TONE/PULSE DIALER WITH REDIAL FUNCTION

GENERAL DESCRIPTION

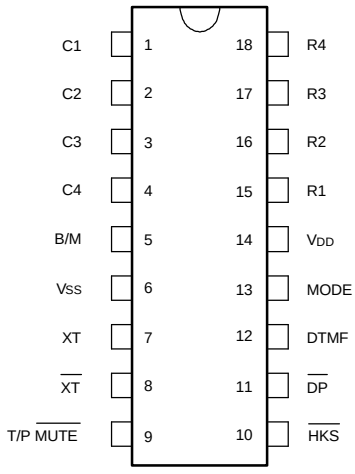
The W91312N are monolithic ICs that provide the necessary signals for either pulse or tone dialing. The W91312 N feature a redial memory.

FEATURES

- DTMF/Pulse switchable dialer
- 32 digits for redial memory
- Pulse-to-tone (P→T) keypad for long distance call operation
- Break/Make ratio is selectable by pin option
- Uses 4 × 4 keyboard
- Easy operation with redial, flash, pause, and P→T keypads
- Pause, P→T (pulse-to-tone) can be stored as a digit in memory
- Minimum tone output duration: 93 mS
- Minimum intertone pause: 93 mS
- On-chip power-on reset
- Uses 3.579545 MHz crystal or ceramic resonator
- Packaged in 18-pin plastic DIP
- The different dialers in the W91310 series are shown in the following table:

TYPE NO.	PULSE (ppS)	FLASH (mS)	FLASH PAUSE (S)	PAUSE (S)
W91312N	10/20	600/100/300/73	1.0	3.6/2.0

PIN CONFIGURATION



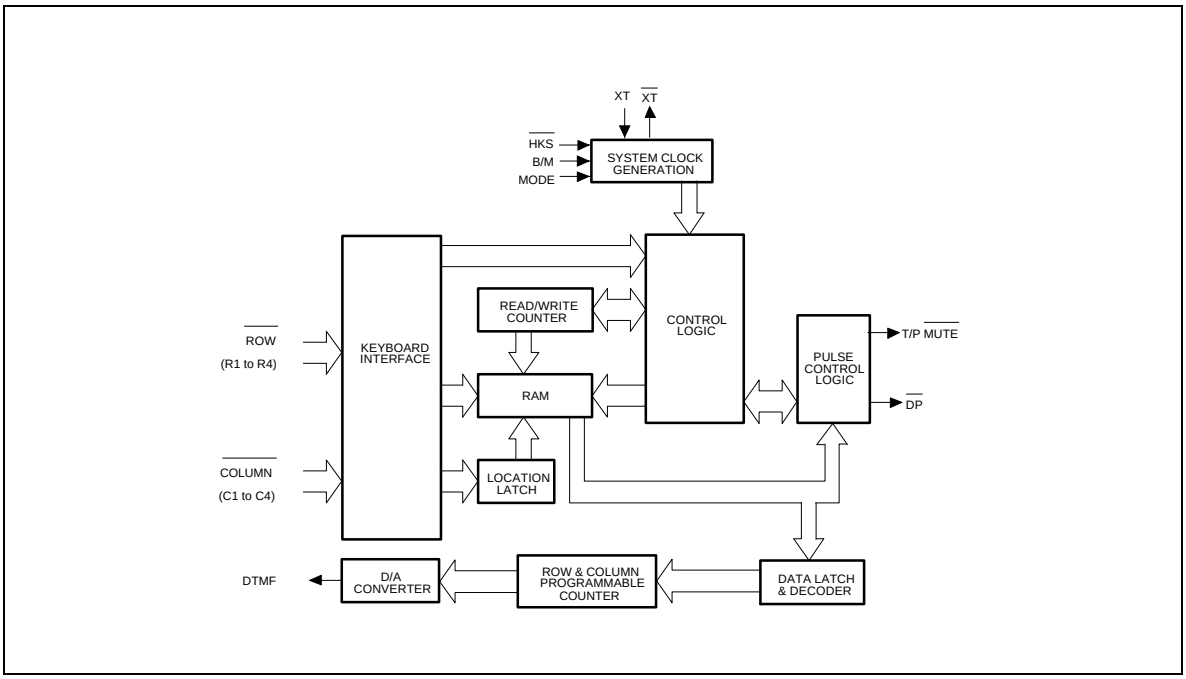
PIN DESCRIPTION

SYMBOL	PIN	I/O	FUNCTION
Column-Row Inputs	1–4 & 15–18	I	The keyboard input may be from either the standard 4 × 4 keyboard or an inexpensive single contact (form A) keyboard. Electronic input from a µC can also be used. A valid key entry is defined as a single row being connected to a single column.
XT, $\overline{XT}$	7, 8	I, O	A built-in inverter provides oscillation with an inexpensive 3.579545 MHz crystal or ceramic resonator.
T/P $\overline{MUTE}$	9	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	13	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). Leaving mode pin floating places the dialer in pulse mode (20 ppS).
$\overline{HKS}$	10	I	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. The $\overline{HKS}$ pin is pulled to V_{DD} by an internal resistor.
$\overline{DP}$	11	O	N-channel open drain dialing pulse output (Figure 1). Flash key will cause $\overline{DP}$ to go active in both pulse mode and tone mode.
DTMF	12	O	In pulse mode, remains in low state at all times. In tone mode, outputs a dual or single tone. Detailed timing diagram for tone mode is shown in Figure 2(a, b).
V_{DD}, V_{SS}	14, 6	I	Power input pins.
B/M	5	I	The break make ratio is 60:40 if B/M = 1 and is 66.6:33.3 if B/M = 0. This pin has no function in DTMF mode.

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

BLOCK DIAGRAM



FUNCTIONAL DESCRIPTION

Keyboard Operation

C1	C2	C3	C4	
1	2	3		R1
4	5	6	F1	R2
7	8	9	F2	R3
∗/T	0	#	R/P1	R4
R/P2	R	F3	F4	Vx

- R/P1, R/P2: Redial and pause function key, P1 is 3.6 sec. and P2 is 2.0 sec.
- ∗/T: ∗ in tone mode and P→T in pulse mode
- F1, …, F4: Flash keys, the flash break time of F1 = 600 mS, F2 = 100 mS, F3 = 300 mS, F4 = 73 mS
- R: One-key redial function

Notes: D1, ..., Dn, D1', ..., Dn': 0, ..., 9, */T, #
R/P: R/P1 or R/P2.
Fn: F1, ..., F4

Normal Dialing

OFF HOOK , D1 , D2 , ..., Dn

1. D1, D2, ..., Dn will be dialed out.
2. Dialing length is unlimited, but redial is inhibited if length oversteps 32 digits.

Redialing

OFF HOOK , D1 , D2 , ..., Dn BUSY, COME ON HOOK , OFF HOOK , R/P

The R/P key can execute redial function only as the first key-in after off-hook; otherwise, it will execute pause function.

Access Pause

OFF HOOK , D1 , D2 , R/P , D3 , ..., Dn

1. The pause function can be stored in memory.
2. The pause function is executed in normal dialing or memory dialing.
3. The pause function timing diagram is shown in Figure 3.

Pulse-to-tone (*/T)

OFF HOOK , 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, */T D1, D2, ..., Dn,

   (Tone) (Pause) (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 P→T function timing diagram is shown in Figure 4.

Flash

OFF HOOK , F

1. Flash key can't be stored as a digit in memory.
2. The system will return to the initial state after the break time is finished.
3. The flash function timing diagram is shown in Figure 5.

