Winbond Electronics Corp.

TONE/PULSE DIALER WITH TWO-STAGE REDIAL FUNCTION

GENERAL DESCRIPTION

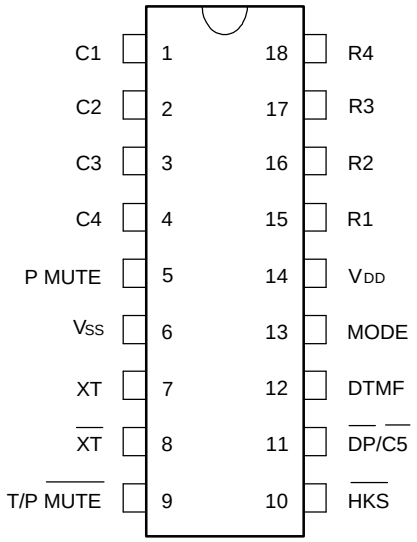
The W91610 series are Si-gate CMOS ICs that provide the signals needed for either pulse or tone dialing.

FEATURES

- DTMF/Pulse switchable dialer
- 32-digit redial memory
- Two-stage redial function
- Pulse-to-tone (P→T) keypad for long distance call operation
- Easy operation with redial, flash, pause and P→T keypads
- Pause, pulse-to-tone (P→T) can be stored as a digit in memory
- Tone output duration: as long as key is depressed or 90 mS minimum
- Minimum intertone pause: 90 mS
- Flash time: 100 mS
- Uses 4 × 5 keyboard
- On-chip power-on reset
- Uses 3.579545 MHz crystal or ceramic resonator
- Packaged in 18-pin DIP
- The different dialers in the W91610 series are shown in the following table:

TYPE NO.	DIALING RATE	PAUSE	B:M	FLASH
W91610	10 ppS	4 sec	2:1	100 mS
W91611			3:2	

PIN CONFIGURATION



PIN DESCRIPTION

SYMBOL	PIN NO.	I/O	FUNCTION
Column-Row Inputs	1–4 & 15–18	I	Keyboard inputs are designed for use with either a standard 4 × 5 keyboard or an inexpensive single contact (Form A) keyboard. Electronic input from a μC can also be used. Valid key entry is defined by a connection between a single row and 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 inverter output. It is low during pulse and tone mode dialing sequence and flash break; otherwise, it remains high.
MODE	13	I	Pulling the mode pin to VSS place the dialer in tone mode. Pull to VDD or leave floating: Pulse mode (10 ppS, M/B = 2:3 or 1:2)

