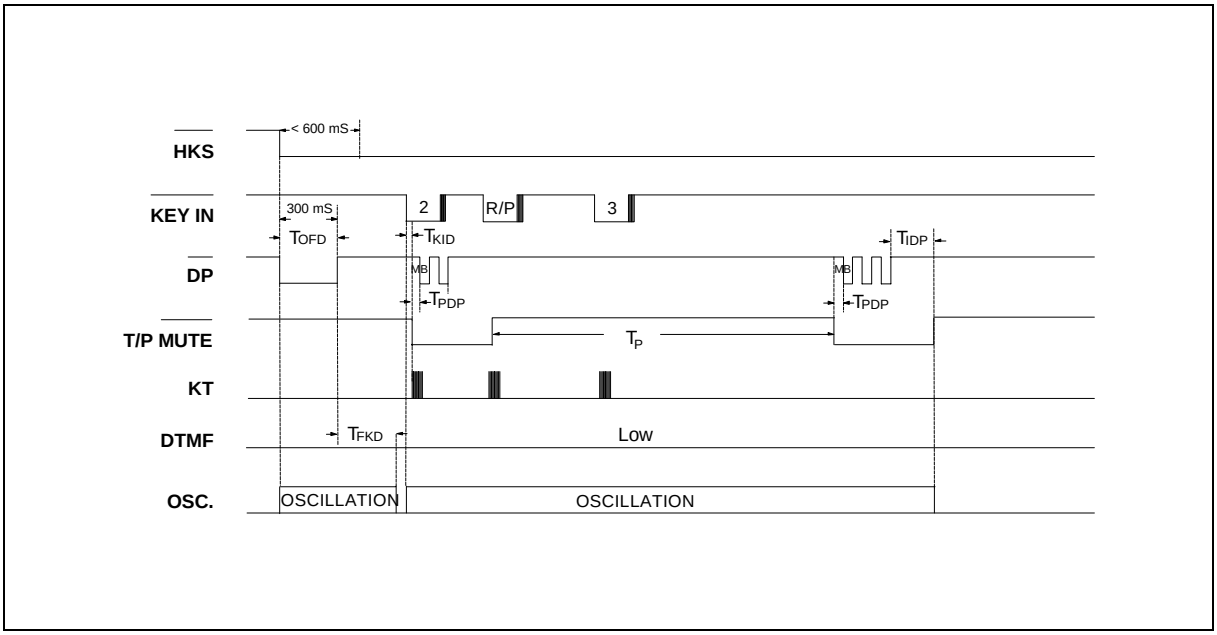


Figure 4. Pause Function Timing Diagram

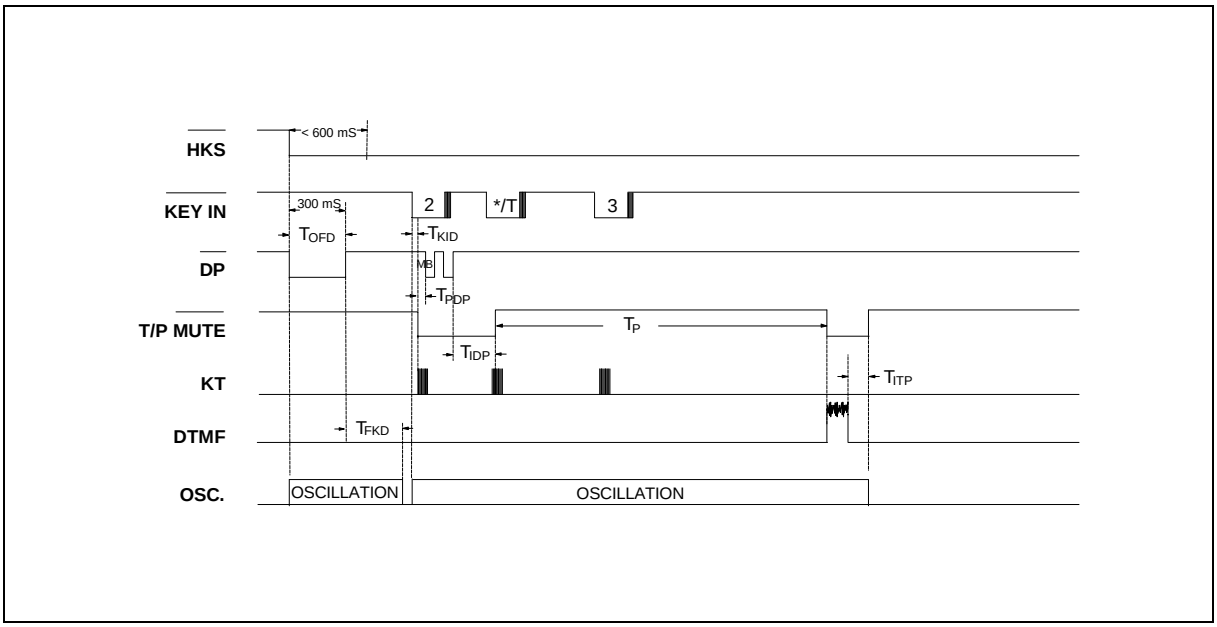


Figure 5 Pulse-to-tone Timing Diagram

Timing Waveforms, continued

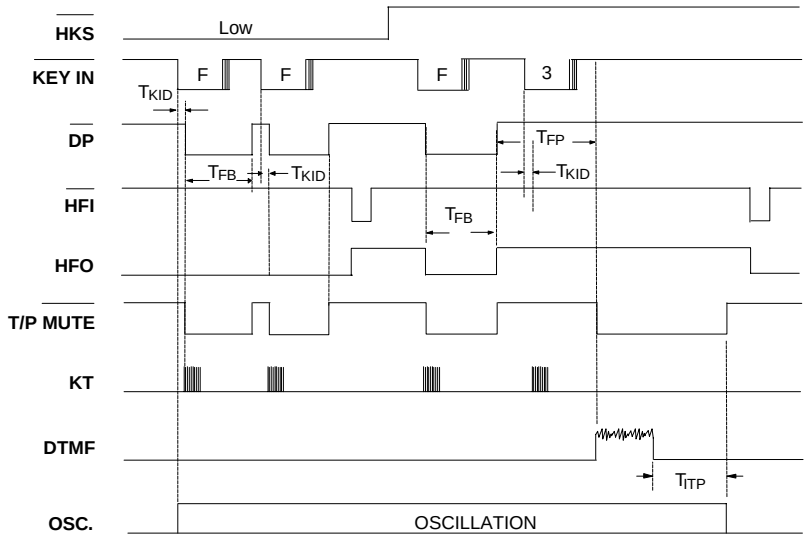


Figure 6. Flash Timing Diagram

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