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	SYM.	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Operating Voltage	V_{DD}		2.0	-	5.5	V
Operating Current	I_{OP}	Tone	-	0.3	0.5	mA
		Pulse	-	0.15	0.3	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
DTMF 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
T/P $\overline{MUTE}$ Output Sink Current	I_{ML}	V_{MO} = 0.5V	0.5	-	-	mA
$\overline{HKS}$ I/P Pull-high Resistor	R_{KH}		-	300	-	KΩ

DC Characteristics, continued

PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Keypad Input Drive Current	I_{KD}	V_I = 0V	30	-	-	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
Keypad Active in Debounce	T_{KID}		-	20	-	mS
Key Release Debounce	T_{KRD}		-	20	-	mS
Pre-digit Pause[1]	$T_{PDP}1$	B/M = 1	-	40	-	mS
	10 ppS	B/M = 0	-	33.3	-	
Pre-digit Pause[2]	$T_{PDP}2$	B/M = 1	-	20	-	mS
	20 ppS	B/M = 0	-	16.7	-	
Interdigit Pause (Auto dialing)	T_{IDP}	10 ppS	-	800	-	mS
		20 ppS	-	500	-	
Make/Break Ratio	M/B	B/M = 1	-	40:60	-	%
		B/M = 0	-	33:67	-	
DTMF Output Duration	T_{TD}	Auto Dialing	-	100	-	mS
Intertone Pause	T_{ITP}	Auto Dialing	-	100	-	mS
Flash Break Time	T_{FB}	F1	-	600	-	mS
		F2	-	100	-	
		F3	-	300	-	
		F4	-	73	-	
Flash Pause Time	T_{FP}	-	-	1.0	-	S
Pause Time	T_P	Pause 1	-	3.6	-	S
		Pause 2	-	2.0	-	