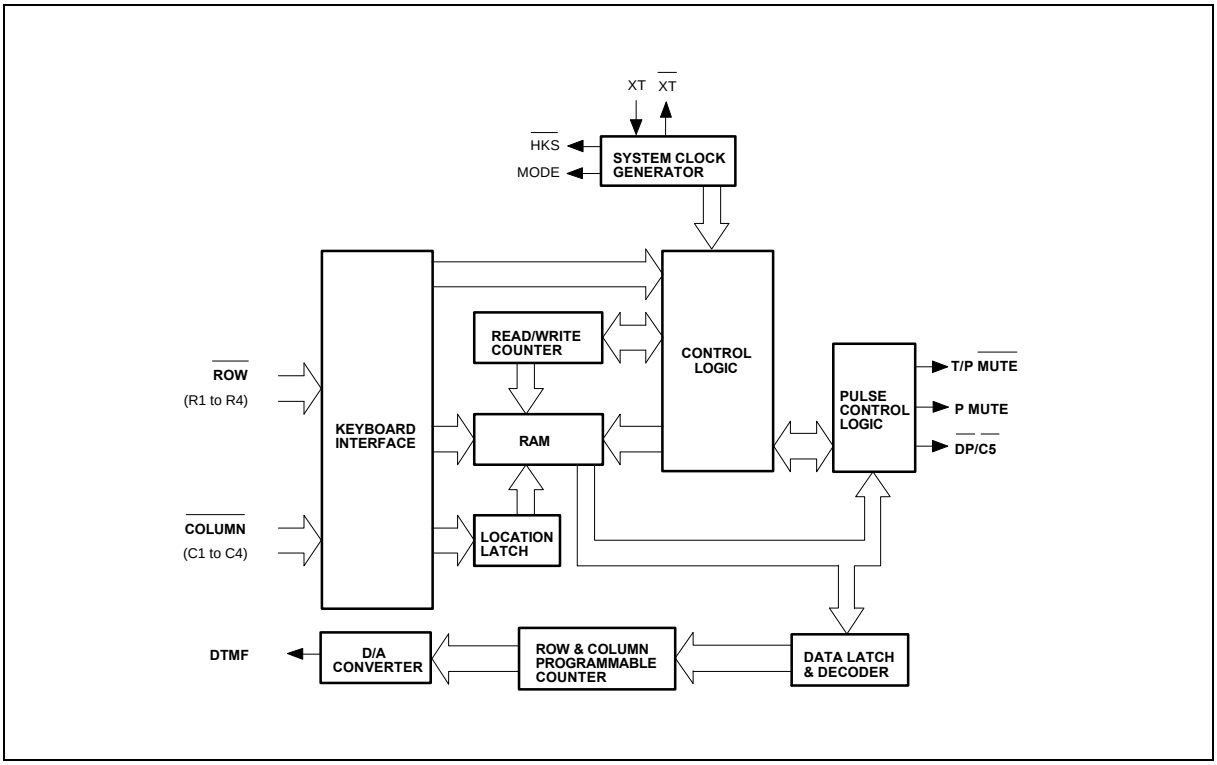
Pin Description, continued

SYMBOL	PIN NO.	I/O	FUNCTION
$\overline{HKS}$	10	I	Hook switch input. Conventional CMOS input with an internal protection diode and a pull-high resistor to VDD. $\overline{HKS}$ = VDD: On-hook state. Chip in sleep mode, no operation. $\overline{HKS}$ = VSS: Off-hook state. Chip enabled for normal operation. During dialing, this input ignores $\overline{HKS}$ = VDD for durations of less than 150 mS (i.e., dialing is not terminated).
$\overline{DP}/\overline{C5}$	11	O	Open drain dialing pulse output (Figure 1). Flash key causes $\overline{DP}/\overline{C5}$ to be active in both tone mode and pulse mode.
DTMF	12	O	During pulse dialing, maintains 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).
VDD, VSS	14, 6	I	Power input pins.
P MUTE	5	O	The P MUTE is a conventional CMOS inverter output. It is high during pulse dialing sequence and flash break. Otherwise, it remains low.

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	$\overline{DP}$ / $\overline{C5}$	
1	2	3		P→T	R1
4	5	6	F	P	R2
7	8	9			R3
*	0	#	R		R4

- F: Flash key
- P→T: In pulse mode, this key works as Pulse→Tone key
  P→T key can be stored as a digit in pulse or tone mode
- R: Redial function key
- P: Pause key

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 in normal dialing.

3. Dialing mode is determined at the on/off hook transition.

Redialing

1. OFF HOOK , D1 , D2 , ..., Dn , Busy, Come ON HOOK , OFF HOOK , R

   The R key executes the redialing function.

2. Redial content = D1, D2, ..., Dn

   OFF HOOK , R , D1' , D2' , P→T , D3' , D4'

   a. D1, D2, ..., Dn, D1', D2', P→T, D3', D4' will be dialed out.

   b. Redial register is changed to D1, D2, ..., Dn, D1', D2', P→T, D3', D4'.

   c. OFF HOOK , R (1st)

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

   R (2nd); P→T, D3', D4' will be dialed out.

Access Pause

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

1. The pause function can be stored in memory.

2. The pause function may be executed in normal dialing, redialing, or memory dialing (4.0 sec/pause).

3. The pause function can be stored as the first digit in memory.

4. The pause time depends on the number of times the P key is depressed. For example, if the sequence 1, 2, P, P, 4, 5, 6 is keyed in, then the pause time is 8 seconds.

5. The pause function timing diagram is shown in Figure 3.

Pulse-to-tone (P→T)

1. OFF HOOK , D1 , D2 , ..., Dn , P→T , D1' , D2' , ..., Dn'

   a. If the mode switch is set to pulse mode, then the output signal will be as follows:

   D1, D2, ..., Dn, no pause, D1', D2', ..., Dn'
   (Pulse) (Tone)

   In this case, the device can be reset to pulse mode only by going on-hook, because tone mode remains enabled after the digits have been dialed out.

b. If the mode switch is set to tone mode, then the output signal will be as follows:

D1, D2, ..., Dn, no pause, D1', D2', ..., Dn'
(Tone) (Tone)

c. The P→T key may be pressed before the first sequence is dialed out completely.

