Winbond Electronics Corp.

15-MEMORY TONE/PULSE DIALER WITH LOCK AND HANDFREE FUNCTIONS

GENERAL DESCRIPTION

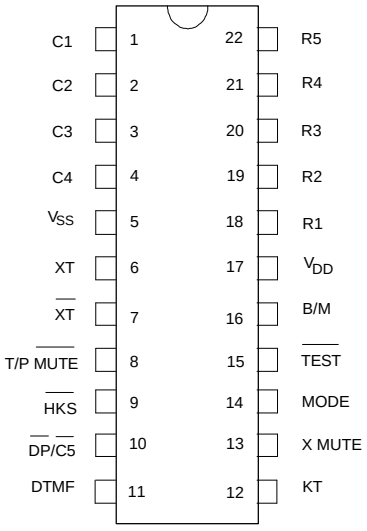
The W9145 series are Si-gate CMOS ICs that provide the necessary signals for either pulse or tone dialing. The W9145 series feature a key tone function, handfree dialing, a lock function, thirteen 16-digit automatic dialing memories, and two by 32-digit for redial and save memory.

FEATURES

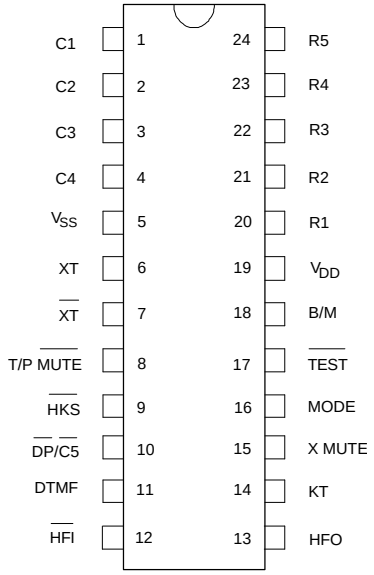
- DTMF/Pulse switchable dialer
- Two by 32 digits for redial and save memory
- Three by 16 digits for one-touch direct repertory
- Ten by 16 digits for two-touch indirect repertory
- Unlimited dialing length (redial inhibited if dialing length exceeds 32 digits in normal dialing)
- Auto Pause Access for PBX and toll service operations (3.1 seconds per pause)
- Easy operation with redial, store, auto and pause keypads
- Key tone output for recognition of valid keypad entry
- Call disconnect (CD) key for line break operation
- Mute key for speech mute
- Flash time: 98 mS, 305 mS or 600 mS
- Minimum tone output duration: 93 mS
- Minimum intertone pause: 93 mS
- 0 or 9 dialing inhibition pin for PABX system or long distance dialing lock out
- Automatic switching from pulse mode to tone mode by */T key operation
- Break/make ratio pin selectable
- Uses Form A keyboard or standard 5 × 5 matrix keyboard
- Uses inexpensive 3.579545 MHz television color-burst crystal
- Internally generated power-on reset
- Packaged in 22/24-pin DIP
- The different dialers in the W9145 series are shown in the following table:

TYPE NO.	PULSE (ppS)	FLASH	B/M	HANDFREE	LOCK
W9145	10	98/305/600	Pin	No	No
W9145A	10	98/305/600	Pin	Yes	No
W9145L	10	98/305/600	Pin	No	Yes
W9145AL	10	98/305/600	Pin	Yes	Yes

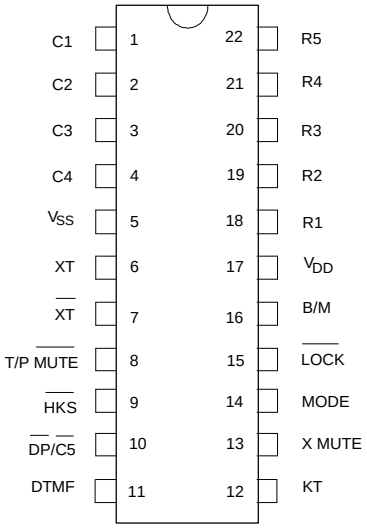
PIN CONFIGURATIONS



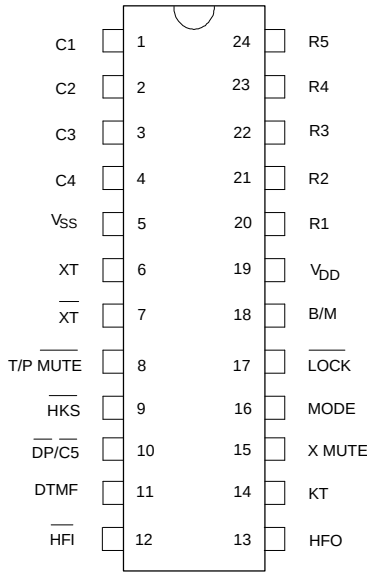
W9145



W9145A



W9145L



W9145AL

PIN DESCRIPTION

SYMBOL	22-PIN	24-PIN	I/O	FUNCTION
Column-Row Inputs	1–4 & 18–22	1–4 & 20–24	I	Keyboard inputs may be connected to either a standard keyboard, an inexpensive signal contact (Form A) keyboard, or electronic input from a µC. A valid key entry is defined by a single row being connected to a single column.
XT, $\overline{XT}$	6, 7	6, 7	I, O	A built-in inverter provides oscillation by means of an inexpensive 3.579545 MHz crystal or ceramic resonator.
T/P $\overline{MUTE}$	8	8	O	The T/P $\overline{MUTE}$ is a conventional CMOS inverter that pulls to VDD in the absence of keypad input and pulls to VSS when an address keypad entry is sensed (excluding the * and # keypads in pulse mode). When any keypad in row 5 and column 5 is pushed, the mute out remains at high level.
MODE	14	16	I	Pull to VSS to enable tone mode. Pull to VDD to enable pulse mode (10 ppS).
$\overline{HKS}$	9	9	I	Hook switch input. When pulled to high, chip is in on-hook state (no operation). When pulled to low, chip is in off-hook state (enabled for normal operation). This pin is pulled to VDD by internal resistor. Note: This pin operates in conjunction with the handfree control pins; for further information see description of handfree control pins below.
B/M	16	16	I	B/M = 1: Break/Make ratio is 60:40. B/M = 0: Break/Make ratio is 67:33. This pin has no function in tone mode.
VDD, VSS	17, 5	19, 5	I	Power input pins.
X MUTE	13	15	O	The X MUTE is a conventional CMOS inverter that in tone mode is active while a DTMF signal is being transmitted. In pulse mode, this output remains low at all times.