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

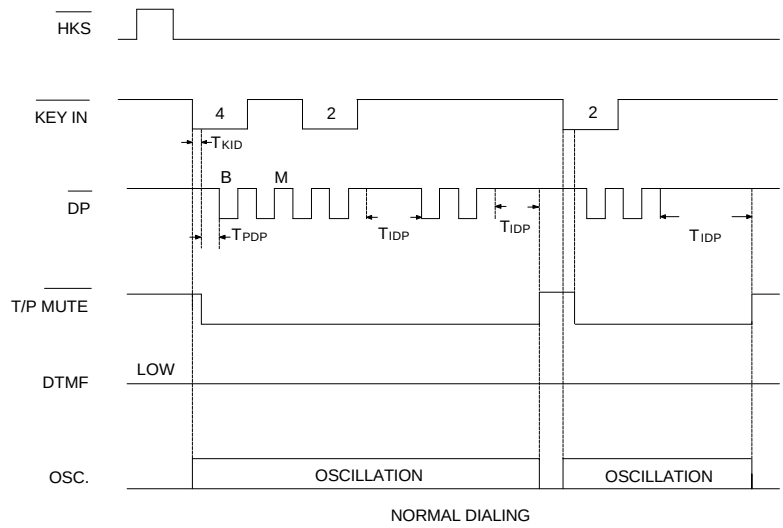


Figure 1(a). Pulse Mode Timing Diagram

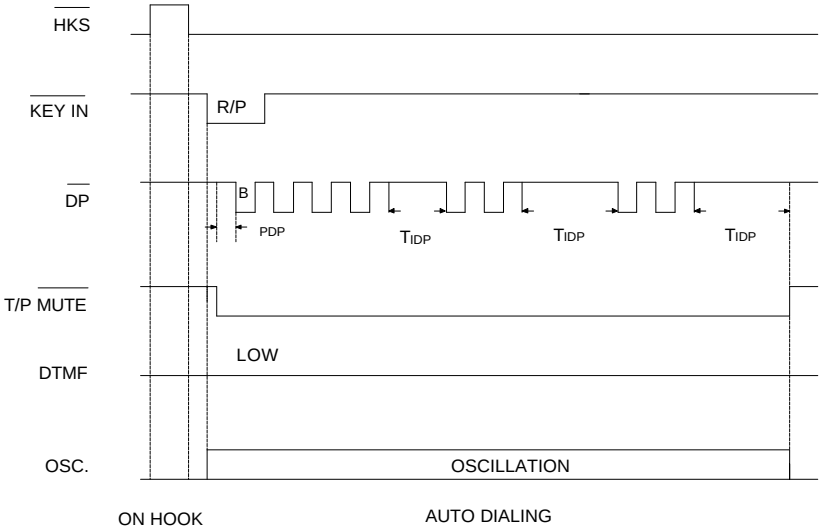


Figure 1(b). Pulse Mode Timing Diagram

TIming Waveforms, continued

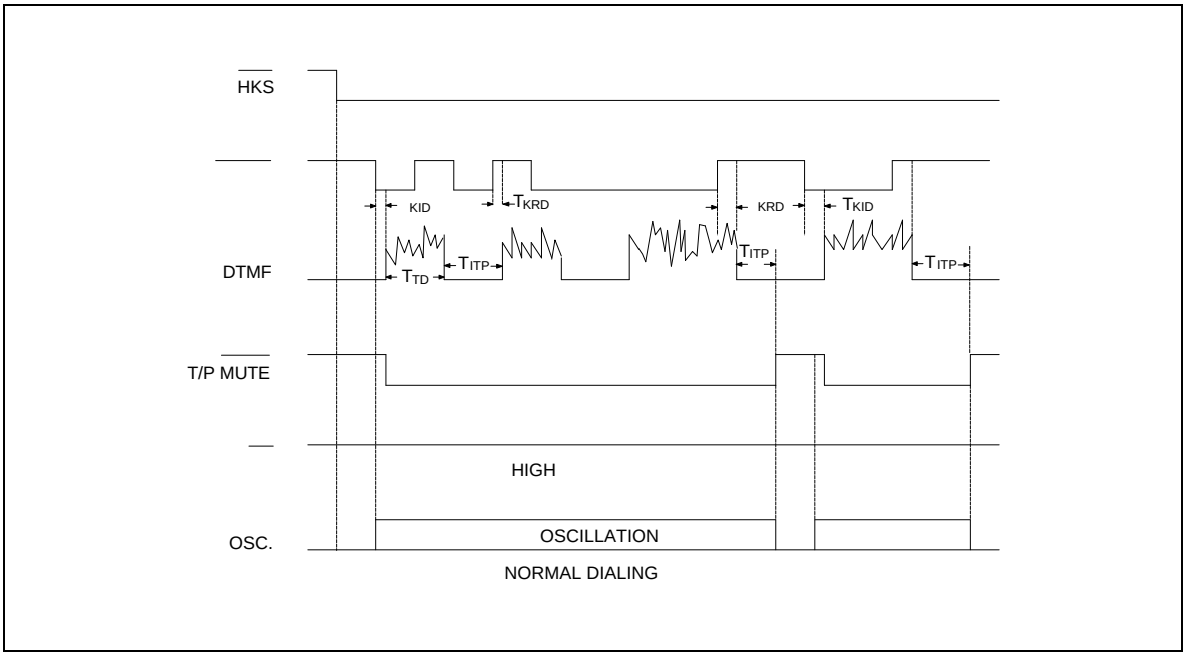