2. [OFF HOOK] , [R]

a. If the mode switch is set to pulse mode, then the output signal will be as follows:

D1, D2, ..., Dn
(Pulse)

b. In the first redial operation, only the digits before the tone key are dialed out.

[R] (2nd)

D1', D2', ..., Dn' are dialed out.
(Tone)

c. In the second redial operation, the digits after the tone key are dialed out.

Flash

[OFF HOOK] , [D1] , [D2] , [D3] , [F] , [D4] , [D5] , [D6]

1. The [F] key may be pressed before digits D1, D2, D3 are sent completely. Digits D4, D5, D6 may be pressed during the 100 mS. flash period.

2. The flash key cannot be stored as a digit in memory or in the redial register.

3. The content of the redial register is D1, D2, D3, D4, D5, D6. The [F] key is not stored in the redial register.

4. The flash does not have first priority among the keyboard functions.

5. The flash pause time is 800 mS, so there is a pause of 800 mS between the flash and the next digit dialed (see Figure 5).

6. The dialer will not return to the initial state after the flash break time has elapsed.

7. 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 +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

($F_{OSC.}$ = 3.58 MHz, Ta = 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, V_{DD} = 2.5V	-	0.30	0.50	mA
		Pulse, V_{DD} = 2.5V	-	0.15	0.30	
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 V_{DD} = 2.5V	0.2	-	-	mA
$\overline{DP}/\overline{C5}$ Output Sink Current	I_{PL}	V_{PO} = 0.5V V_{DD} = 2.5V	0.5	-	-	mA
P MUTE & T/P $\overline{MUTE}$ Output Drive Current	I_{MH}	V_{MO} = 2.0V V_{DD} = 2.5V	0.2	-	-	mA
P MUTE & T/P $\overline{MUTE}$ Output Sink Current	I_{ML}	V_{MO} = 0.5V, V_{DD} = 2.5V	0.5	-	-	mA
Keypad Input Drive Current	I_{KD}	V_I = 0V, V_{DD} = 2.5V	4	-	-	µA
Keypad Input Sink Current	I_{KS}	V_I = 2.5V, V_{DD} = 2.5V	200	400	-	µA
Keypad Resistance	R_K	-	-	-	5.0	KΩ
$\overline{HKS}$ Input Pull High Resistance	R_{HK}	-	-	300	-	KΩ

Input Voltage Low Level	V_{IL}	Pins 1, 2, 3, 4, 10, 13, 15, 16, 17, 18	0	-	0.2 V_{DD}	V
Input Voltage High Level	V_{IH}		0.8 V_{DD}	-	V_{DD}	V

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_{PDP1}	Mode Pin = Floating	-	33.3	-	mS
	10 ppS	Mode Pin = V_{DD}	-	40	-	
Interdigit Pause (Auto Dialing)	T_{IDP}	10 ppS	-	800	-	mS
Make/Break Ratio	M/B	M/B = 1:2	-	33:67	-	%
		M/B = 2:3	-	40:60	-	
DTMF Output Duration	T_{TD}	Auto Dialing	-	90	-	mS
Intertone Pause	T_{ITP}		-	90	-	mS
Flash Break Time	T_{FB}	-	-	100	-	mS
Flash Pause	T_{FP}	-	-	800	-	mS
Pause Time	T_P	-	-	4.0	-	S
Pre-tone Mute	T_{PTM}	-	-	70	-	mS

Notes:

1. Crystal parameters suggested for proper operation are $R_S < 100\ \Omega$, 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