Pin Description, continued

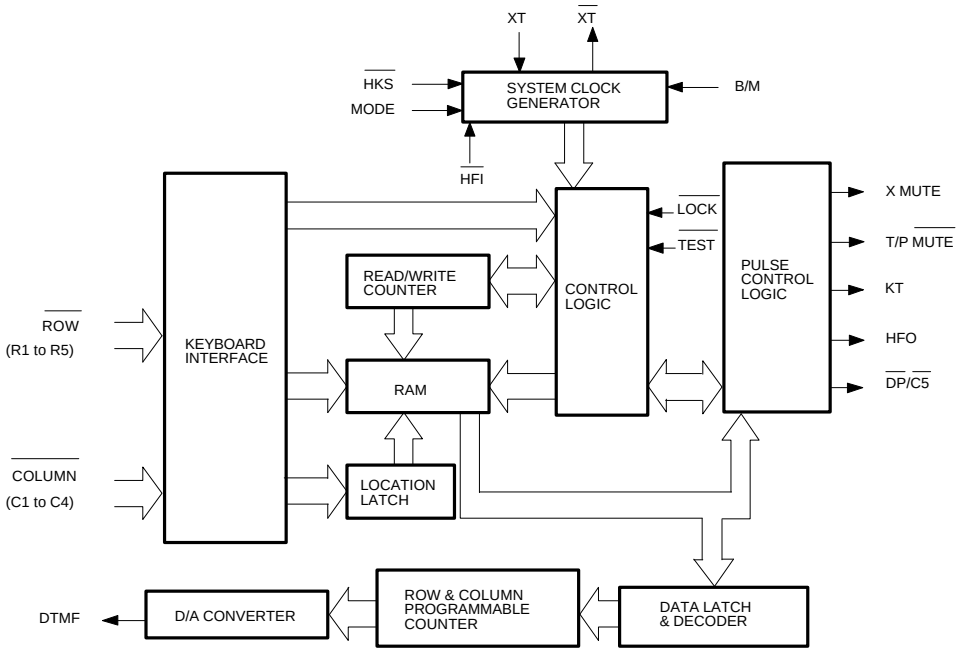
<table>
<tr><th>SYMBOL</th><th>22-PIN</th><th>24-PIN</th><th>I/O</th><th>FUNCTION</th></tr>
<tr><td>$\overline{HFI}$,
HFO</td><td>-</td><td>12, 13</td><td>I, O</td><td>Handfree control pins.
A low pulse on $\overline{HFI}$ toggles on the handfree control state. Status of the handfree control state is indicated 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 internal resistor.</td></tr>
<tr><td>KT</td><td>12</td><td>14</td><td>O</td><td>Key tone signal output. A 1.2 KHz key tone will be generated when any key is depressed in pulse mode or when function keys are depressed in tone mode.</td></tr>
<tr><td>$\overline{LOCK}$</td><td>15
(W9145L only)</td><td>17
(W9145AL only)</td><td>I</td><td>The function of this terminal is to prevent "0" dialing in 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.
<table>
<tr><th>$\overline{LOCK}$ PIN</th><th>FUNCTION</th></tr>
<tr><td>V_{DD}</td><td>Normal dialing mode</td></tr>
<tr><td>Floating</td><td>"0," "9" dialing inhibited</td></tr>
<tr><td>V_{SS}</td><td>"0" dialing inhibited</td></tr>
</table></td></tr>
<tr><td>$\overline{TEST}$</td><td>15
(W9145 only)</td><td>17
(W9145A only)</td><td>I</td><td>During normal operation, the $\overline{TEST}$ pin should be tied to V_{DD}, thereby inhibiting the single tone and setting the pulse rate to 10 ppS.</td></tr>
<tr><td>$\overline{DP}$ / $\overline{C5}$</td><td>10</td><td>10</td><td>O</td><td>This pin is a CMOS inverter output.
The timing diagram is shown in Figure 1. Flash key will cause $\overline{DP}$ / $\overline{C5}$ to go active in either pulse or tone mode.</td></tr>
</table>

Pin Description, continued

SYMBOL	22-PIN	24-PIN	I/O	FUNCTION
DTMF	11	11	O	In pulse mode, remains in low state at all times. In tone mode, will output a dual or single tone. Detailed timing diagram for tone mode is shown in Figure 2(a, b).

OUTPUT FREQUENCY (Hz)			
	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	M1	MUTE	R1
4	5	6	M2	CD	R2
7	8	9	M3	F1	R3
*/T	0	#	SAVE	F2	R4
RD	S	A	P	F3	R5

- MUTE: Mute key
- CD: Call Disconnect
- */T: * & P→T key
- RD: One-key Redial
- S: Store
- A: Auto dialing
- P: Pause
- M1 to M3: Memory 1 to 3
- SAVE: Save Memory
- F1, F2, F3: 98/305/600 mS

Normal Dialing

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

1. OFF HOOK (or ON HOOK & $\overline{HFI}$), D1 , D2 , ..., Dn , BUSY RD
   a. The one-key redialing function timing diagram is shown in Figure 4.
   b. Once dialing of D1 to Dn is finished, pressing RD key will cause the pulse output pin to go low for 2.2 seconds break time and 600 mS pause will automatically be added.
   c. If the pulses of the dialed number D1 to Dn have not finished, RD key will be ignored.
2. OFF HOOK , D1 , D2 , ..., Dn BUSY, Come ON HOOK , OFF HOOK (or ON HOOK & $\overline{HFI}$), RD

Or (ON HOOK & HFI), D1 , D2 , ..., Dn , BUSY, HFI , Come HFI , RD

If RD is the first key after off-hook, only the redialing function will be executed and the pulse output pin will not go low for the break time of 2.2 seconds.

Access Paus

OFF HOOK (or ON HOOK & HFI), 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 repertory dialing.
3. The pause function timing diagram is shown in Figure 5.

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 (3.1S) 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 device can be reset to pulse mode only by going on-hook; device remains in tone mode when the digits have been dialed out.
4. The P→T function timing diagram is shown in Figure 6.

Flash

OFF HOOK (or ON HOOK & HFI), F

1. Flash key cannot be stored as a digit in memory. Flash key has first priority among keyboard functions.
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 7.

Number Store

1. OFF HOOK (or ON HOOK & HFI), D1 , D2 , ..., Dn , S , S ,

   Mn (or Ln) ON HOOK (or ON HOOK & HFI)

   a. The dialing of D1, D2, ..., Dn must be finished before S key may be pressed.

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

   c. Mn = M1 to M3; Ln = 0 to 9, *, Pause.

2. OFF HOOK (or ON HOOK & HFI), S , D1 , D2 , ..., Dn , S ,

   Mn (or Ln) ON HOOK (or ON HOOK & HFI)

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

   b. P and */T keys can be stored as a digit in memory. In store P is the pause mode,
   function key.

   c. The store mode is released once the store function is completed or the state of the hook switch changes.

Repertory Dialing

1. OFF HOOK (or ON HOOK & HFI), Mn

2. OFF HOOK (or ON HOOK & HFI), A , Ln

Save Key

1. OFF HOOK (or ON HOOK & HFI), D1 , D2 , ..., SAVE

If the dialing D1 to Dn is finished, pressing the SAVE key will cause D1 to Dn to be of
duplicated to the SAVE memory.

2. ON HOOK Come OFF HOOK , SAVE

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

Call Disconnect

OFF HOOK CD

The $\overline{DP}/\overline{C5}$ pin will go low (line break) when the CD key is pressed and the system will be reset to initial state.

Mute Key

OFF HOOK MUTE

The mute output will be switched on as long as the MUTE key is depressed.

CD and MUTE key function timing diagram is shown in Figure 8.

Mixed Dialing

OFF HOOK (or ON HOOK & HFI),

1. Normal dialing + Repertory dialing + Normal dialing
2. Repertory dialing + Normal dialing + Repertory dialing
3. Redialing + Normal dialing + Repertory dialing

a. Redialing and SAVE dialing are valid for first key-in only.

b. The second sequence should not be performed until the first sequence is dialed out completely.

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} = 2.5V, F_{OSC} = 3.58 MHz, T_A = 25° C, unless otherwise noted

PARAMETER	SYM.	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Operating Voltage	V_{DD}	Tone	2.0	-	5.5	V
		Pulse	2.0	-	5.5	V
Operating Current	I_{OP}	Tone, Unloaded	-	0.6	2	mA
		Pulse, Unloaded	-	0.2	0.5	mA
Memory Retention	I_{MR}	$\overline{HKS}$ = 1, T_A = 25° C V_{DD} = 1.0V	-	0.1	0.2	µA
Standby Current	I_S	$\overline{HKS}$ = 0, V_{DD} = 2.5V	-	0.1	5	µA
Tone Output	V_{TO}	Row Group, R_L = 5 KΩ	130	150	170	Vrms

DC Characteristics, continued

PARAMETER	SYM.	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Pre-Emphasis		Column Group/Row Group V_{DD} = 2.0–5.5V	1	2	3	dB
DTMF Distortion	T_{HD}	R_L = 5 KΩ	-	-30	-23	dB
HFO Drive/Sink Current	I_{HFH}	V_{HFH} = 2.0V	0.5	-	-	mA
	I_{HFL}	V_{HFL} = 0.5V	0.5	-	-	mA
Tone Output External Load Impedance	R_L	T_{HD} < -23 dB	5	-	-	KΩ
Tone Output DC Level	V_{DC}	V_{DD} = 2.0–5.5V	1.0	-	3.0	V
Tone Output Sink Current	I_{TL}	V_{TO} = 0.5V	0.2	-	-	mA
Pulse Output Drive/Sink Current	I_{PH}	V_{PO} = 2.0V	-0.2	-	-	mA
	I_{PL}	V_{PO} = 0.5V	0.2	-	-	mA
T/P $\overline{\text{MUTE}}$ Output Drive/Sink Current	I_{MH}	V_{MO} = 2.0V	-0.2	-	-	mA
	I_{ML}	V_{MO} = 0.5V	2	-	-	mA
Key Tone Output Drive/Sink Current	I_{KH}	V_{KO} = 2.0V	-0.5	-	-	mA
	I_{KL}	V_{KL} = 0.5V	0.5	-	-	mA
X MUTE Drive/Sink Current	I_{LH}	V_{LO} = 2.0V	-0.2	-	-	mA
	I_{IL}	V_{LO} = 0.5V	0.2	-	-	mA
Input Voltage Low	V_{IL}		GND	-	0.3 V_{DD}	V
Input Voltage High	V_{IH}		0.7 V_{DD}	-	V_{DD}	V
Keypad Input Drive/Sink Current	I_{KD}	V_I = 0V	10	30	80	µA
	I_{KS}	V_I = 2.5V	200	400	-	µA
Control Pin Input	I_{IN}	$\overline{\text{HKS}}$, MODE, $\overline{\text{TEST}}$, B/M	-	-	±25	µA

AC CHARACTERISTICS

PARAMETER	SYM.	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Key-in Debounce	T_{KID}		-	20	-	mS
Key-release Debounce	T_{KRD}		-	20	-	mS
Key tone Delay	T_{KD}		-	20	-	mS

AC Characteristics, continued

PARAMETER	SYM.	CONDITIONS	MIN.	TYP.	MAX.	UNIT
One-key Redial Break Time	TRB		-	2.2	-	S
One-key Redial Break Pause Time	TRP		-	600	-	mS
Pulse Mute Delay	TMD	B/M = 1	-	40	-	mS
		B/M = 0	-	33.3	-	mS
Pre-digit Pause	TPDP	B/M = 1	-	40	-	mS
		B/M = 0	-	33.3	-	mS
Pulse Rate	TPR	Mode = 1	-	10	-	ppS
Interdigit Pause	TIDP		-	800	-	mS
Make/Break Ratio	M:B	B/M = 1	-	40:60	-	%
		B/M = 0	-	33.3:66.7	-	%
Tone Duration	TTD	Auto Dialing	-	93	-	mS
Intertone Pause	TITP	Auto Dialing	-	93	-	mS
Flash Break Time	TFB	F1	-	98	-	mS
		F2	-	305	-	mS
		F3	-	600	-	mS
Pause Time	TP		-	3.1	-	S
Key Tone Frequency	f8		-	1.2	-	KHz

TIMING WAVEFORMS

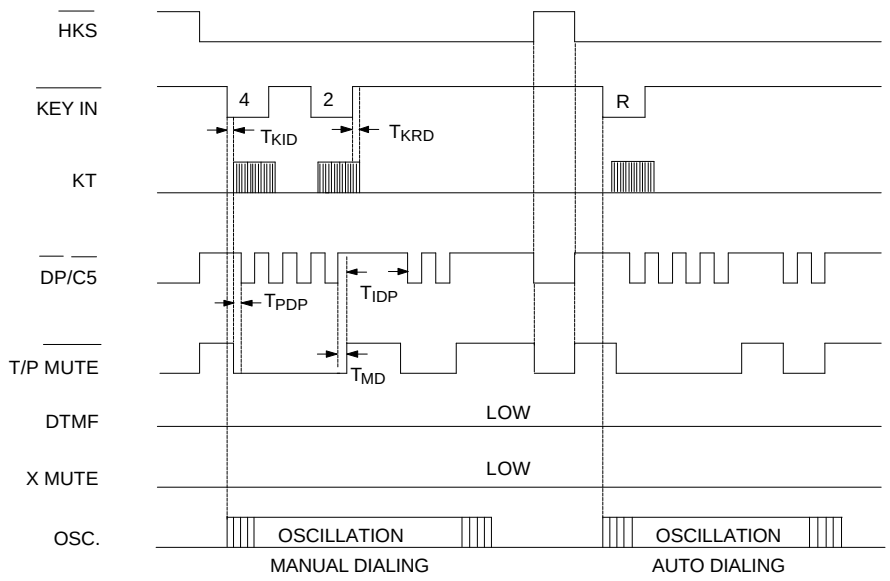


Figure 1. Pulse Mode Dialing Timing Diagram

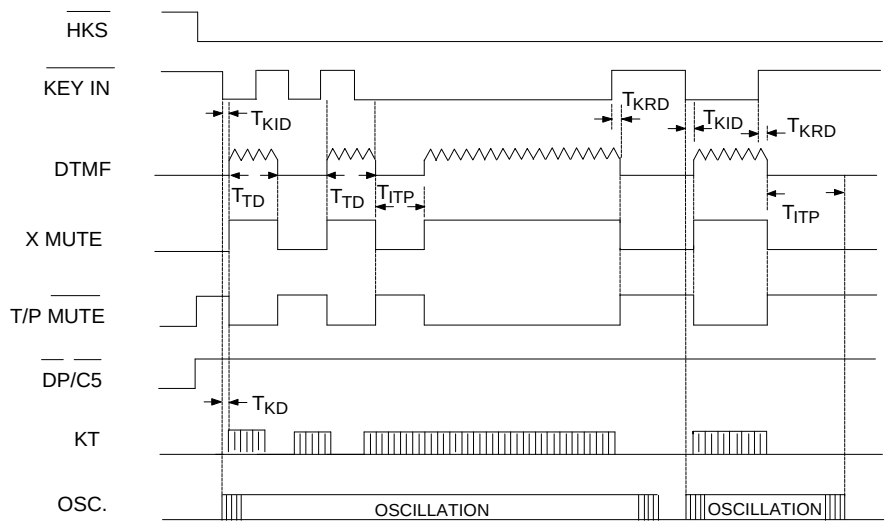


Figure 2(a). Tone Mode Normal Dialing Diagram

Timing Waveforms, continued

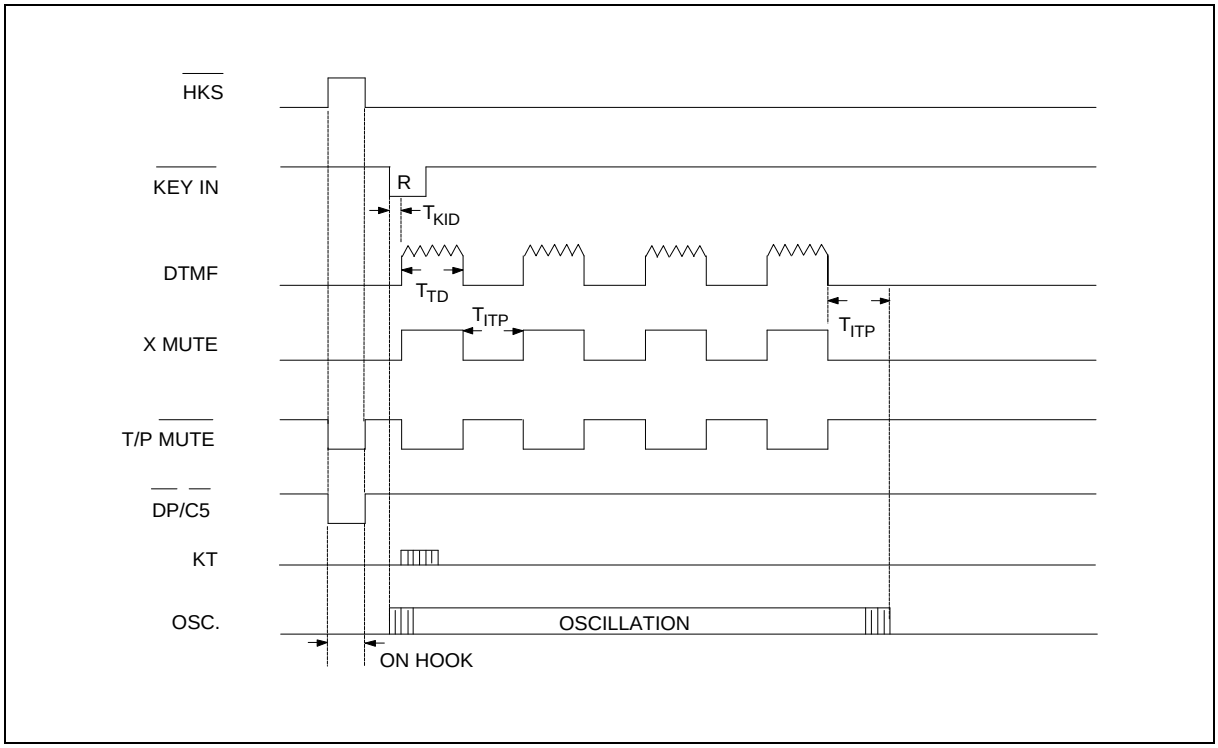


Figure 2(b). Tone Mode Redialing Timing Diagram

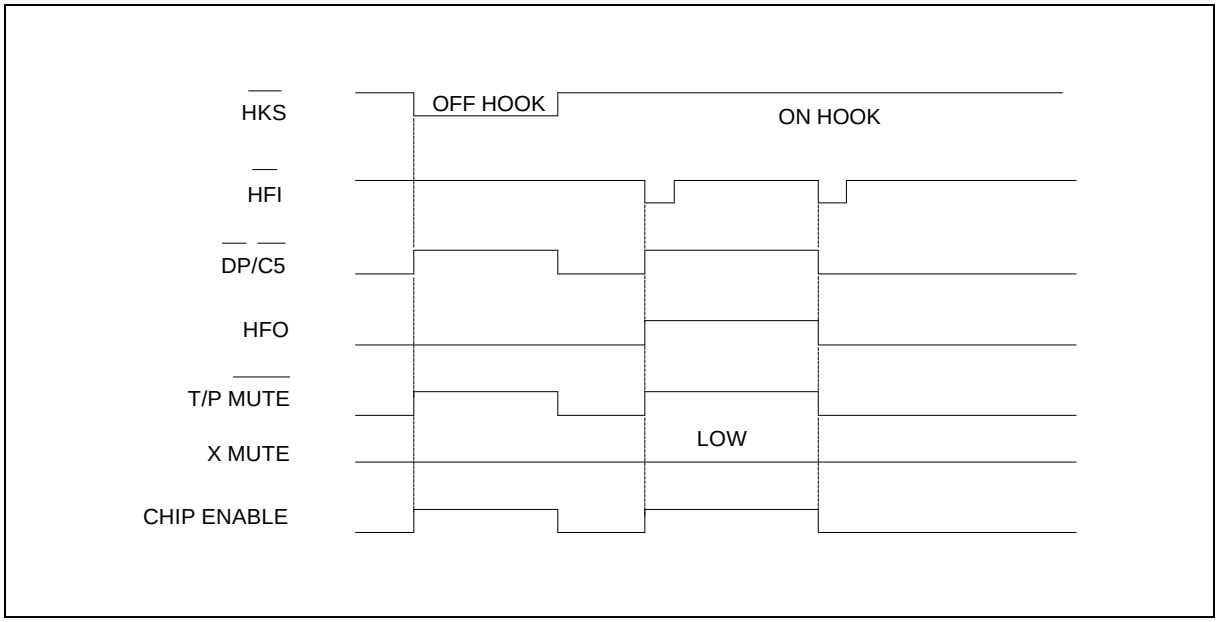


Figure 3(a). Handfree Function Timing Diagram

Timing Waveforms, continued

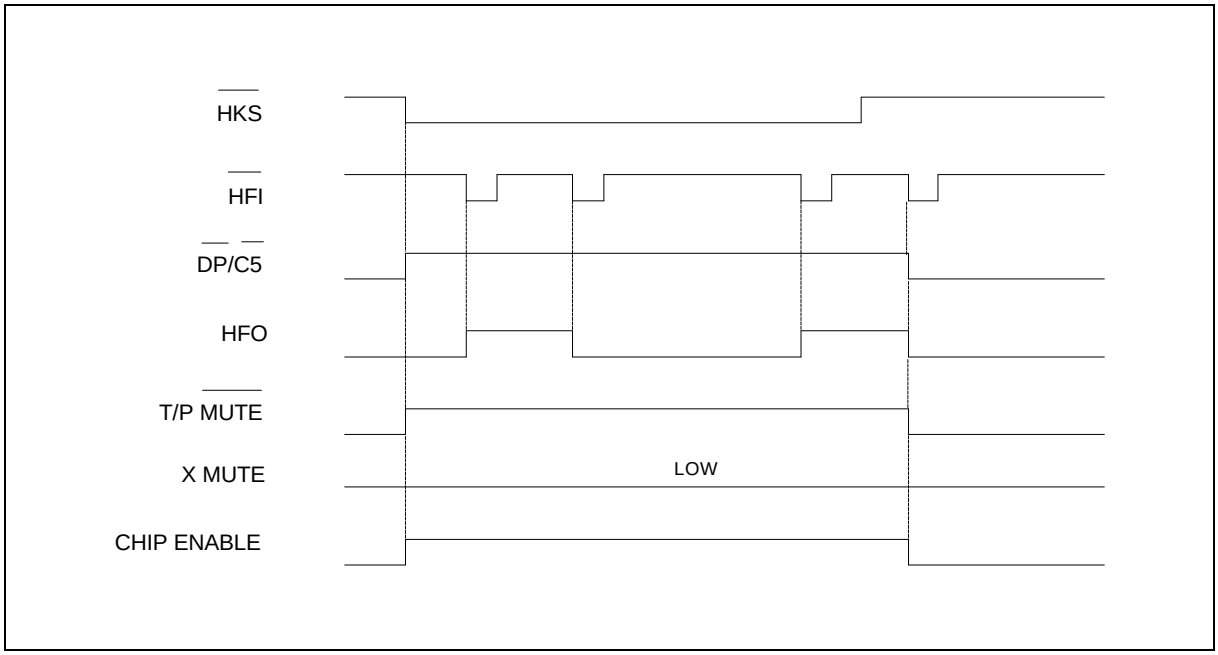


Figure 3(b). Handfree Function Timing Diagram

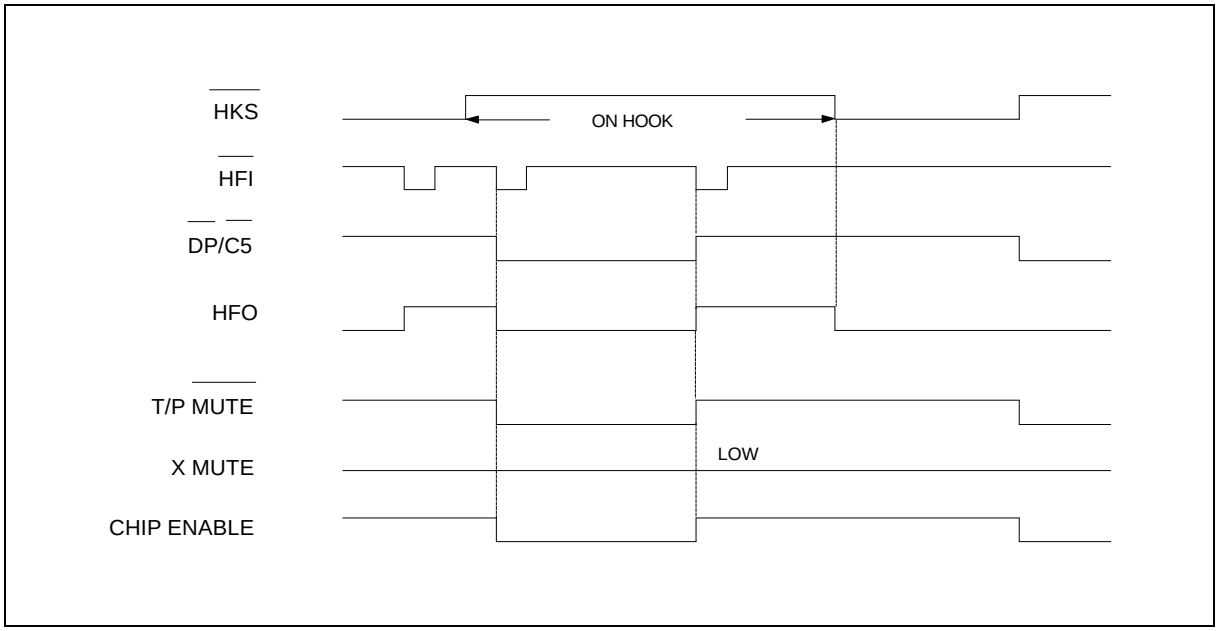


Figure 3(c). Handfree Function Timing Diagram

Timing Waveforms, continued

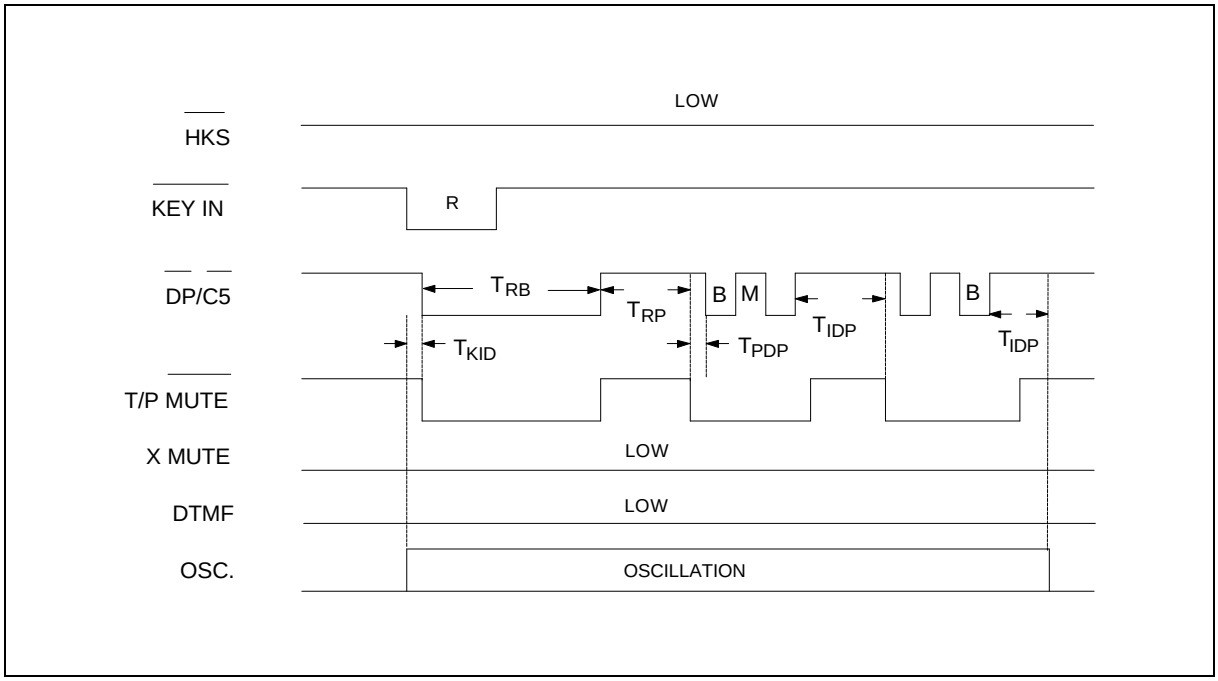


Figure 4. Pulse Mode Timing Diagram

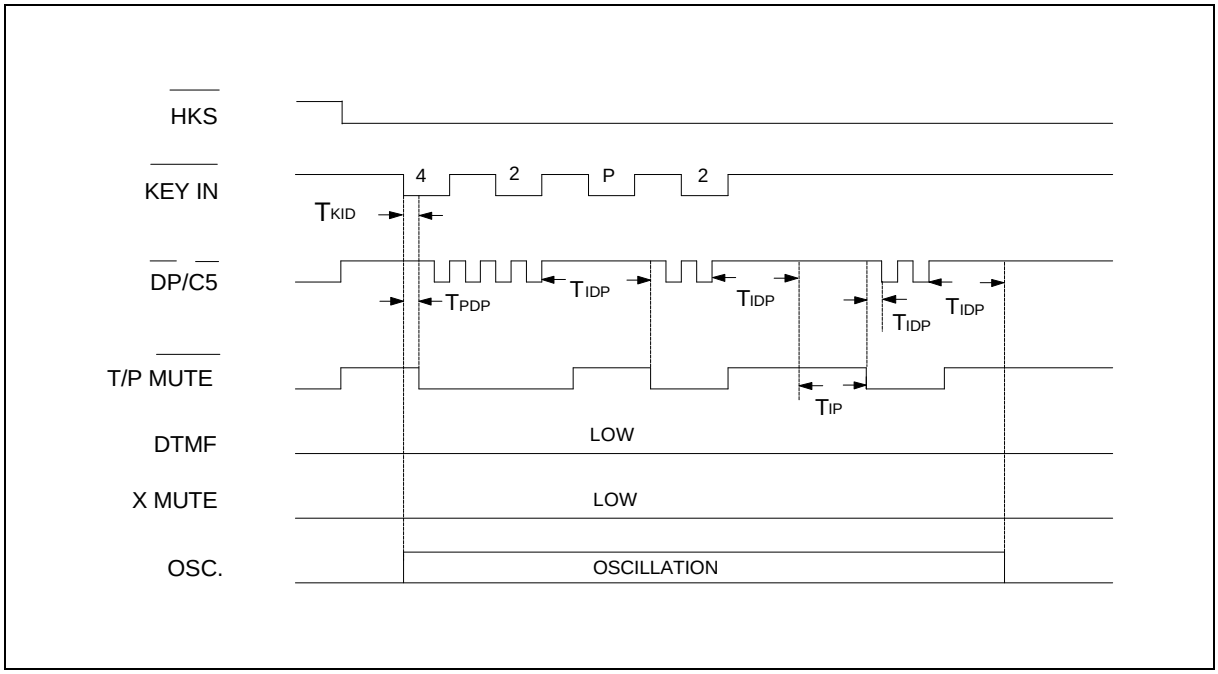


Figure 5. Pause Function Timing Diagram

Timing Waveforms, continued

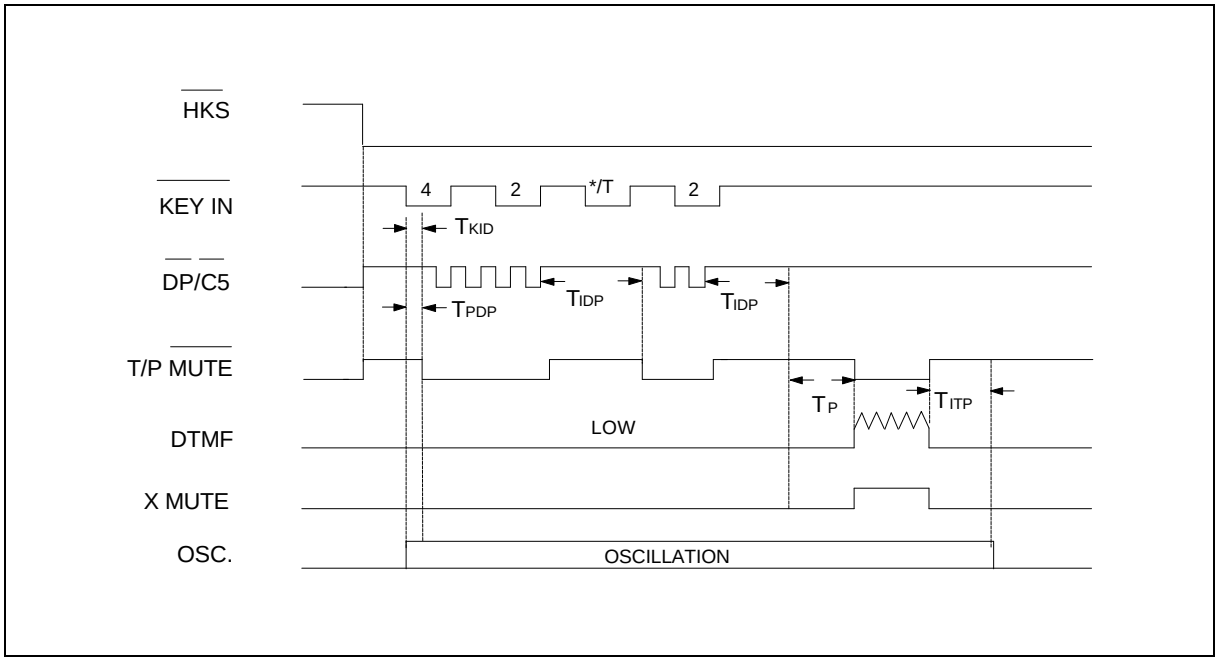


Figure 6. P→T Operation Timing Diagram in Normal Dialing

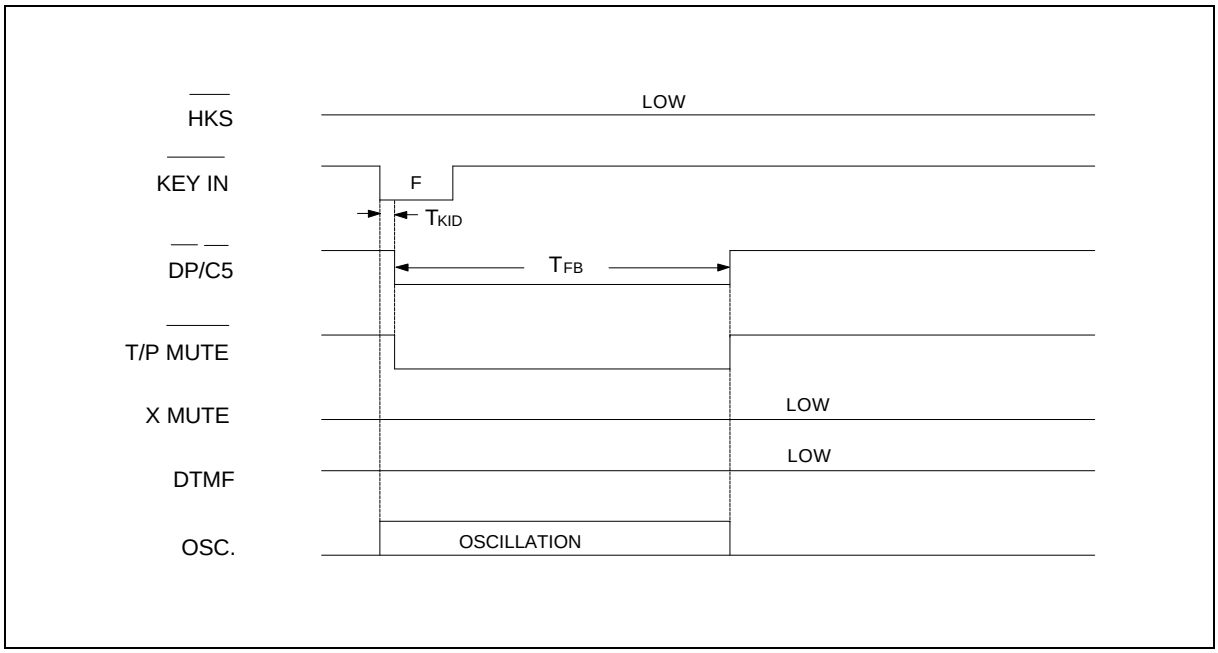


Figure 7. Flash Operation Timing Diagram

Timing Waveforms, continued

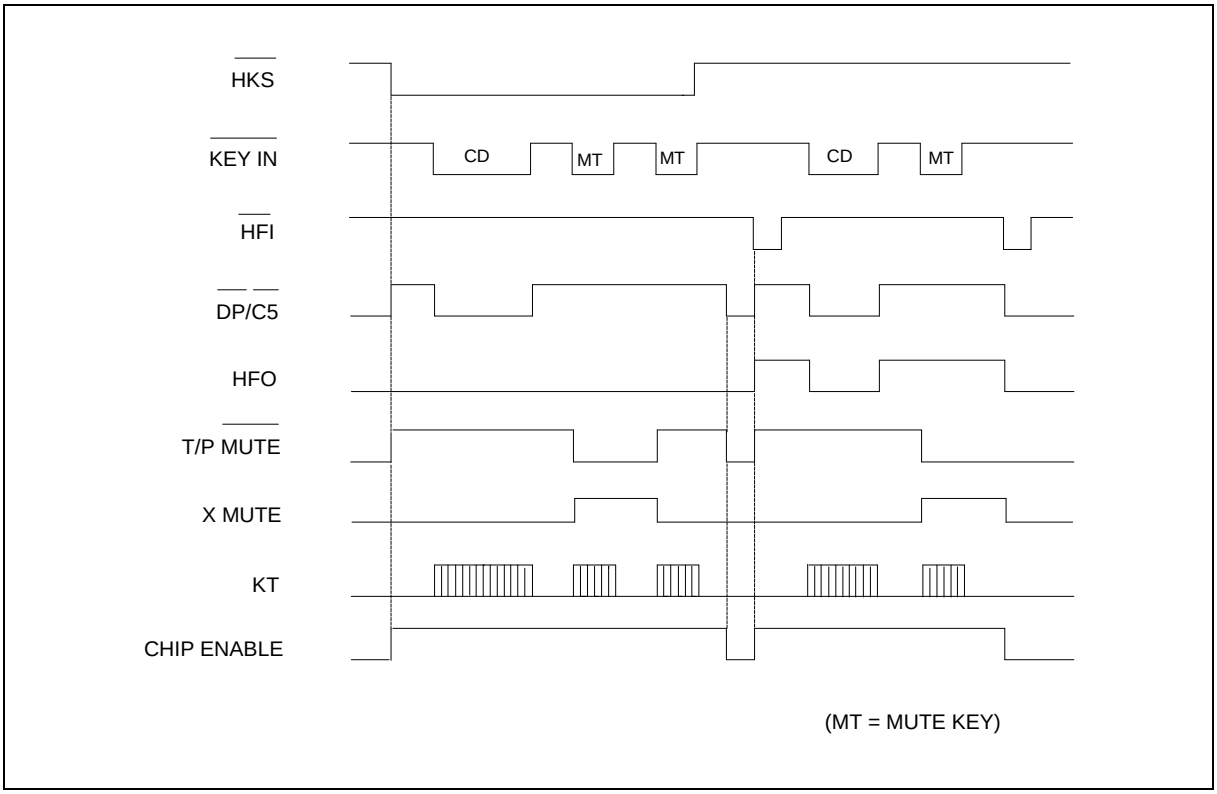


Figure 8. Mute Key Operation Timing Diagram

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