Figure 2(a). Tone Mode Timing Diagram

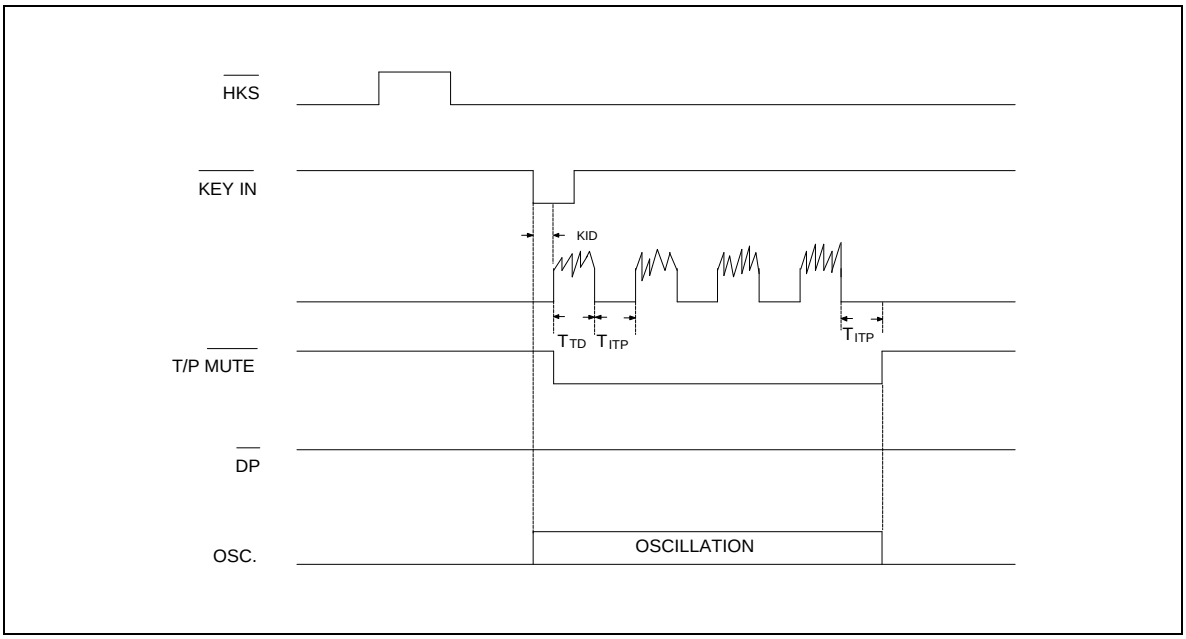


Figure 2(b). Tone Mode Auto Dialing Timing Diagram

TIming Waveforms, continued

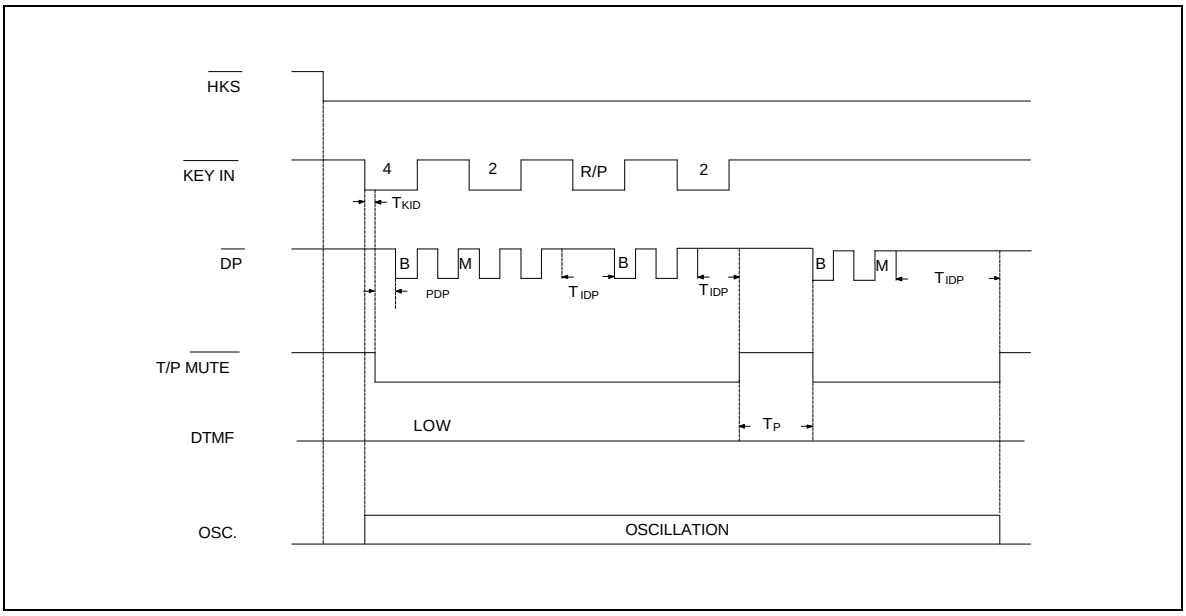


Figure 3. Pause Function Timing Dragram

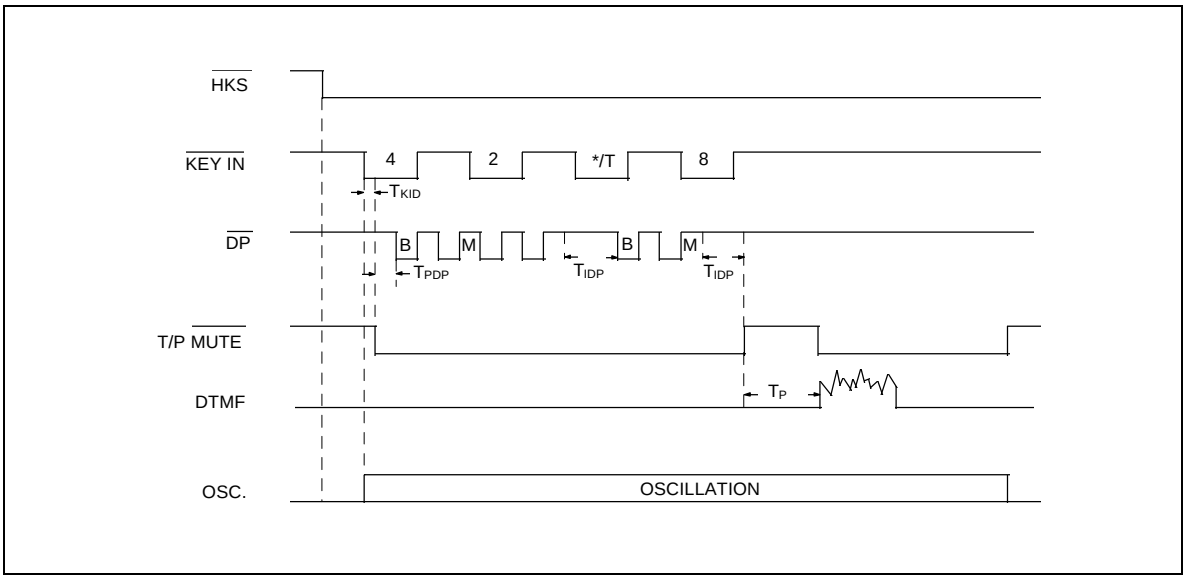


Figure 4. Pulse-to-tone Function Timing Dragram

TIming Waveforms, continued

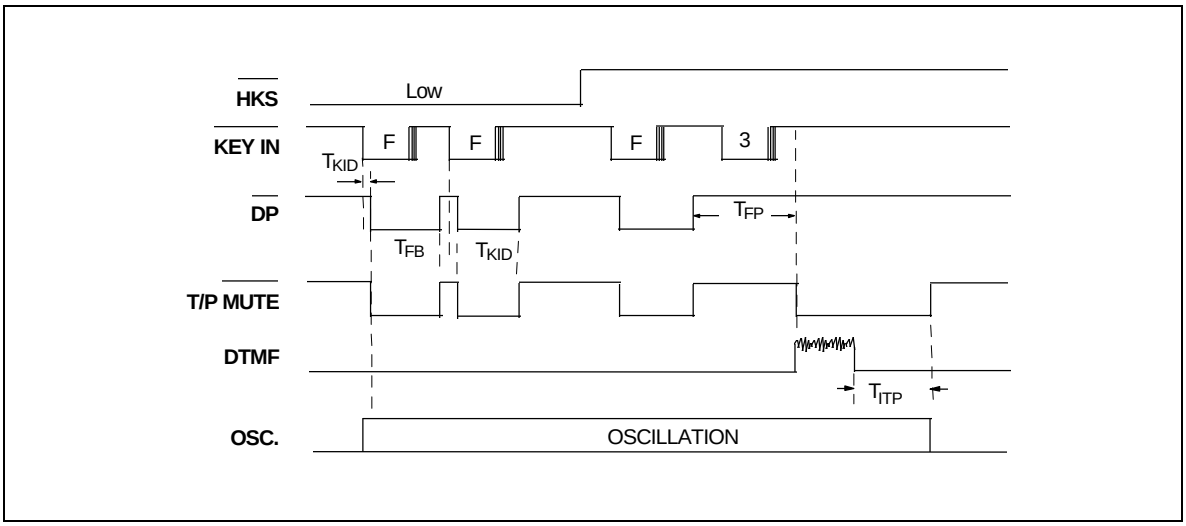


Figure 5. Flash Function Timing Diagram

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Note: All data and specifications are subject to change withou t notice.

TYPICAL APPLICATION CIRCUIT

