Winbond
Electronics Corp.

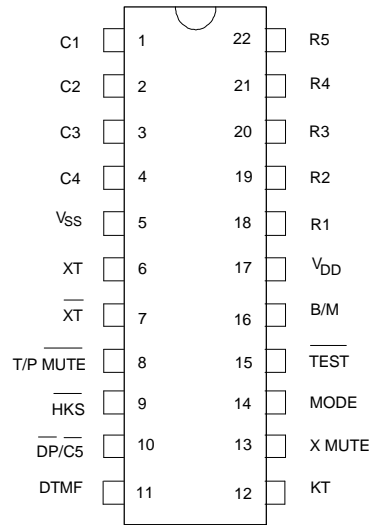# 15-MEMORY TONE/PULSE DIALER WITH LOCK AND HANDFREE FUNCTIONS

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.
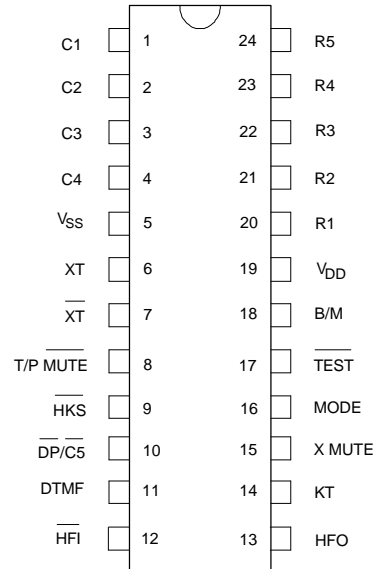
FEATURES

- 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

Winbond
Electronics Corp.

W9145

C1	1	22	R5
C2	2	21	R4
C3	3	20	R3
C4	4	19	R2
V_{SS}	5	18	R1
XT	6	17	V_{DD}
$\overline{XT}$	7	16	B/M
T/P MUTE	8	15	$\overline{TEST}$
$\overline{HKS}$	9	14	MODE
$\overline{DP/C5}$	10	13	X MUTE
DTMF	11	12	KT

W9145

W9145A

C1	1	24	R5
C2	2	23	R4
C3	3	22	R3
C4	4	21	R2
V_{SS}	5	20	R1
XT	6	19	V_{DD}
$\overline{XT}$	7	18	B/M
T/P MUTE	8	17	$\overline{TEST}$
$\overline{HKS}$	9	16	MODE
$\overline{DP/C5}$	10	15	X MUTE
DTMF	11	14	KT
$\overline{HFI}$	12	13	HFO

W9145A

W9145L

C1	1	22	R5
C2	2	21	R4
C3	3	20	R3
C4	4	19	R2
V_{SS}	5	18	R1
XT	6	17	V_{DD}
$\overline{XT}$	7	16	B/M
T/P MUTE	8	15	$\overline{LOCK}$
$\overline{HKS}$	9	14	MODE
$\overline{DP/C5}$	10	13	X MUTE
DTMF	11	12	KT

W9145L

W9145AL

C1	1	24	R5
C2	2	23	R4
C3	3	22	R3
C4	4	21	R2
V_{SS}	5	20	R1
XT	6	19	V_{DD}
$\overline{XT}$	7	18	B/M
T/P MUTE	8	17	$\overline{LOCK}$
$\overline{HKS}$	9	16	MODE
$\overline{DP/C5}$	10	15	X MUTE
DTMF	11	14	KT
$\overline{HFI}$	12	13	HFO

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 V$_{DD}$ in the absence of keypad input and pulls to V$_{SS}$ 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 V$_{SS}$ to enable tone mode. Pull to V$_{DD}$ 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 V$_{DD}$ 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.
V$_{DD}$, V$_{SS}$	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.

W9145 SERIES

Winbond
Electronics Corp.

Pin Description, continued

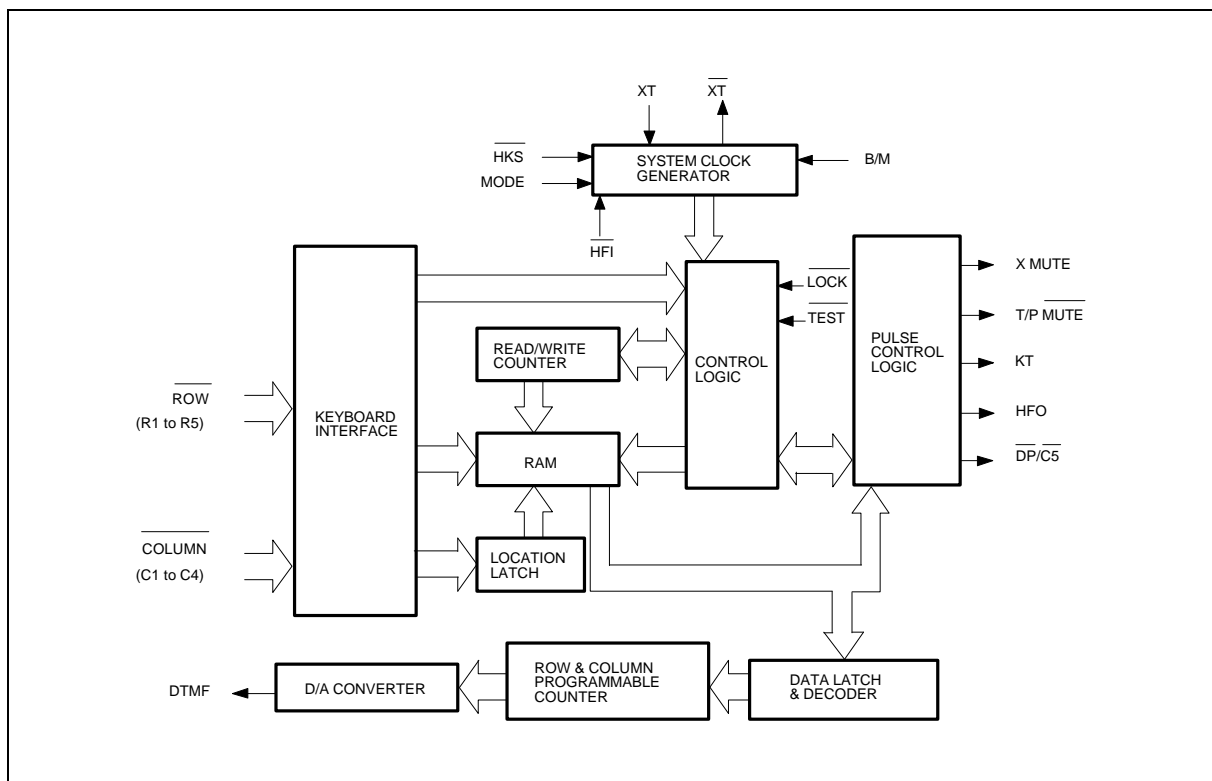| SYMBOL	22-PIN	24-PIN	I/O	FUNCTION
$\overline{\text{HFI}}$, HFO	-	12, 13	I, O	Handfree control pins. A low pulse on $\overline{\text{HFI}}$ toggles on the handfree control state. Status of the handfree control state is indicated in the following table:
KT	12	14	O	Key tone signal output. A 1.2 KHz key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

Within HFI row, table:

CURRENT STATE		NEXT STATE		
HOOK SW.	HFO	INPUT	HFO	DIALING
-	Low	$\overline{\text{HFI}}$ ↓	High	Yes
On Hook	High	$\overline{\text{HFI}}$ ↓	Low	No
Off Hook	High	$\overline{\text{HFI}}$ ↓	Low	Yes
On Hook	-	Off Hook	Low	Yes
Off Hook	Low	On Hook	Low	No
Off Hook	High	On Hook	High	Yes

$\overline{\text{HFI}}$ pin is pulled to VDD by internal resistor.

Within LOCK row, table:

LOCK PIN	FUNCTION
VDD	Normal dialing mode
Floating	"0," "9" dialing inhibited
VSS	"0" dialing inhibited

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 | & | $\overline{HF}|\bar{\bar{i}}\check{o}$ |), | 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 | & | $\overline{HF}|\bar{\bar{i}}\check{o}$ |), | 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.
      the

2. | OFF HOOK | , | D1 | , | D2 | , ..., | Dn | BUSY, Come | ON HOOK | , | OFF HOOK |

   (or | ON HOOK | & | $\overline{HF}|\bar{\bar{i}}\check{o}$ |), | RD |

Or (| ON HOOK | & | $\overline{HFI}$ |), | D1 | , | D2 | , ..., | Dn | , BUSY, | $\overline{HFI}$ | , Come

| $\overline{HFI}$ | , | 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 | & | $\overline{HFI}$ |), | 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 | & | $\overline{HFI}$ |), | 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 | & | $\overline{HFI}$ |), | 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.

Winbond
Electronics Corp.

Number Store

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

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

    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 io |), | S | , | D1 | , | D2 | , ..., | Dn | , | S | ,

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

    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 io |), | Mn |

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

Save Key

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

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

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 & $\overline{\text{HFI}}\ \overline{\text{ı}\tilde{\text{o}}}$),

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}	$\overline{\text{HKS}}$ = 1, T_A = 25° C V_{DD} = 1.0V	-	0.1	0.2	µA
Standby Current	I_S	$\overline{\text{HKS}}$ = 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	I_{HFH}	V_{HFH} = 2.0V	0.5	-	-	mA
Current	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	I_{PH}	V_{PO} = 2.0V	-0.2	-	-	mA
Drive/Sink Current	I_{PL}	V_{PO} = 0.5V	0.2	-	-	mA
T/P $\overline{MUTE}$ Output	I_{MH}	V_{MO} = 2.0V	-0.2	-	-	mA
Drive/Sink Current	I_{ML}	V_{MO} = 0.5V	2	-	-	mA
Key Tone Output	I_{KH}	V_{KO} = 2.0V	-0.5	-	-	mA
Drive/Sink Current	I_{KL}	V_{KL} = 0.5V	0.5	-	-	mA
X MUTE Drive/Sink	I_{LH}	V_{LO} = 2.0V	-0.2	-	-	mA
Current	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	I_{KD}	V_I = 0V	10	30	80	μA
Drive/Sink Current	I_{KS}	V_I = 2.5V	200	400	-	μA
Control Pin Input	I_{IN}	$\overline{HKS}$, MODE, $\overline{TEST}$, 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

Winbond
Electronics Corp.

AC Characteristics, continued

PARAMETER	SYM.	CONDITIONS	MIN.	TYP.	MAX.	UNIT
One-key Redial Break Time	T_{RB}		-	2.2	-	S
One-key Redial Break Pause Time	T_{RP}		-	600	-	mS
Pulse Mute Delay	T_{MD}	B/M = 1	-	40	-	mS
		B/M = 0	-	33.3	-	mS
Pre-digit Pause	T_{PDP}	B/M = 1	-	40	-	mS
		B/M = 0	-	33.3	-	mS
Pulse Rate	T_{PR}	Mode = 1	-	10	-	ppS
Interdigit Pause	T_{IDP}		-	800	-	mS
Make/Break Ratio	M:B	B/M = 1	-	40:60	-	%
		B/M = 0	-	33.3:66.7	-	%
Tone Duration	T_{TD}	Auto Dialing	-	93	-	mS
Intertone Pause	T_{ITP}	Auto Dialing	-	93	-	mS
Flash Break Time	T_{FB}	F1	-	98	-	mS
		F2	-	305	-	mS
		F3	-	600	-	mS
Pause Time	T_{P}		-	3.1	-	S
Key Tone Frequency	f8		-	1.2	-	KHz

TIMING WAVEFORMS
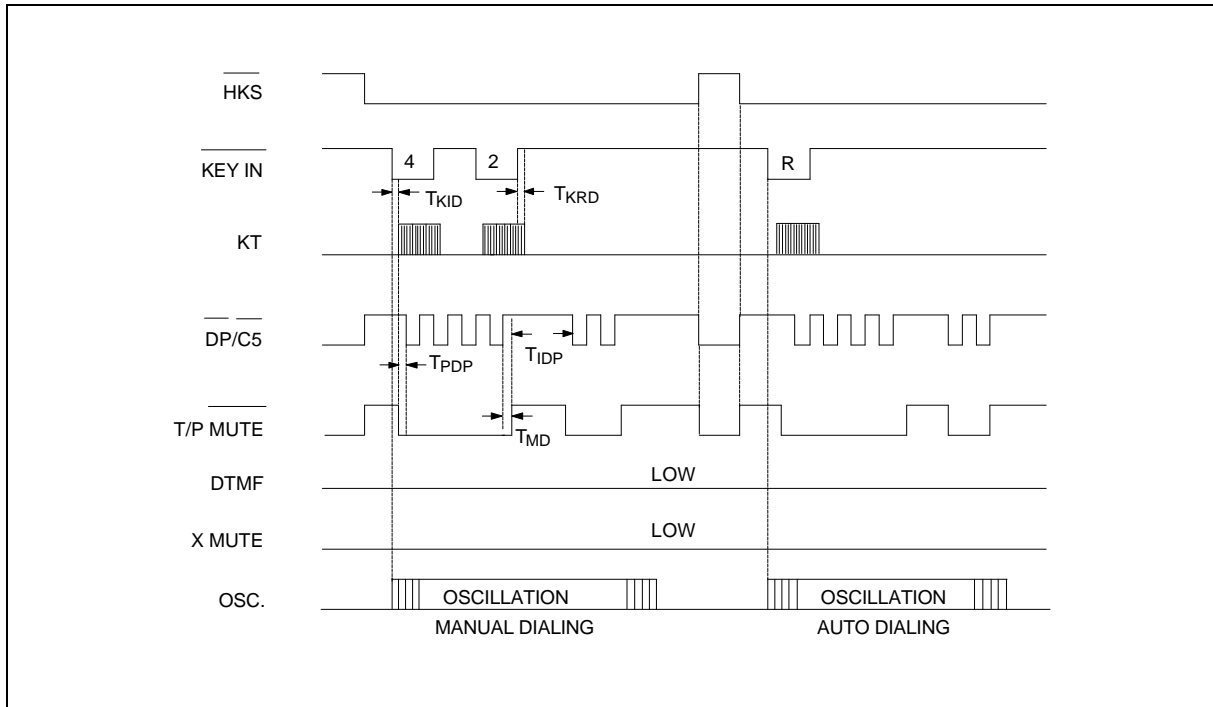
Figure 1. Pulse Mode Dialing Timing Diagram
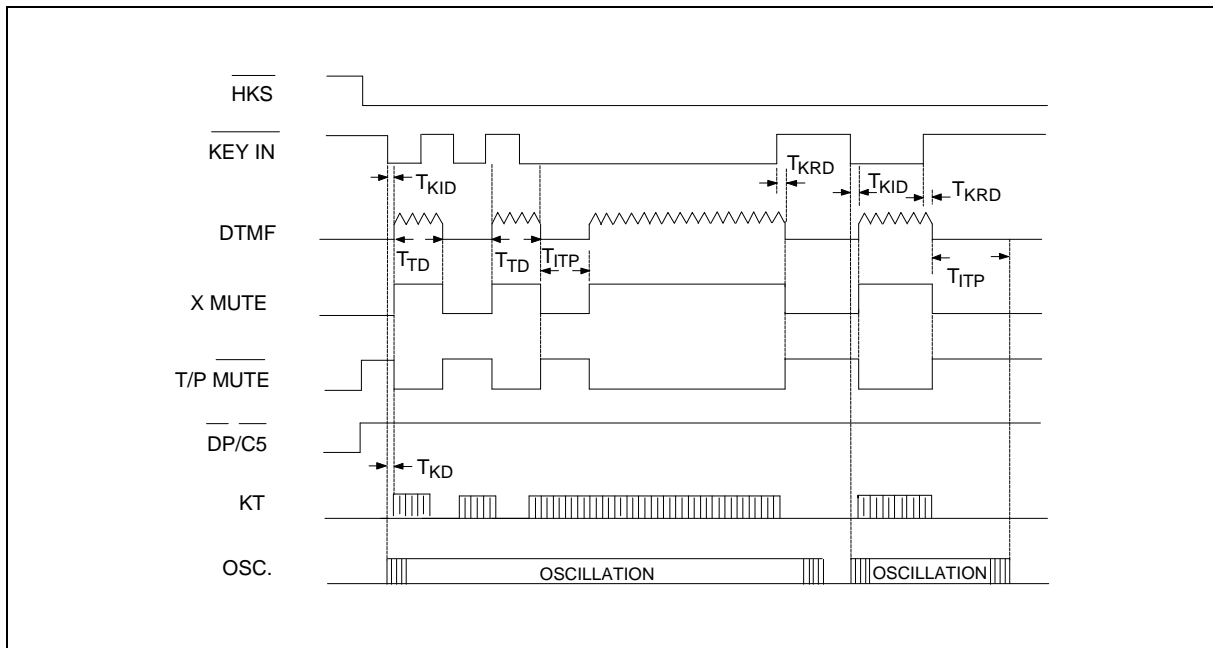
Figure 2(a). Tone Mode Normal Dialing Diagram

Winbond
Electronics Corp.
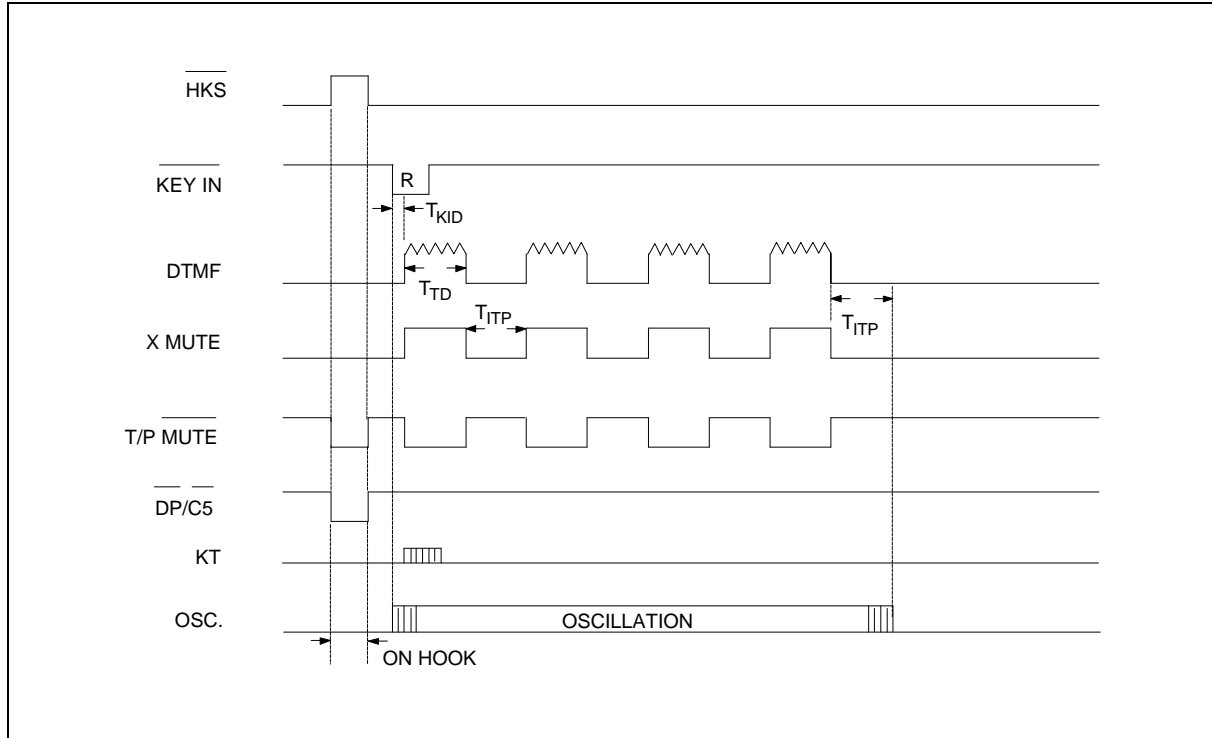
Timing Waveforms, continued

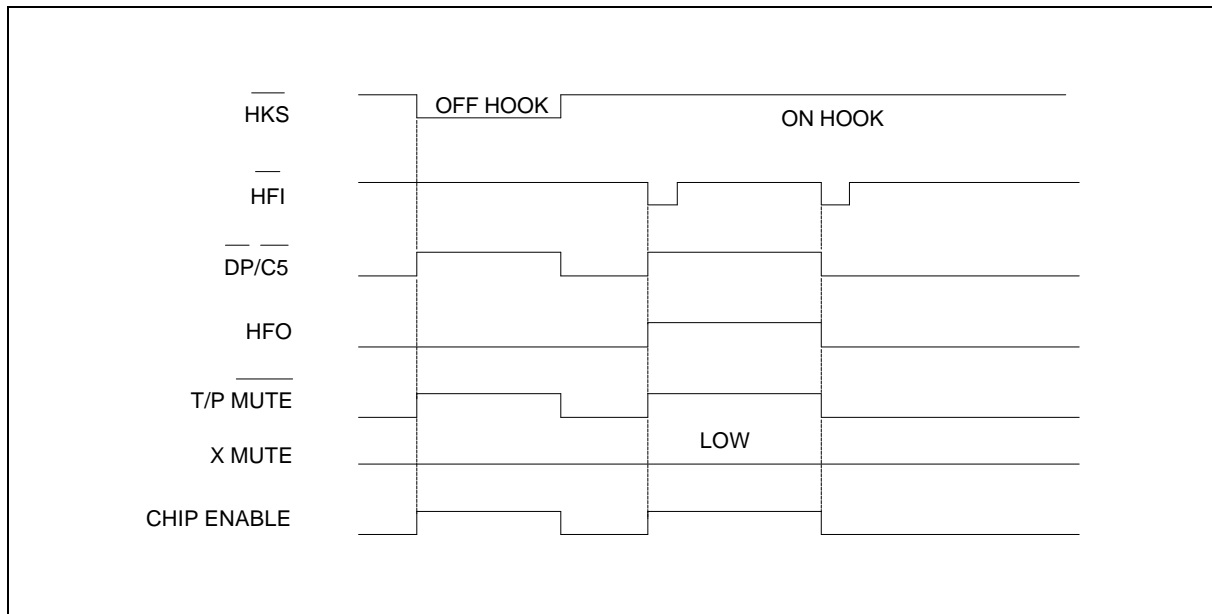

Figure 2(b). Tone Mode Redialing Timing Diagram

Figure 3(a). Handfree Function Timing Diagram
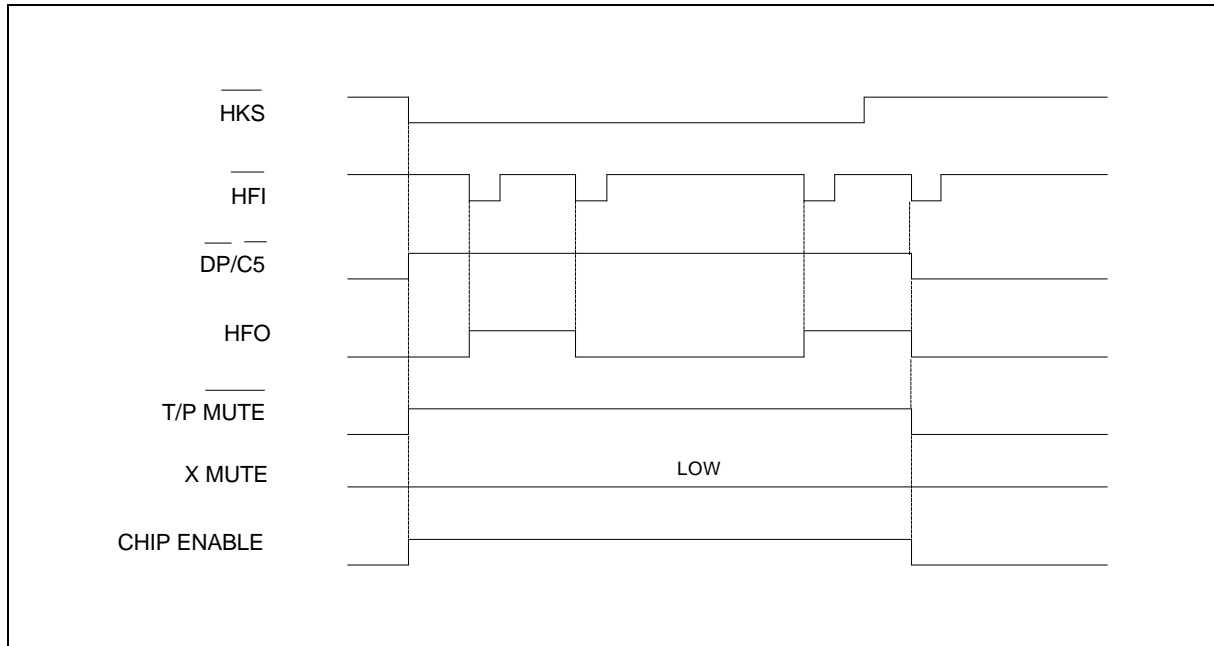
Timing Waveforms, continued
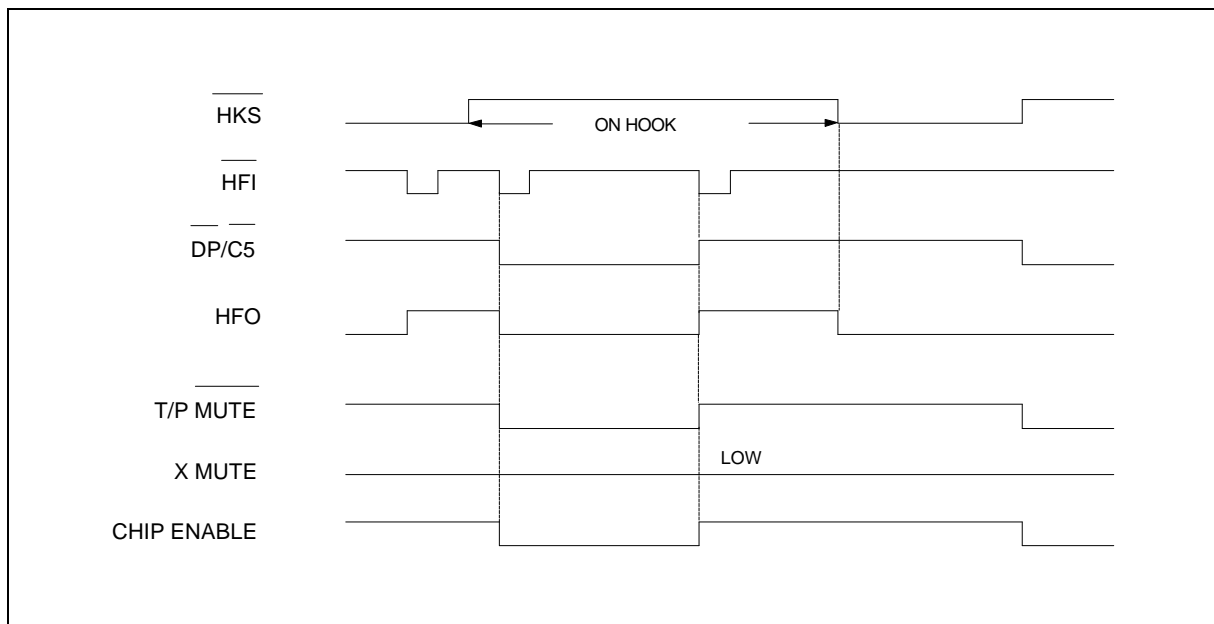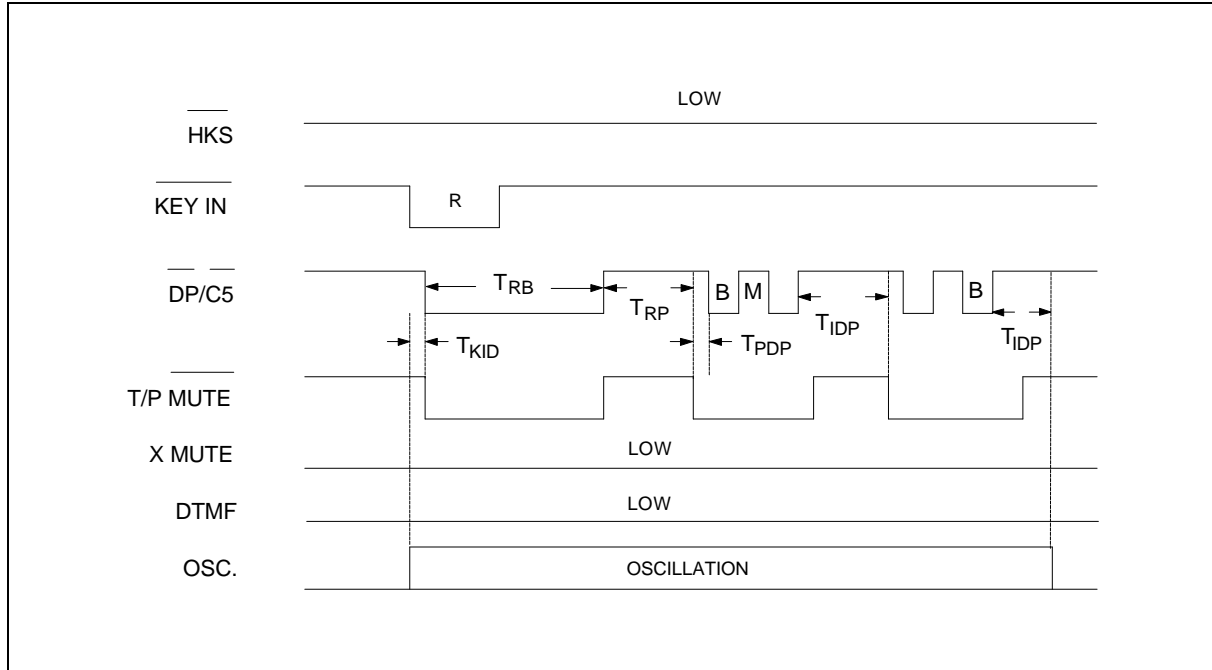
Figure 3(b). Handfree Function Timing Diagram

Figure 3(c). Handfree Function Timing Diagram

Winbond
Electronics Corp.

Timing Waveforms, continued

Figure 4. Pulse Mode Timing Diagram
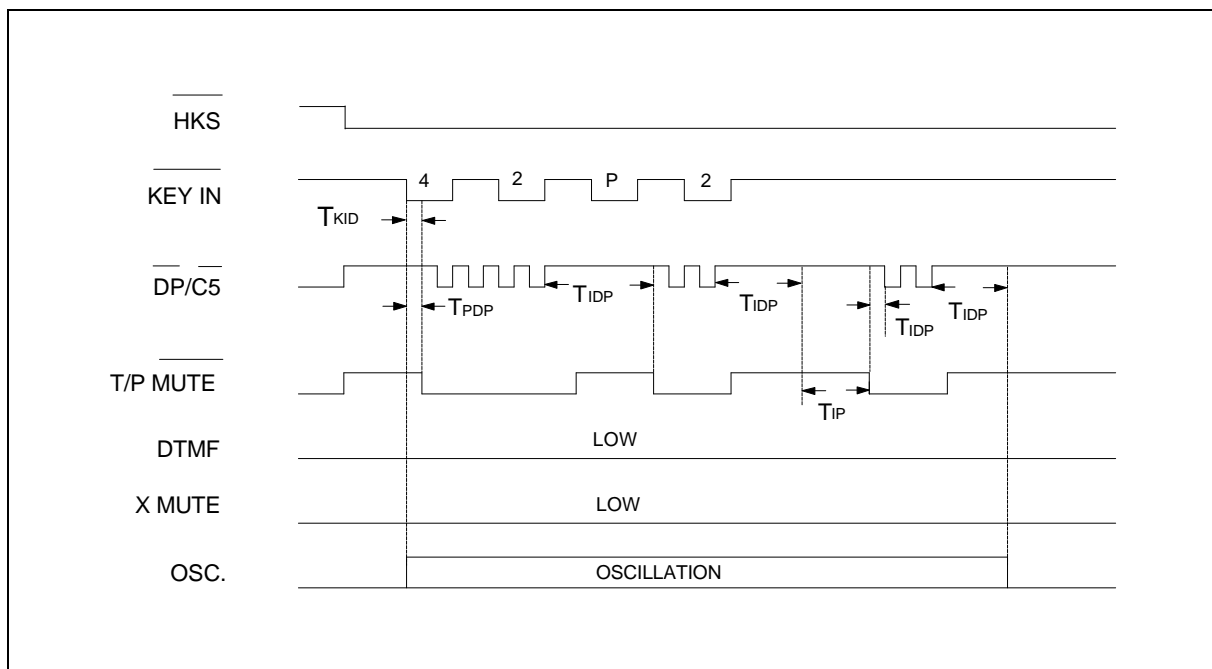
Figure 5. Pause Function Timing Diagram
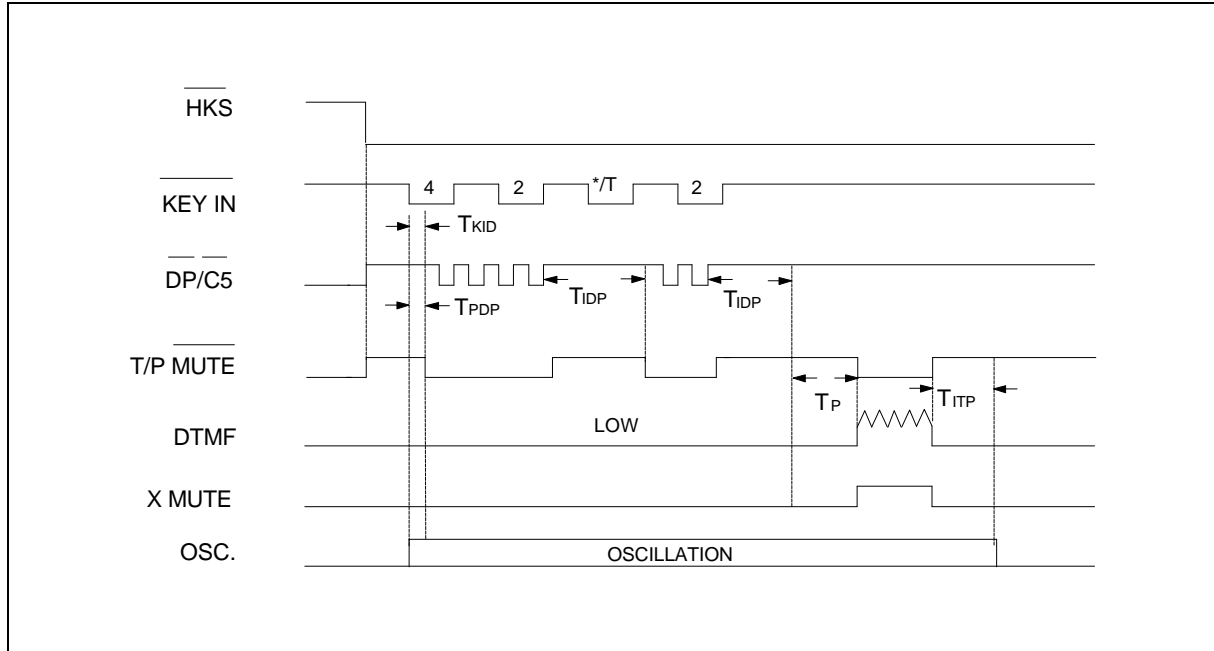
Timing Waveforms, continued

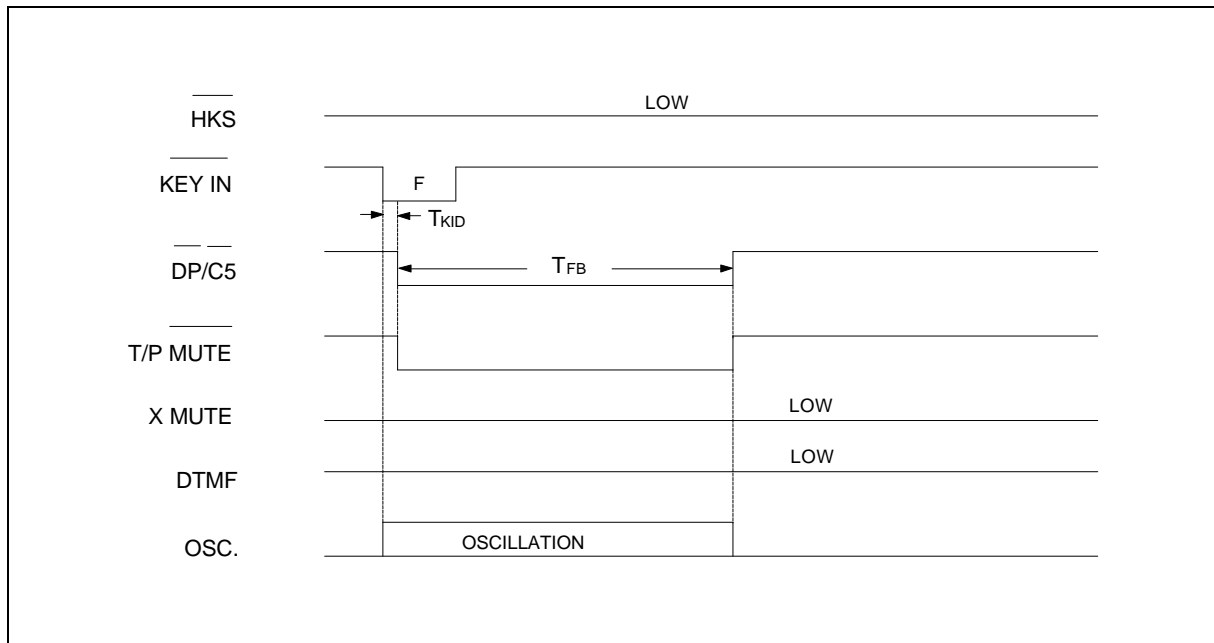

Figure 6. P→T Operation Timing Diagram in Normal Dialing

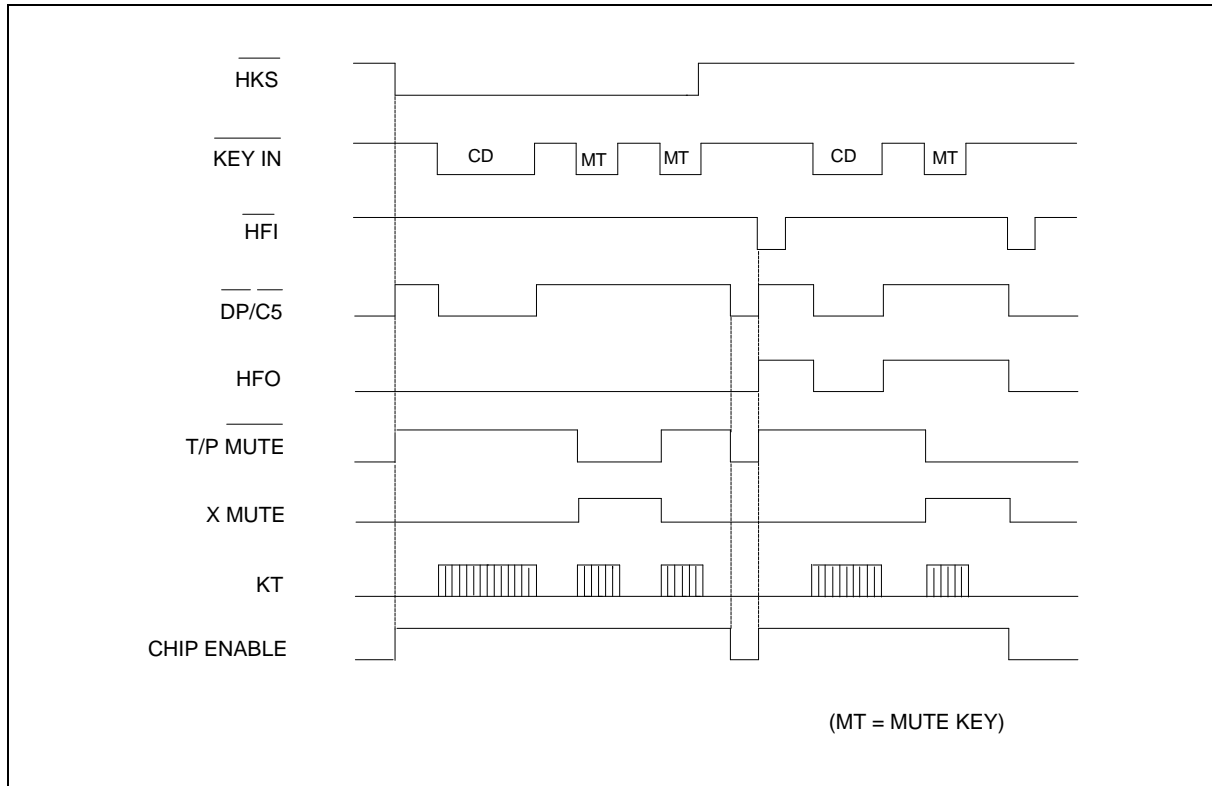Figure 7. Flash Operation Timing Diagram

Timing Waveforms, continued

Figure 8. Mute Key Operation Timing Diagram

Winbond
Electronics Corp.

Headquarters

No. 4, Creation Rd. III,
Science-Based Industrial Park,
Hsinchu, Taiwan
TEL: 886-3-5770066
FAX: 886-3-5792697
http://www.winbond.com.tw/
Voice & Fax-on-demand: 886-2-7197006

Taipei Office

11F, No. 115, Sec. 3, Min-Sheng East Rd.,
Taipei, Taiwan
TEL: 886-2-7190505
FAX: 886-2-7197502

Winbond Electronics (H.K.) Ltd.

Rm. 803, World Trade Square, Tower II,
123 Hoi Bun Rd., Kwun Tong,
Kowloon, Hong Kong
TEL: 852-27516023
FAX: 852-27552064

Winbond Electronics North America Corp.
Winbond Memory Lab.
Winbond Microelectronics Corp.
Winbond Systems Lab.

2730 Orchard Parkway, San Jose,
CA 95134, U.S.A.
TEL: 1-408-9436666
FAX: 1-408-9436668

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