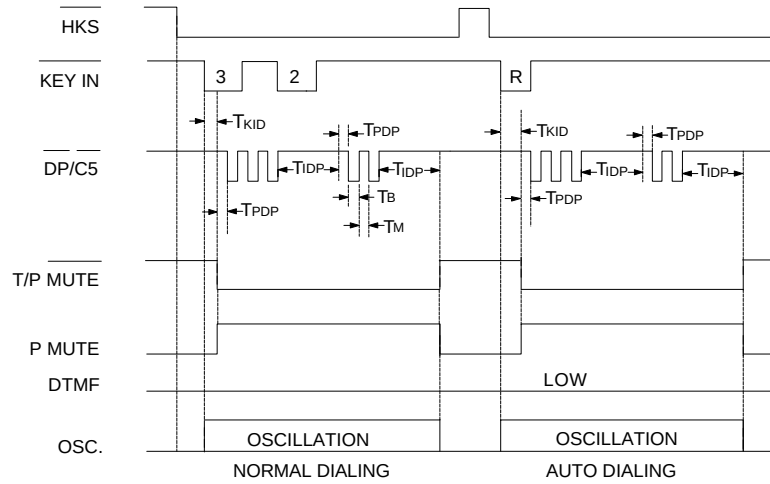


Figure 1. Pulse Mode Timing Diagram

Timing Waveforms, continued

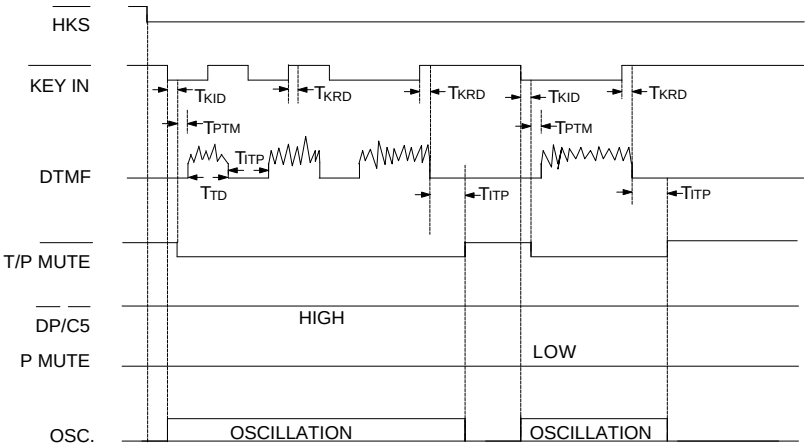


Figure 2(a). Tone Mode Normal Dialing Timing Diagram

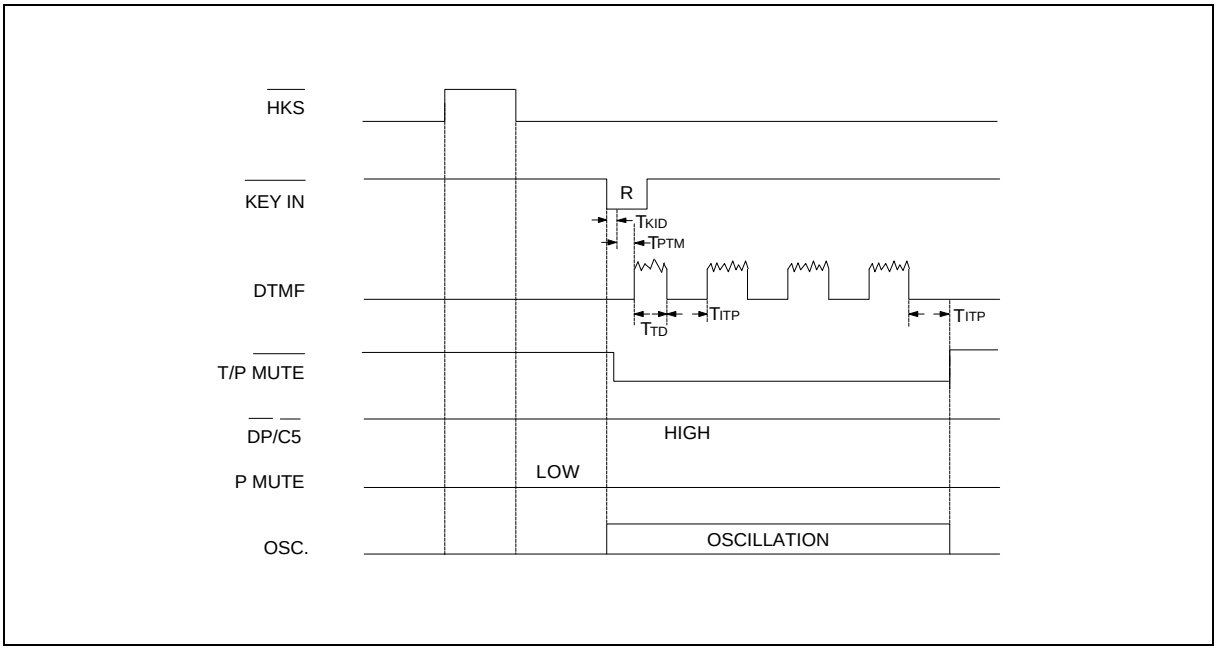


