

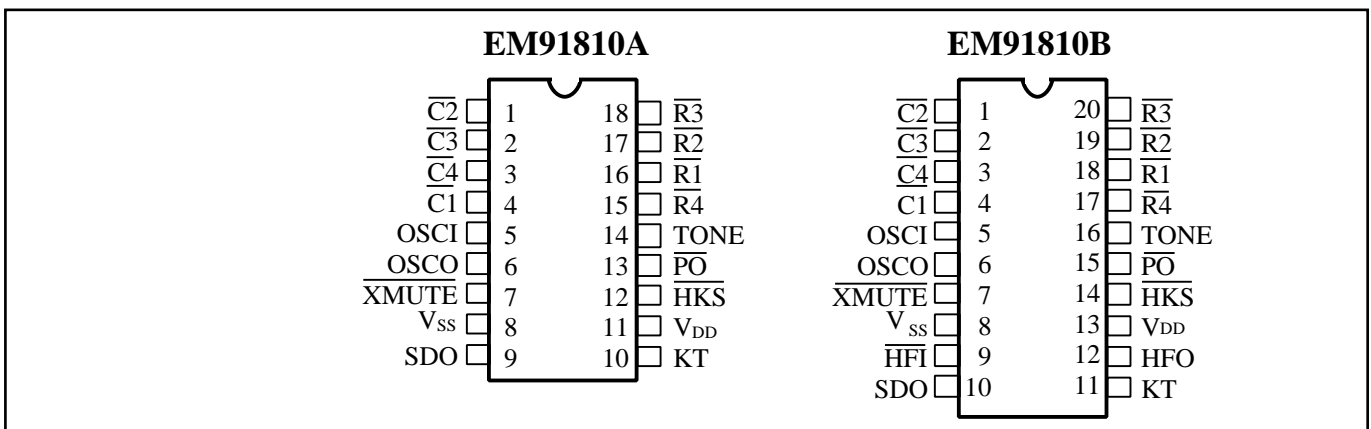
## GENERAL DESCRIPTION

The EM91810A/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. EM91810A/B also provide SDO (serial data output) function to drive LCD driver (EM32100, EM32116, EM32117) and voice synthesizer.

## 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 DIP20.
- SDO function that is supported to drive LCD driver (EM32100) and voice synthesizer to indicate dialing number.
- Key tone function is provided.

## PIN ASSIGNMENTS

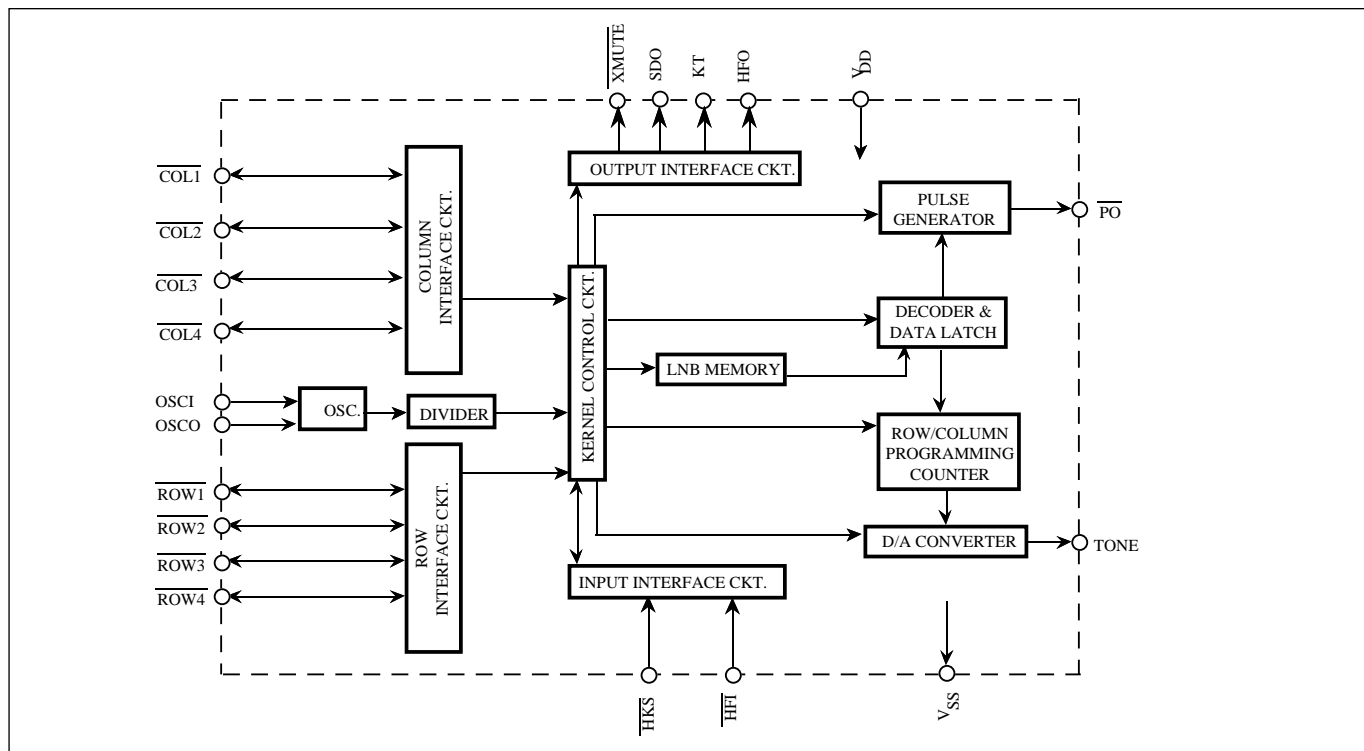


**KEYBOARD ASSIGNMENT**

	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
$\overline{C1}$ $\overline{C2}$ $\overline{C3}$ $\overline{C4}$  $\overline{R1}$ $\overline{R2}$ $\overline{R3}$ $\overline{R4}$	<p>Provides keyboard scanning .</p> <p><b>a. Keyboard scanning:</b></p> <p>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 &amp; Column connection or by electronic input; (as show in Figure 1c).</p> <p>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.)</p> <div style="text-align: center;"> <p>Figure 1a : Single contact form keyboard configuration</p> </div> <div style="text-align: center;"> <p>Figure 1b : Dual contact form keyboard configuration</p> </div> <div style="text-align: center;"> <p>Figure 1c : Electronic signal input keyboard configuration</p> </div>
OSCI OSCO	<p>Oscillator input &amp; Oscillator output pins.</p> <p>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)</p> <p>When HKS is "low", a valid key-in may turn on this oscillator and generates a 3.579545 MHz clock.</p>
$\overline{XMUTE}$	<p>Mute output pins.</p> <p>NMOS open drain output structure.</p> <p>The output is in "low" state during dialing sequence (both Pulse and Tone mode) otherwise this pin is "high-impedance".</p> <p>Long (continue) Mute.</p>
$V_{SS}$	Negative power supply pin.
$V_{DD}$	Positive power supply pin.
HKS	<p>Hook switch input pin.</p> <p>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.</p> <p>When in OFF-HOOK state, the HKS pin must be pulled "low" state for all function operation.</p>
$\overline{PO}$	<p>Pulse output signal pin.</p> <p>NMOS open drain output structure.</p> <p>The output is "low" during pulse dialing and Flash operation, otherwise this output is "floating".</p>

Symbol	Function
TONE	<p>Dual Tone Multi-frequency output pin.</p> <p>In TONE mode, when a entry of digit key (include * , # key), this pin will sent out a corresponding DTMF signal.</p> <p>The TONE pin provides minimum tone duration (<math>t_{TD}</math>), &amp; minimum intertone pause time to support rapid key-in. If key-in time is less than <math>t_{TD}</math> , DTMF signal will last for <math>t_{TD}</math> , otherwise the tone duration will last as long as the key is pressed.</p>
HFI	<p>Handfree input control pin.</p> <p>Toggle input sturcture, falling edge trigger.</p> <p>It is used to enable and disable Handfree function.</p> <p>With waveshaped by a built-in Schmit trigger, the bounce of input can be eliminated by external R, C debounce circuit.</p> <p>A built-in pull up resistor is 200K typical.</p>
HFO	<p>Handfree output pin.</p> <p>Inverter output structure (normally "low", active "high").</p> <p>When a HFI pin is active, