

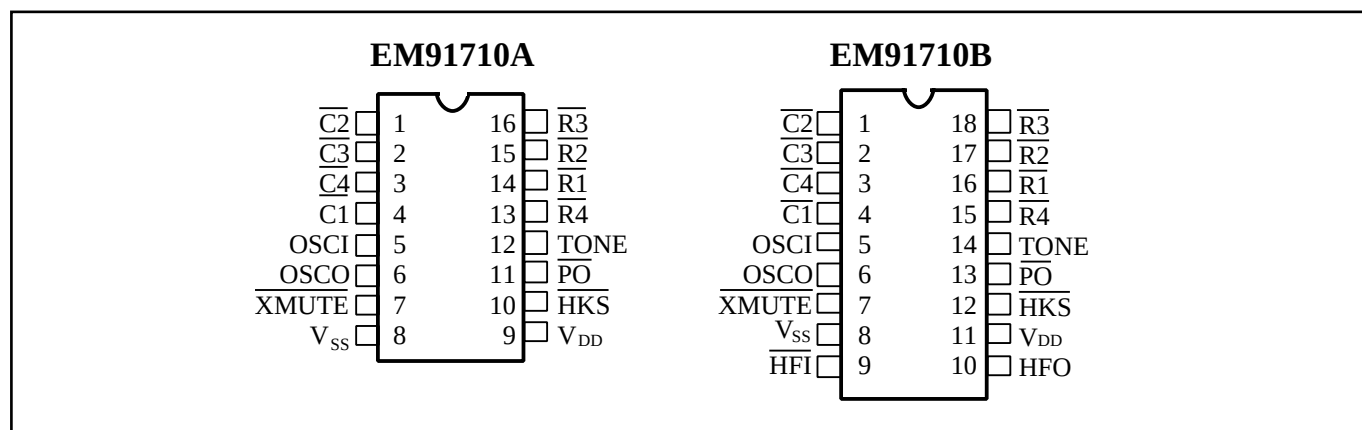
GENERAL DESCRIPTION

The EM91710A/B are Tone/Pulse switchable dialer which are fabricated in CMOS technology with wide operating voltage for both tone and pulse mode, and consumes very low memory retention current in ON-HOOK state.

FEATURES

- Tone/pulse switchable dialer.
- One 32-digit last number redial memory.
- Pulse to tone (P→T) is provided for PBX operation.
- Flash key is available.
- Minimum tone duration is 98ms or 83ms.
- Minimum intertone pause is 98ms or 83ms.
- Uses 3.579545 MHz crystal or ceramic resonator.
- Many options can be selected.
Mode (10 PPS ; 20 PPS ; Tone)
M/B ratio (40 : 60 ; 33 : 66)
Pause time (3.6s)
- Flash function (RESET)
P→T pause time (3.6s)
Flash time (600ms; 300ms; 100ms; or 80ms).
- Mixed dialing.
- Handfree function is provided for speaker phone application.
- Power on reset circuit is provided.
- Package in DIP18 or DIP16.

PIN ASSIGNMENTS

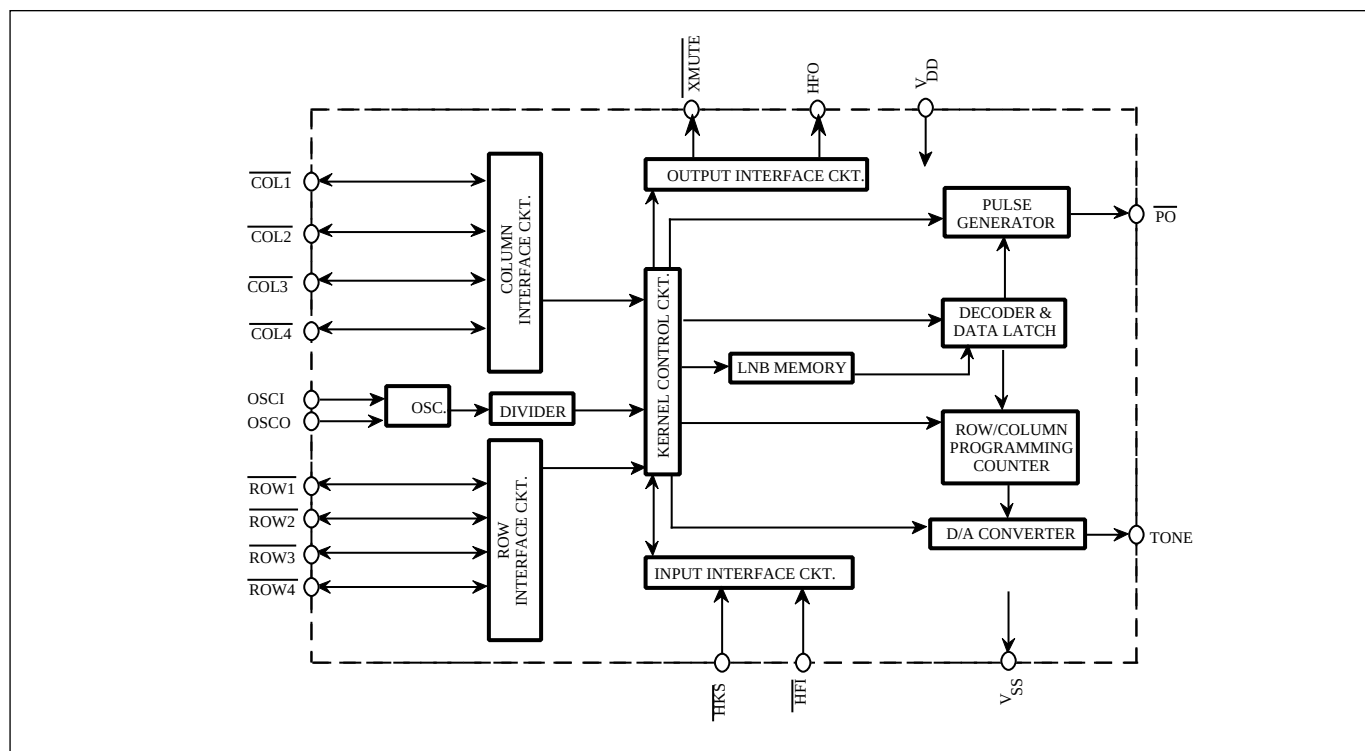


KEYBOARD ASSIGNMENT

	C1	C2	C3	C4
R1	1	2	3	P→T
R2	4	5	6	F
R3	7	8	9	P
R4	*or*/T	0	#	RD

- 1). P→T : In pulse mode, execute P→T function.
- 2). F : Flash key.
- 3). RD : Redial key.
- 4). P : Pause key.
- 5). */T : In pulse mode, execute P→T function
In tone mode, execute "*" key.

FUNCTIONAL BLOCK DIAGRAM



DIALING SIGNAL OPTION :

a):Flash time:

Row3	Row4	flash time(ms)
NR	NR	600
NR	R	300
R	NR	100
R	R	80

b).

Row1	Row2	MODE	PULSE RATE	M/B
R	NR	TONE	—	—
R	R	TONE	—	—
NR	NR	PULSE	20PPS	40:60
NR	R	PULSE	20PPS	33:66
UR	NR	PULSE	10PPS	40:60
UR	R	PULSE	10PPS	33:66

c):Tone function:

Col1	Tone Duration	inter-Tone Pause
NR	98 ms	98 ms
R	83 ms	83 ms

d):Key type select

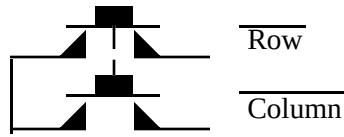
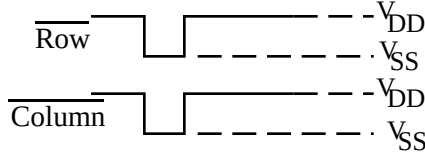
Col2	*or*/T select
NR	*
R	*/T

Note: NR:no resistance.

R : A resistance connect to Vss (820KΩ typically)

UR: A resistance connect to VDD

PIN DESCRIPTION

Symbol	Function
$\overline{C1}$ $\overline{C2}$ $\overline{C3}$ $\overline{C4}$ $\overline{R1}$ $\overline{R2}$ $\overline{R3}$ $\overline{R4}$	Provides keyboard scanning . a. Keyboard scanning: HKS pin is LOW, the column group stays in "HIGH" state and row group stays in "LOW" state. The key pad is compatible with the standard dual contact matrix keyboard (as Figure 1b.), the inexpensive single contact keyboard (as Figure 1a.), and electronic input (as Figure 1c.). When HKS is "low", a valid key entry is defined by related Row & Column connection or by electronic input; (as show in Figure 1c). Activation of two or more keys will result in no response, except for single key. To avoid keyboard bouncing error, this chip provides built-in debounce circuit. (The debounce time = 20 ms.)  Figure 1a : Single contact form keyboard configuration  Figure 1b : Dual contact form keyboard configuration  Figure 1c : Electronic signal input keyboard configuration
OSCI OSCO	Oscillator input & Oscillator output pins. The 3.579545 MHz oscillator is formed by a built-in inverter inside of this chip and by connecting a 3.579545 MHz crystal or a ceramic resonator across the OSCI and OSCO pins. (built-in feedback resistor and capacitor) When HKS is "low", a valid key-in may turn on this oscillator and generates a 3.579545 MHz clock.
$\overline{XMUTE}$	Mute output pins. NMOS open drain output structure. The output is in "low" state during dialing sequence (both Pulse and Tone mode) otherwise this pin is "high-impedance". Long (continue) Mute.
V_{SS}	Negative power supply pin.
V_{DD}	Positive power supply pin.
$\overline{HKS}$	Hook switch input pin. When the handset is in ON-HOOK state, this pin must be pulled "high" in order to disable the dialing operation and decrease the power consumption. When in OFF-HOOK state, the HKS pin must be pulled "low" state for all function operation.
$\overline{PO}$	Pulse output signal pin. NMOS open drain output structure. The output is "low" during pulse dialing and Flash operation, otherwise this output is "floating".

Symbol	Function
TONE	Dual Tone Multi-frequency output pin. In TONE mode, when a entry of digit key (include * , # key), this pin will sent out a corresponding DTMF signal. The TONE pin provides minimum tone duration (t_{TD}), & minimum intertone pause time to support rapid key-in. If key-in time is less than t_{TD} , DTMF signal will last for t_{TD} , otherwise the tone duration will last as long as the key is pressed.
$\overline{\text{HFI}}$	Handfree input control pin. Toggle input sturcture, falling edge trigger. It is used to enable and disable Handfree function. With waveshaped by a built-in Schmit trigger, the bounce of input can be eliminated by external R, C debounce circuit. A built-in pull up resistor is 200K typical.
HFO	Handfree output pin. Inverter output structure (normally "low", active "high"). When a HFI pin is active, Handfree function will be enabled (HFO=1) or disabled (HFO=0). When the Handfree function is enable (HFO=1), after OFF-HOOK action, it can reset Handfree function and HFO pin return to "low" state.

FUNCTION DESCRIPTION

Keyboard Operation

Symbol definitions:

- a). $\uparrow$: OFF-HOOK or enable Hand Free function.
- b). $\downarrow$: ON-HOOK or disable Hand Free function.
- c). $D_1 \dots D_n$: Digit key; 1,2,3,4,5,6,7,8,9,0,*,# ($C_1 \dots C_n$ is same as $D_1 \dots D_n$).
- d). $D_{p1} \dots D_{pn}$: Pulse digit ; 1,2,3,4,5,6,7,8,9,0, ($C_{p1} \dots C_{pn}$ is same as $D_{p1} \dots D_{pn}$).
- e). $D_{t1} \dots D_{tn}$: Tone digit ; 1,2,3,4,5,6,7,8,9,0,*, # ($C_{t1} \dots C_{tn}$ is same as $D_{t1} \dots D_{tn}$).
- f). t_F : Flash time.
- g). t_p : Pause time.
- h). t_{PT} : Pulse to Tone wait time.
- i). t_{FP} : Pause time for flash.
- j). t_{RP} : Pause time for redial.
- k). LNB : Last number redial buffer.

A. Normal Dialing

1. Digit Dialing

- Procedure : $\uparrow D1, D2 \dots \dots, Dn \downarrow$
- Dial out : $Dt1, Dt2 \dots \dots, Dtn$ in tone mode
- Dial out : $Dp1, Dp2 \dots \dots, Dpn$ in pulse mode
- LNB : $D1, D2 \dots \dots Dn$

2. Dialing with flash key

Procedure : $\uparrow F, D1, D2 \dots \dots, Dn \downarrow$
Dial out : $t_F, Dt1, Dt1 \dots \dots, Dtn$ in tone mode
Dial out : $t_F, Dp1, Dp1 \dots \dots, Dpn$ in pulse mode
LNB : $D1, D2 \dots \dots Dn$

3. Dialing with P $\rightarrow$ T key

Procedure : $\uparrow D1, D2 \dots \dots, P \rightarrow T, \dots \dots, Dn \downarrow$
Dial out : $Dp1, Dp2, \dots t_{PT}, \dots \dots, Dtn$ in pulse mode
LNB : $D1, D2 \dots \dots, P \rightarrow T, \dots \dots Dn$
Note : If key in digit over maximum digit stored in LNB, then RD is inhibited even after on/off hook.

B. Mixed dialing

Procedure : $\uparrow D1, D2 \dots \dots, P \rightarrow T, D9, D10, \dots \dots, Dn \downarrow$
Dial out : $Dp1, Dp2, \dots t_{PT}, Dt9, Dt10 \dots \dots, Dtn$
LNB : $D1, D2 \dots \dots, P \rightarrow T, D9, D10 \dots \dots Dn$

C. Redial

LNB : $D1, D2 \dots \dots Dn$
Procedure : $\uparrow RD \downarrow$
Dial out : $Dt1, Dt2, \dots \dots Dtn$ in tone mode
Dial out : $Dp1, Dp2, \dots \dots Dpn$ in pulse mode
Note : If key in digit over maximum digit stored in LNB, then RD is inhibited.

D. Pause Function

Procedure : $\uparrow D1, D2, \dots \dots Dn, P, C1 \dots \dots Cn \downarrow$
Dial out : $Dt1, Dt2, \dots \dots Dtn, t_P, Ct1 \dots \dots \dots Ctn$ in tone mode
Dial out : $Dp1, Dp2, \dots \dots Dpn, t_P, Cp1 \dots \dots \dots Cpn$ in pulse mode
LNB : $D1, D2 \dots \dots Dn, P, C1, C2 \dots \dots \dots Cn$

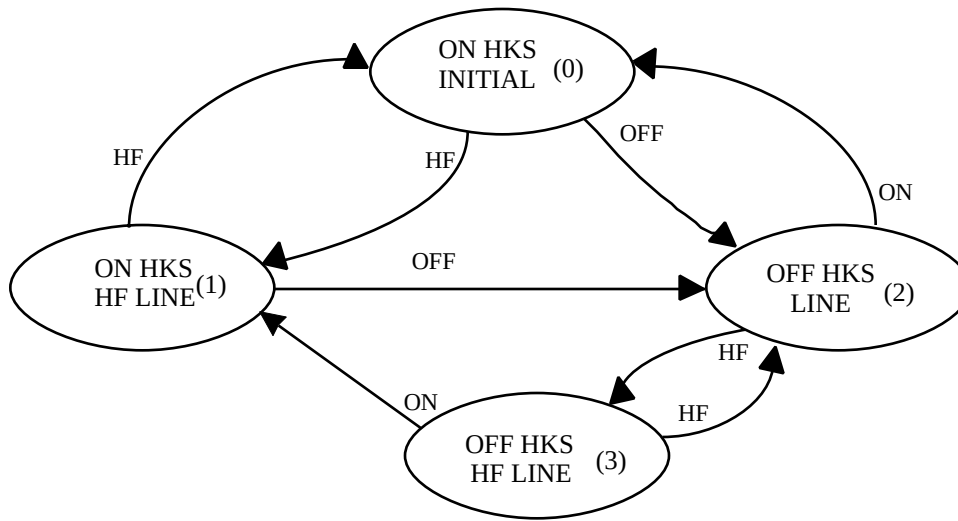
E. Flash Function

1. Reset
Procedure : $\uparrow D1, D2, \dots \dots Dn, F, C1 \dots \dots Cn \downarrow$
Dial out : $Dt1, Dt2, \dots \dots Dtn, t_F, Ct1 \dots \dots \dots Ctn$ in tone mode
Dial out : $Dp1, Dp2, \dots \dots Dpn, t_F, Cp1 \dots \dots \dots Cpn$ in pulse mode
LNB : $C1, C2 \dots \dots Cn$

Handfree function operation:

- A). To execute Handfree function : When HFO = "low", $\overline{HFI}$ pin is active , the Handfree function will be enabled (HFO="HIGH").
B). Reset Handfree function:
a. OFF-HOOK action.
b. When HFO="high", a $\overline{HFI}$ pin is active again , the Handfree function will be reset (HFO="LOW").

Operating flow chart of Handfree

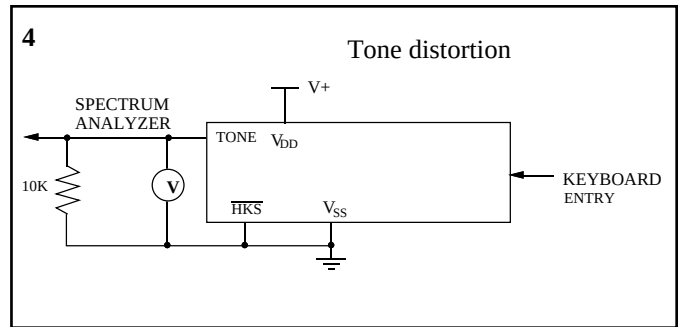
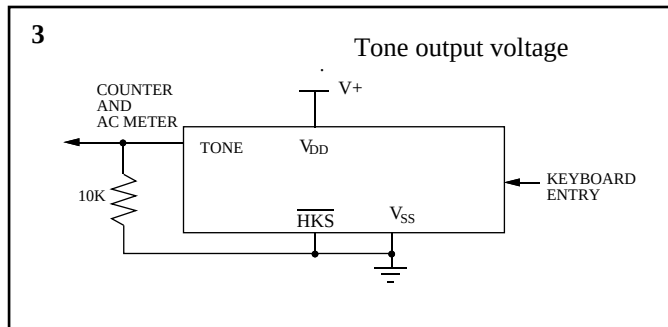
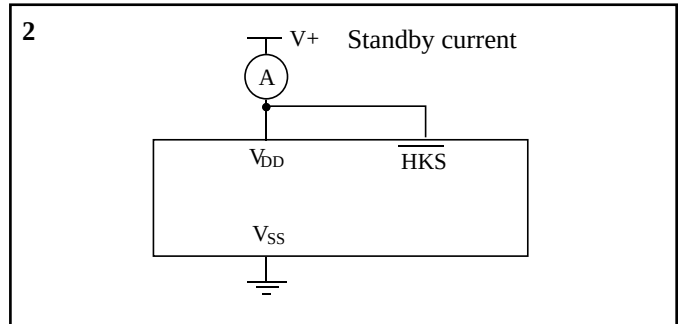
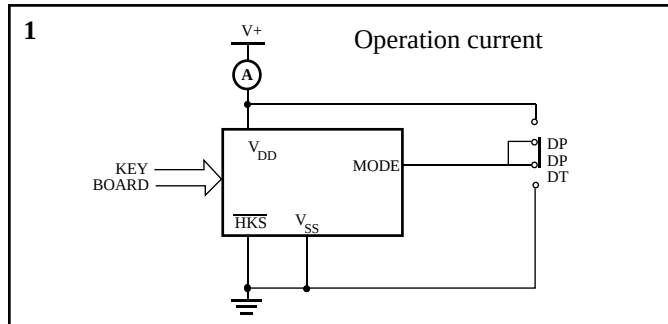


STATE NO.	$\overline{PO}$	$\overline{XMUTE}$	HFO
(0) INITIAL STATE	F	F	0
(1) ON HKS HF LINE	F	F	1
(2) OFF HKS LINE	F	F	0
(3) OFF HKS HF LINE	F	F	1

* F : Floating (Hi-impedance)

* Note :
ON : ON HKS
OFF : OFF HKS
HF : Pressed HF key

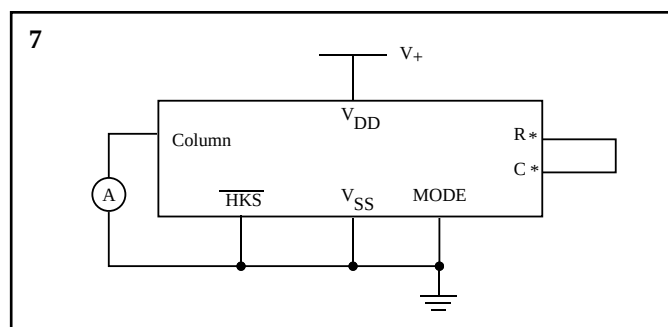
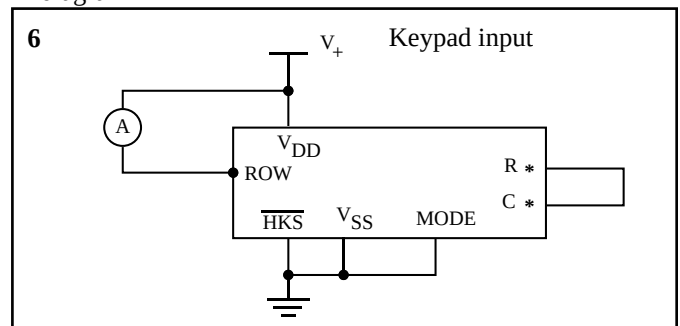
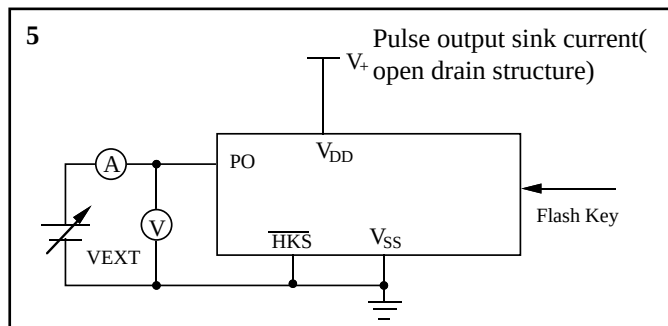
TEST CIRCUIT



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$$\text{DIST. (dB)} = 20 \log \frac{\sqrt{(V1)^2 + (V2)^2 + \dots + (Vn)^2}}{\sqrt{(VL)^2 + (VH)^2}}$$

- V1....Vn are extraneous frequencies (ie, inter modulation and harmonic) components in the 500Hz to 3400Hz band.
- VL, VH are the individual frequency components of the DTMF signal
- Whether keyboard is pushed refer to the TONE mode time diagram



$I_{\text{sink}} = I / (1 - \text{Duty Cycle})$ I is the net DC current measured from ampere meter.

R*, C* mean others column and row.

ABSOLUTE MAXIMUM RATINGS (Ambient Temperature is 25°C, All voltage referenced to V_{SS} .)

Parameter	Sym.	Ratings	Unit
Power Supply Voltage	V_{DD}	6.0	V
Input Voltage Range	V_{IN}	$-0.3 \sim V_{DD} + 0.3$	V
Operating Temperature	T_{OPR}	0 ~ 50	°C
Storage Temperature	T_{STO}	-55 ~ 125	°C
Power Dissipation	P_D	500	mw

ELECTRICAL CHARACTERISTICS (I) (Ambient Temperature is 25°C, All voltage referenced to V_{SS} , $V_{DD} = 2.5V$, unless otherwise noted.)

(General purpose specification, fosc. = 3.579545 MHz)

Parameter	Sym.	Conditions	Min.	Typ.	Max.	Unit
Operating Voltage	V_{DD}	Tone	2.5	-	5.5	V
		Pulse	2.0	-	5.5	
		Memory retension	1.0	-	5.5	
Operating Current	I_{op}	Tone OFF-HOOK, Keypad entry	-	0.6	2	mA
		Pulse	-	0.2	0.5	mA
Standby Current	I_s	ON-HOOK, No Keypad entry	-	0.1	1	μA
Memory retention current	I_{mr}	ON-HOOK, $V_{DD} = 1.0V$	-	0.1	0.2	μA
Control pin input voltage	V_{il}		V_{SS}	-	$0.3V_{DD}$	V
	V_{ih}		$0.7V_{DD}$	-	V_{DD}	V
XMUTE pin leakage current sink current	I_{mth}	$\overline{V_{xmute}} = 6.0V$	-	-	1	μA
	I_{mtl}	$V_{xmute} = 0.5V$	0.2	0.5	-	mA
HKS pin input current	I_{hks}	$V_{hks} = 2.5V$	-	-	0.1	μA
Keyboard scanning pin drive current sink current	I_{kbd}	* $V_n = 0V$,	4	10	30	μA
	I_{kbs}	* $V_n = 2.5V$,	200	400	800	μA
Key-in debounce time	t_{DB}		-	20	-	ms
HFI pin input resistor	R_{hfi}	$V_{hfi} = 0$	-	200	-	KΩ
HFO pin drive current sink current	I_{hdoh}	$V_{hfo} = 2.0V$	0.5	-	-	mA
	I_{hdol}	$V_{hfo} = 0.5V$	0.5	-	-	mA

 * V_n : Input voltage of any keyboard scanning pin (Row group, Column group).

ELECTRICAL CHARACTERISTICS (II) (Ambient Temperature is 25°C, All voltage referenced to V_{SS} , $V_{DD} = 2.5V$, unless otherwise noted.)

(Pulse mode specification, $f_{osc} = 3.579545$ MHz)

Parameter	Sym.	Conditions	Min.	Typ.	Max.	Unit
Pulse output pin, SDO pin leakage current sink current	Ipoh	$V_{po} = 2.5V$	-	-	0.1	uA
	Ipol	$V_{po} = 0.5V$	0.5	-	-	mA
Pulse rate	fpr		-	10	-	pps
			-	20	-	pps
Make/Break ratio	TM:TB		-	40:60	-	%
			-	33:66	-	%
Pre-digit Pause	t_{PDP}	M/B ratio = 40:60	-	40	-	ms
		M/B ratio = 33:66	-	33	-	ms
Inter-digit Pause	t_{IDP}	Pulse rate = 10pps	-	800	-	ms
		Pulse rate = 20pps	-	500	-	ms

ELECTRICAL CHARACTERISTICS (III) (Ambient Temperature is 25°C, All voltage referenced to V_{SS} , $V_{DD} = 2.5V$, unless otherwise noted.)

(TONE mode specification, $f_{osc} = 3.579545$ MHz)

Parameter	Sym.	Conditions	Min.	Typ.	Max.	Unit
TONE output pin DC level sink current	Vdc	$V_{DD} = 2.0V \sim 5.5V$	$0.5V_{DD}$	-	$0.7V_{DD}$	V
	Itl	Vdtmf = 0.5V	0.2	-	-	mA
AC level	Vdtmf	Row group, $R_L = 10K\Omega$	130	155	170	mVrms
Load resistor	RL	Dist. $\leq -23dB$	10	-	-	K Ω
DTMF signal: pre-emphasis *distortion	twist	$V_{DD} = 2.0 \sim 5.5V$, Column-Row group	1	2	3	dB
	Dist.	$R_L = 10K\Omega$	-	-30	-23	dB
Minimum tone duration	t_{TD}	Auto redial	-	98/83	-	ms
Minimum intertone pause	t_{ITP}	Auto redial	-	98/83	-	ms

* Distortion (dB) = $20 \log \{ [(V_1^2 + V_2^2 + V_3^2 + \dots + V_n^2)^{1/2}] / [(V_L^2 + V_H^2)^{1/2}] \}$.

 V_L, V_H : Row group and Column group signal.

 $V_1, V_2, \dots, V_n$: Harmonic signal (BW = 300 Hz ~ 3500 Hz).

* **Actual frequency output ($f_{osc} = 3.579545$ MHz)**

KEYBOARD SCANNING PIN		STANDARD (Hz)	OUTPUT (Hz)	DEVIATION (%)
R1	f1	697	699	+0.28
R2	f2	770	766	-0.52
R3	f3	852	848	-0.47
R4	f4	941	948	+0.74
C1	f5	1209	1216	+0.57
C2	f6	1336	1332	-0.30
C3	f7	1477	1472	-0.34

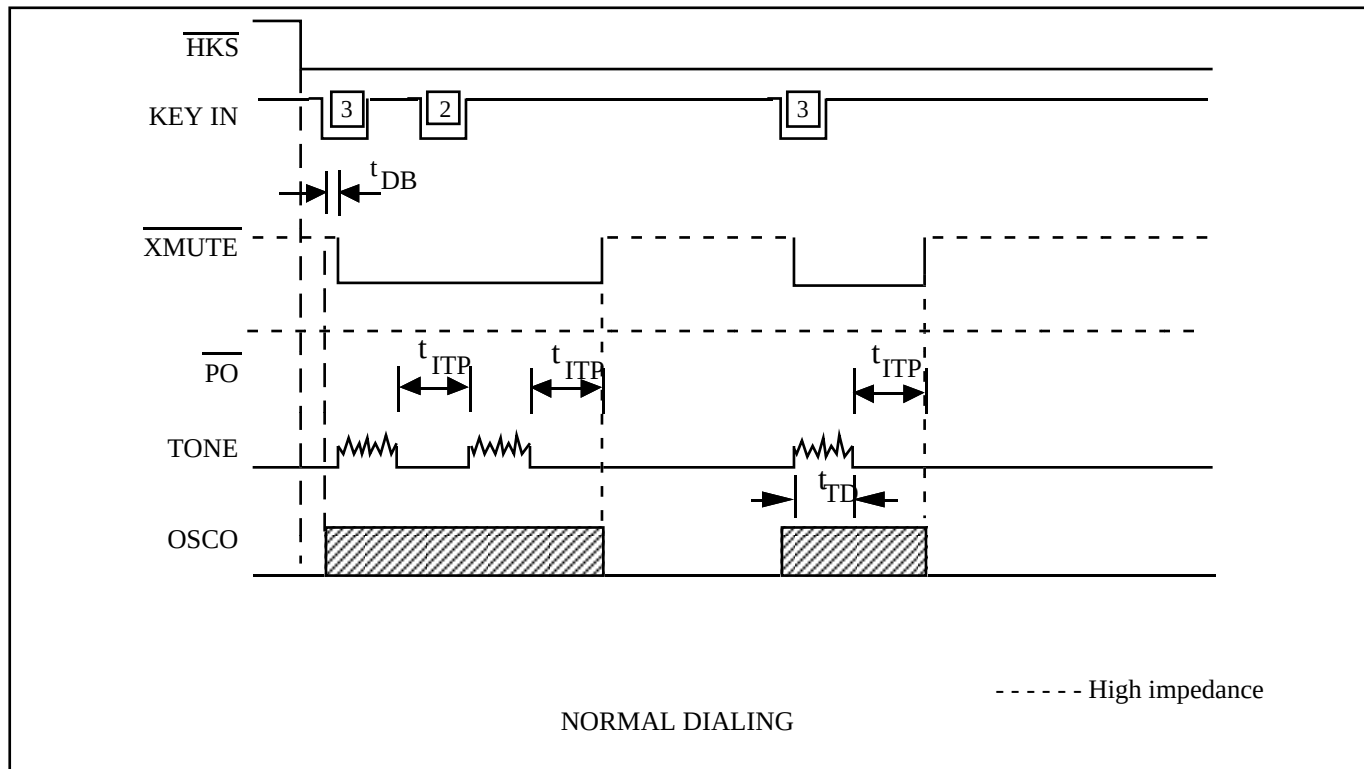


Figure 2: Tone Mode Timing Diagram

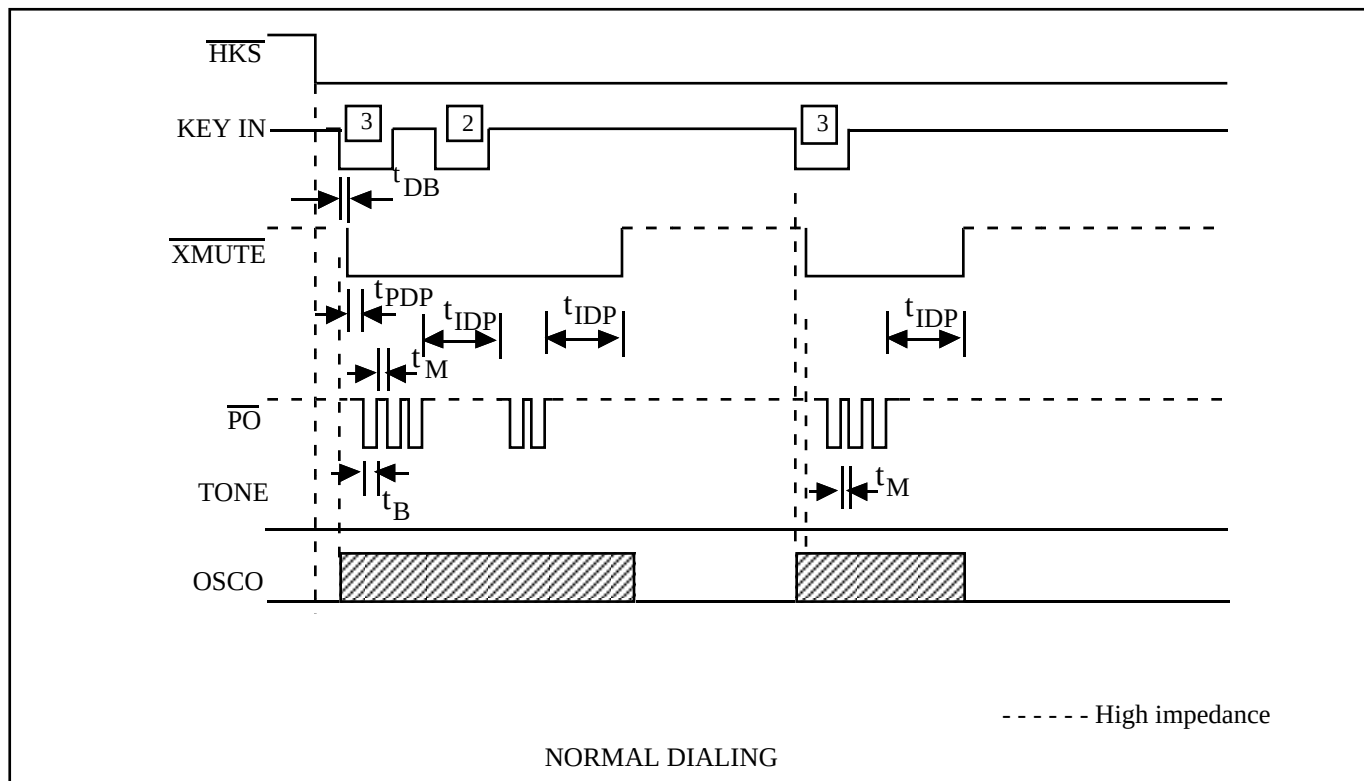


Figure 3: Pulse Mode Timing Diagram

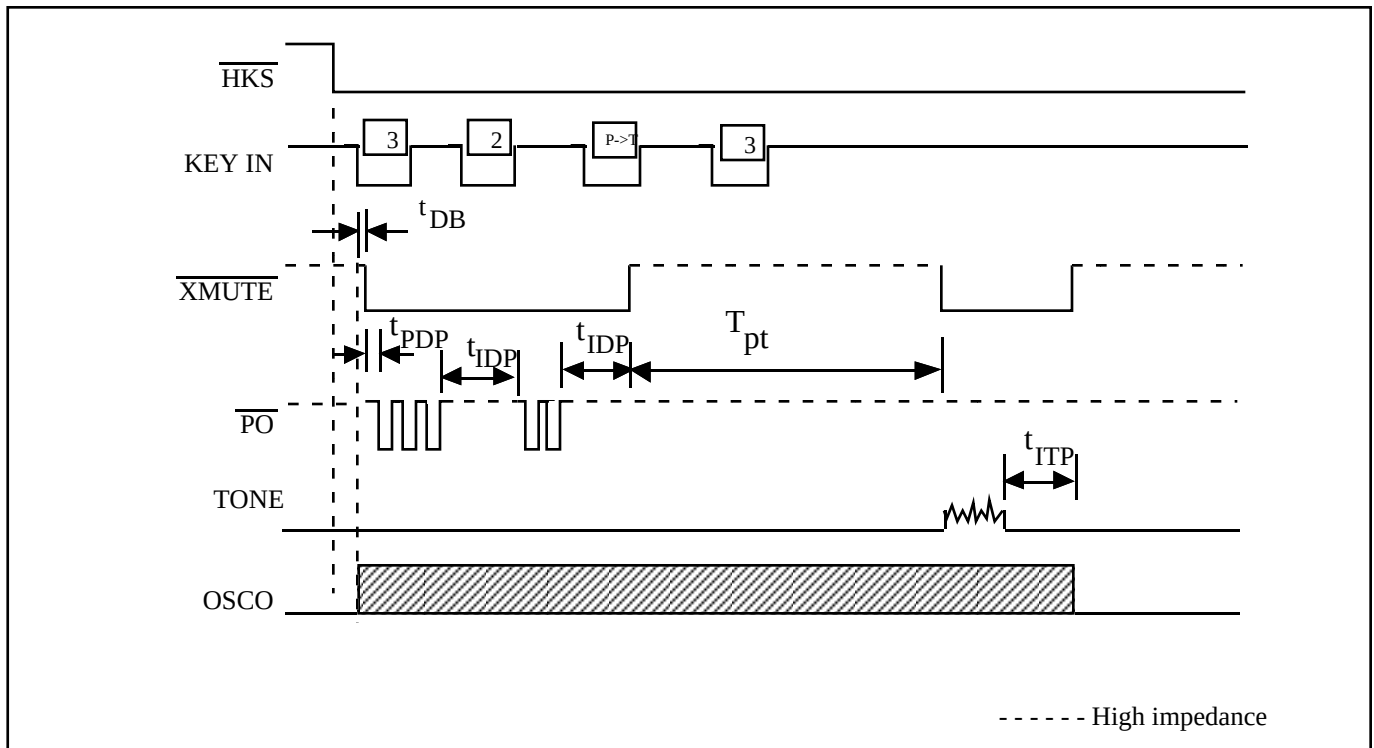


Figure 4: Timing Waveform for mixed dialing Operation (by P→T key entry)

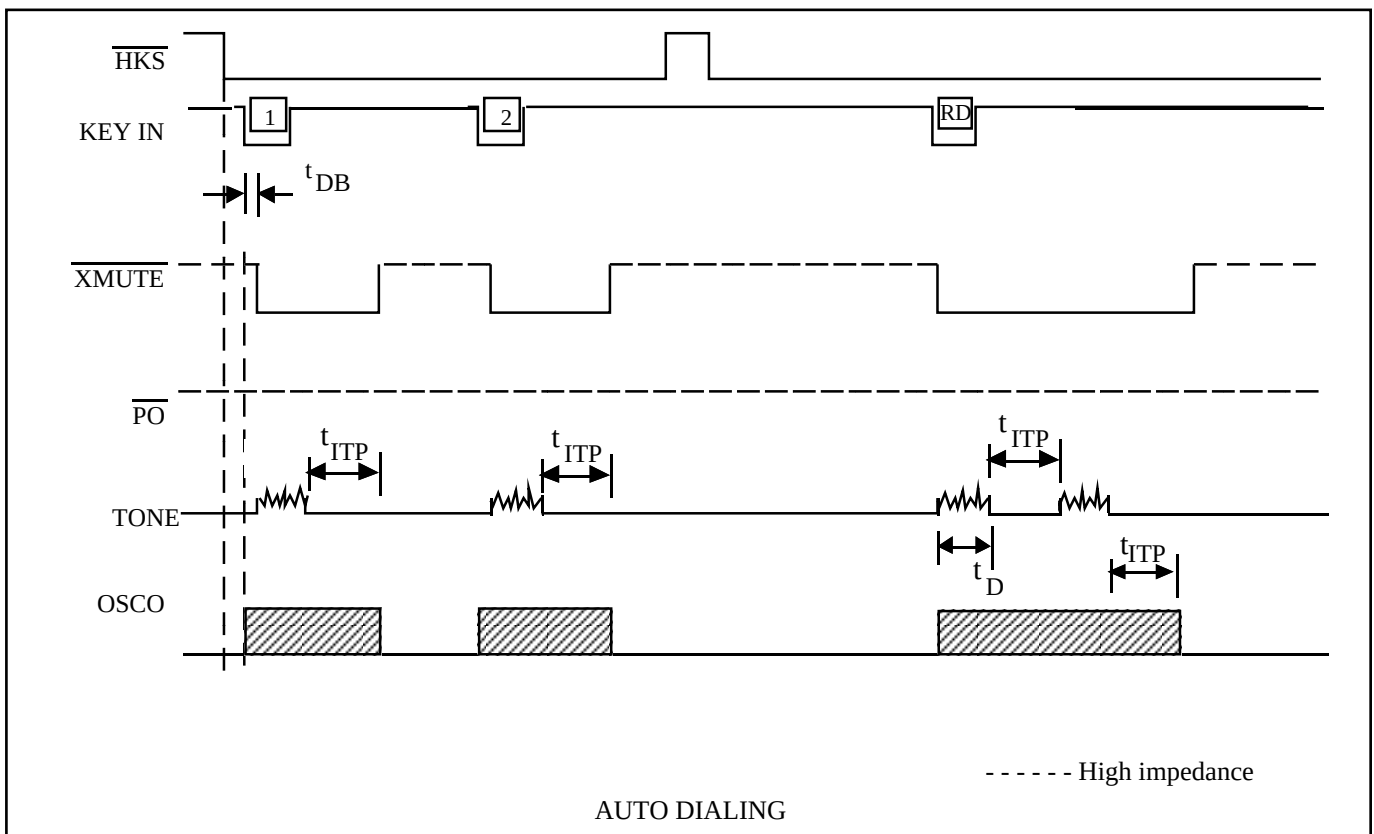


Figure 5: Tone Mode Redial Timing Diagram

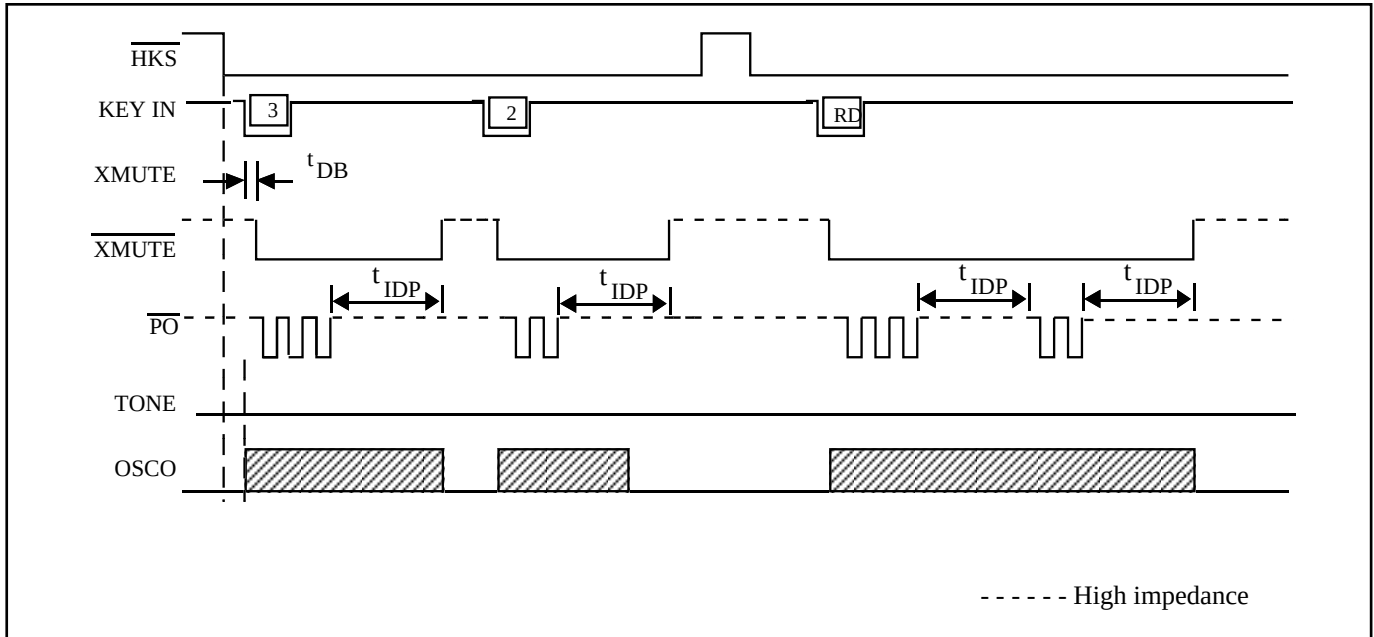


Figure 6: Pulse Mode Redial Timing Diagram

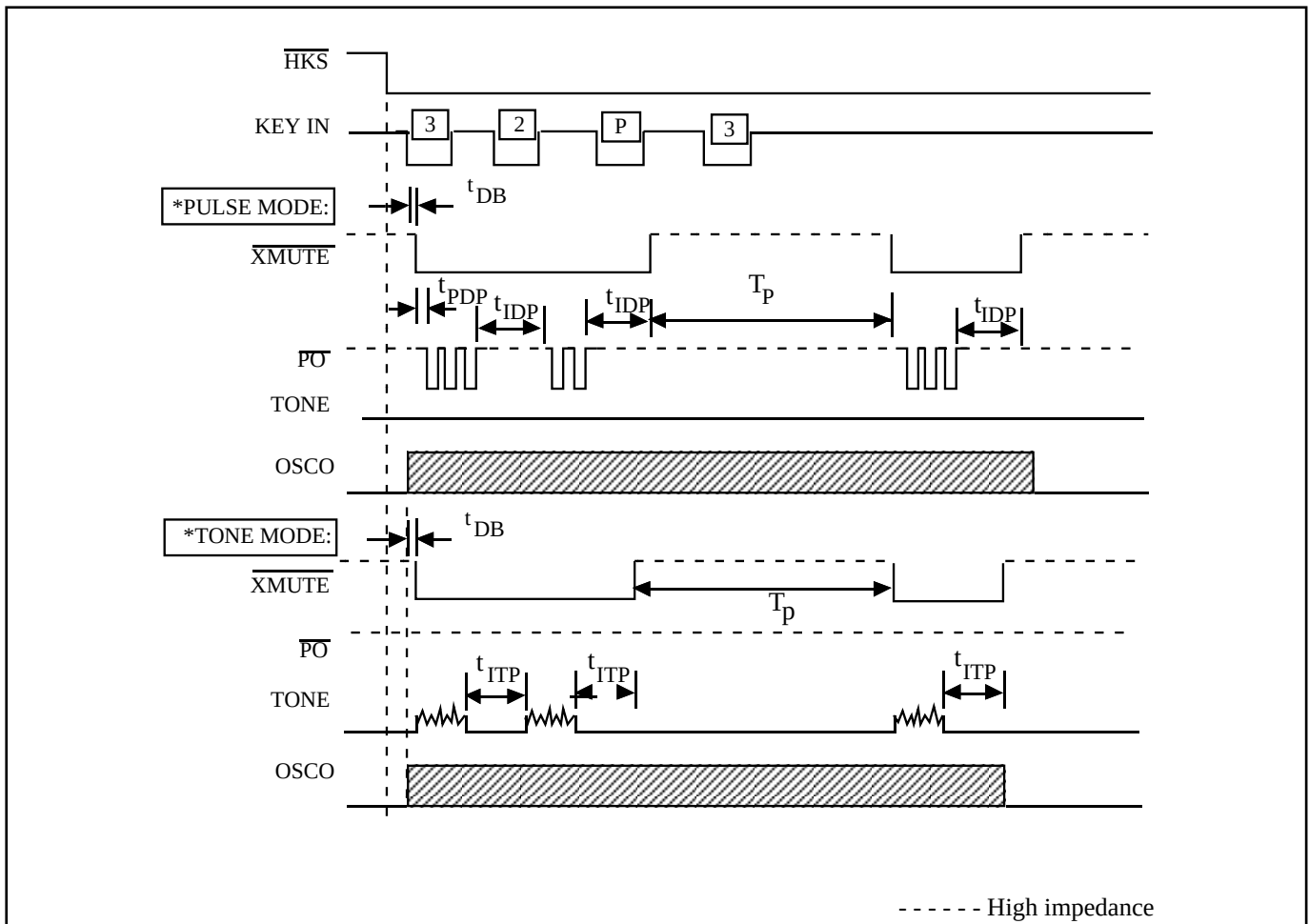


Figure 7: Pause key operating timing

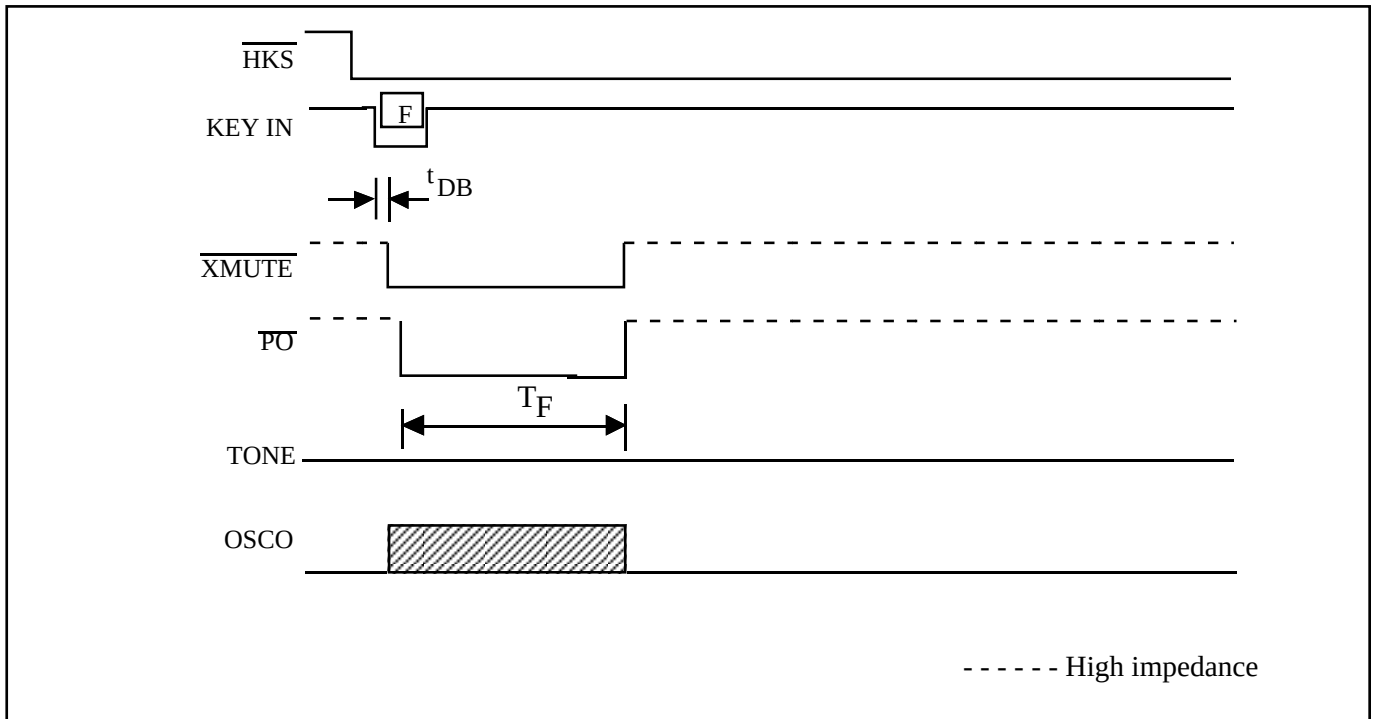
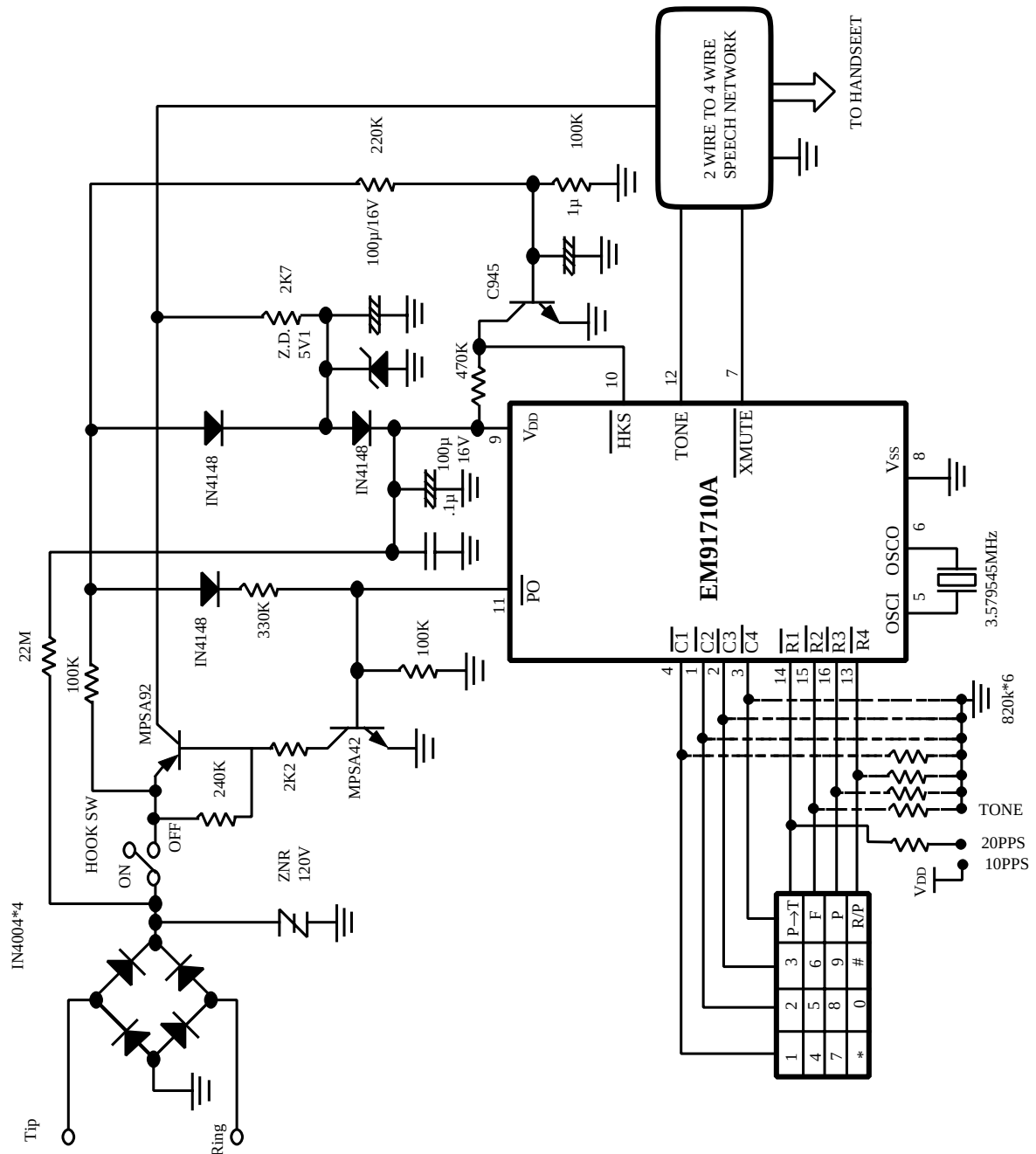


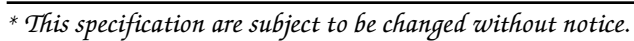
Figure 8: Flash key operation timing

APPLICATION CIRCUIT

EM91710A Application Example



EM91710B Application Example



PACKAGE INFORMATION

Example :

EM 91710 P
(1) (2) (3)

(1) ELAN MICRO. pefix

(2) Type number

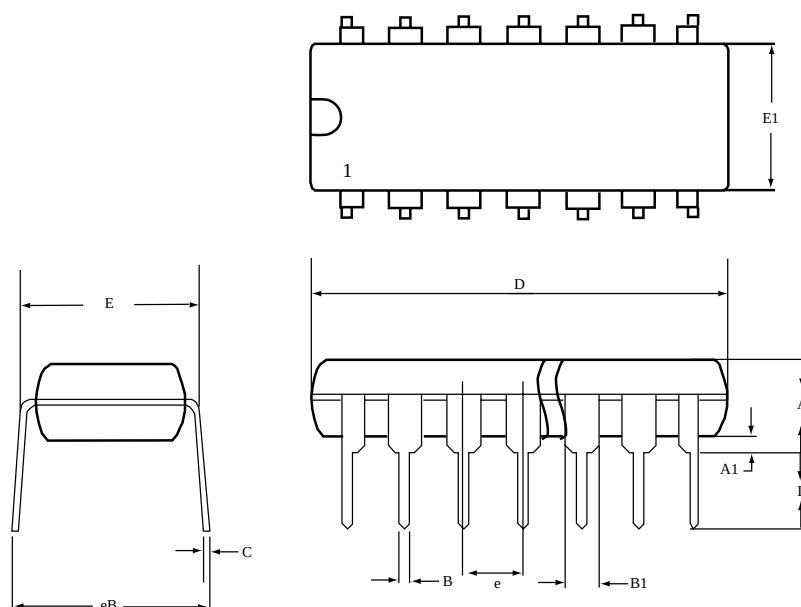
(3) Package code:

P→PDIP

K→Skinny

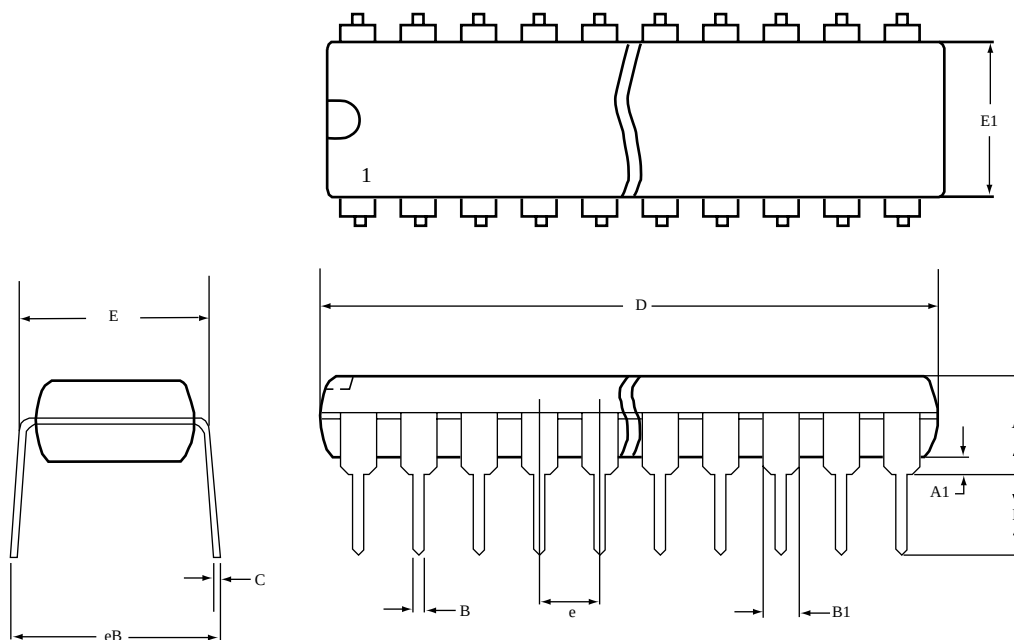
R→SDIP

16 Lead Plastic Package



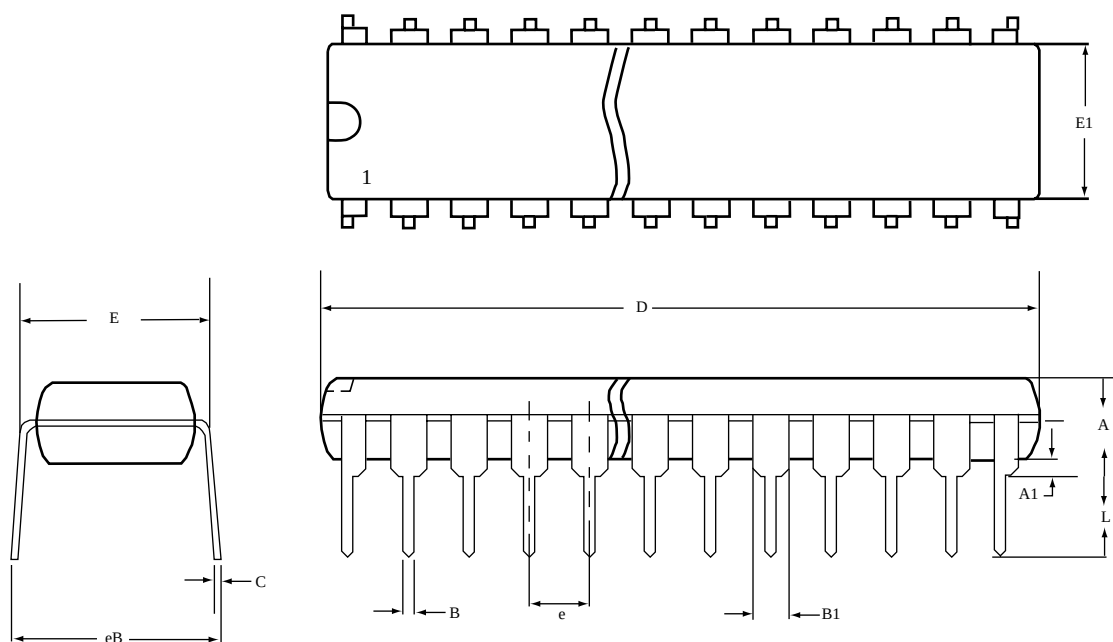
16 PDIP				
DIM	MILIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A	-	5.334	-	.210
A1	0.381	-	.015	-
B	0.356	0.558	.014	.022
B1	1.150	1.778	.045	.070
C	0.204	0.381	.008	.015
D	19.05	20.07	.750	.790
E	7.620	8.255	.300	.325
E1	6.096	7.112	.240	.280
e	2.286	2.794	.090	.110
eB	-	10.92	-	.430
L	2.921	4.064	.115	.160

18/20/28 Lead Plastic Package



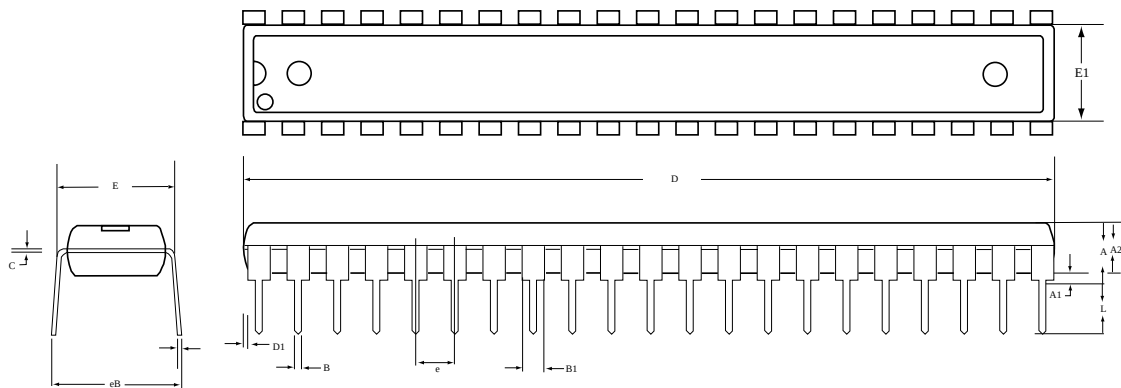
18 PDIP					20 PDIP					28 PDIP				
DIM	MILIMETERS		INCHES		DIM	MILIMETERS		INCHES		DIM	MILIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.		MIN.	MAX.	MIN.	MAX.		MIN.	MAX.	MIN.	MAX.
A	-	5.334	-	.210	A	-	5.334	-	.210	A	-	6.350	-	.250
A1	0.381	-	.015	-	A1	0.381	-	.015	-	A1	0.381	-	.015	-
B	0.356	0.558	.014	.022	B	0.356	0.558	.014	.022	B	0.356	0.558	.014	.022
B1	1.150	1.778	.045	.070	B1	1.150	1.778	.045	.070	B1	1.016	1.778	.040	.070
C	0.204	0.381	.008	.015	C	0.204	0.381	.008	.015	C	0.204	0.381	.008	.015
D	22.35	23.37	.880	.920	D	25.40	26.67	1.000	1.050	D	35.56	37.85	1.400	1.490
E	7.620	8.255	.300	.325	E	7.620	8.255	.300	.325	E	15.24	15.88	.600	.625
E1	6.096	7.112	.240	.280	E1	6.096	7.112	.240	.280	E1	13.21	14.73	.520	.580
e	2.286	2.794	.090	.110	e	2.286	2.794	.090	.110	e	2.286	2.794	.090	.110
eB	-	10.92	-	.430	eB	-	10.92	-	.430	eB	-	17.78	-	.700
L	2.921	4.064	.115	.160	L	2.921	4.064	.115	.160	L	2.921	5.080	.115	.200

22/24 Lead Plastic Package-Skinny



22 PDIP (skinny)					24 PDIP (skinny)				
DIM	MILIMETERS		INCHES		DIM	MILIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.		MIN.	MAX.	MIN.	MAX.
A	-	4.752	-	.180	A	-	4.572	-	.180
A1	0.381	-	.015	-	A1	0.381	-	.015	-
B	0.356	0.558	.014	.022	B	0.356	0.558	.014	.022
B1	1.27	1.778	.050	.070	B1	1.27	1.778	.050	.070
C	0.204	3.556	.008	.014	C	0.204	0.381	.008	.015
D	25.90	26.67	1.02	1.05	D	31.24	32.26	1.23	1.270
E	7.620	8.255	.300	.325	E	7.620	8.255	.300	.325
E1	6.223	6.604	.245	.260	E1	6.223	6.731	.245	.265
e	2.286	2.794	.090	.110	e	2.286	2.794	.090	.110
eB	8.382	10.16	.330	.400	eB	8.636	9.652	.340	.380
L	2.921	4.064	.115	.160	L	2.921	4.064	.115	.160

42 SDIP Package



42 SDIP				
DIM	MILIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A	-	5.08	-	0.200
A1	0.381	-	0.015	-
A2	3.937	4.191	0.155	0.165
B	0.356	0.559	0.014	0.022
B1	0.914	1.116	0.036	0.044
C	0.204	0.304	0.008	0.012
D	36.70	37.34	1.445	1.470
E1	13.84	14.10	0.545	0.555
e	1.727	1.829	0.068	0.072
eB	15.24	17.78	0.600	0.70
D1	0	0.127	0	0.005
L	2.921	3.429	0.115	0.135