Figure 2(b). Tone Mode Auto Dialing Timing Diagram

Timing Waveforms, continued

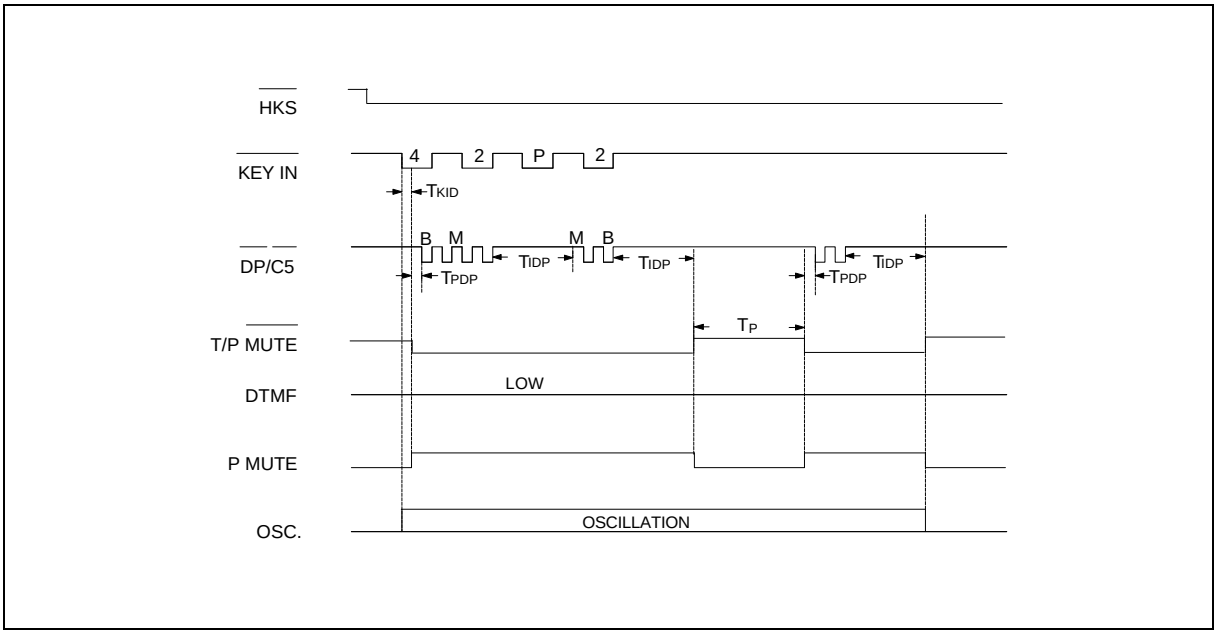


Figure 3. Pause Function Timing Diagram

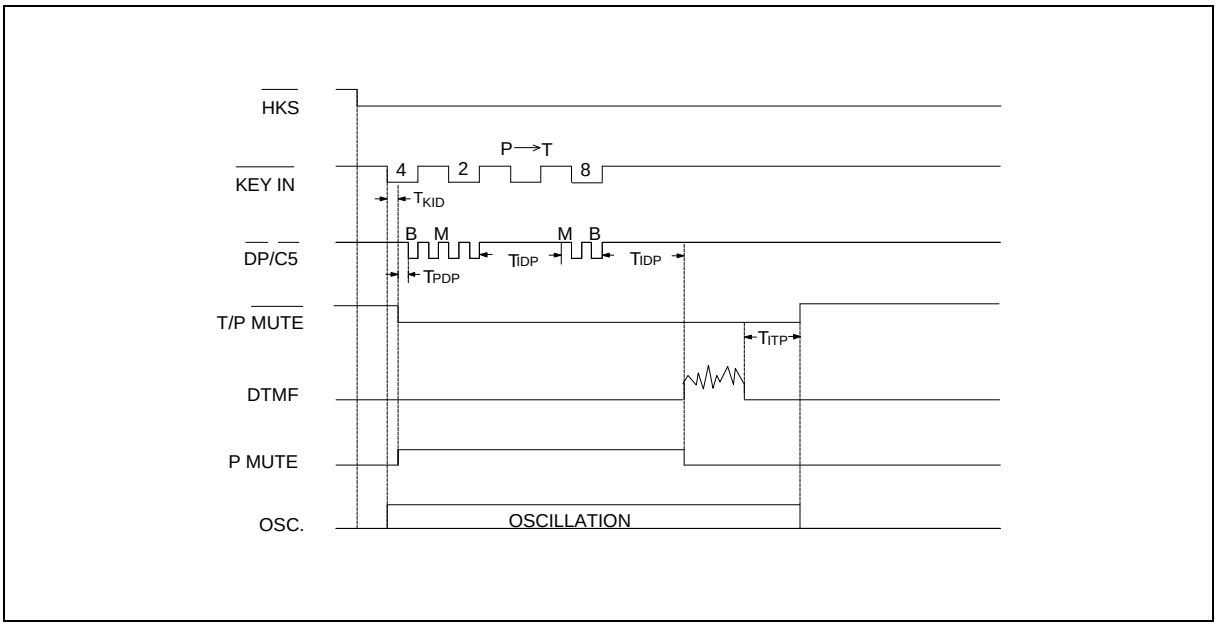


Figure 4. P→T Operation Timing Diagram in Normal Dialing

Timing Waveforms, continued

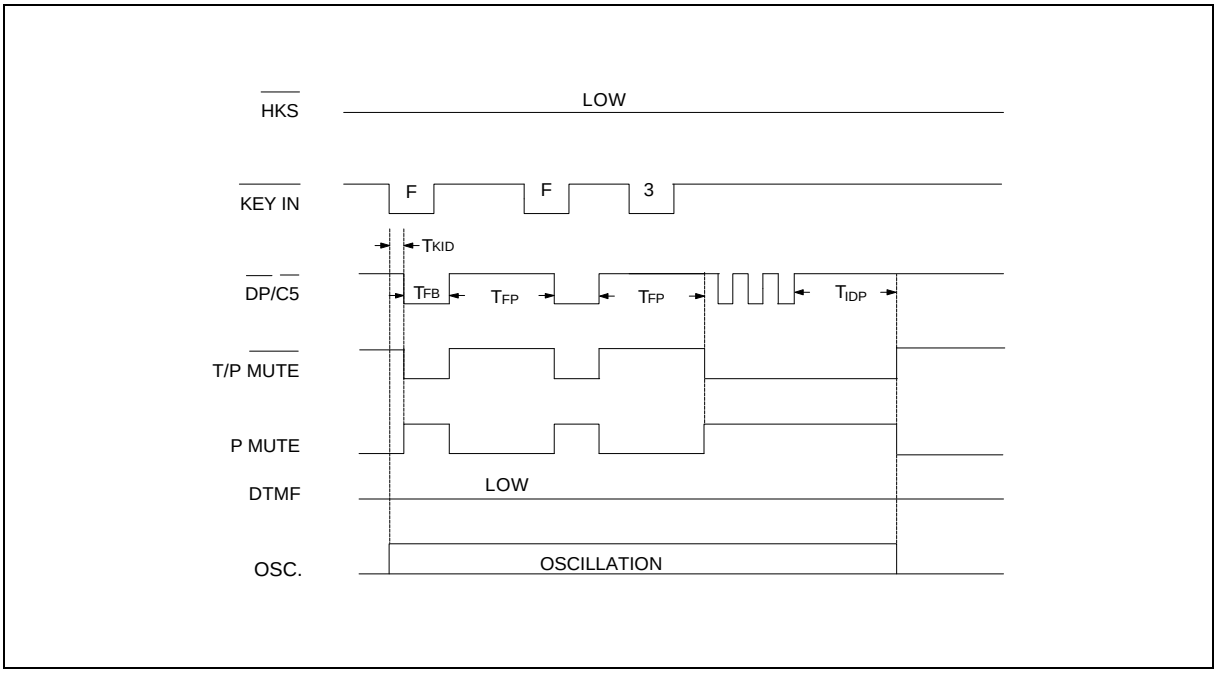


Figure 5. Flash Operation Timing Diagram

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Note: All data and specifications are subject to change without notice.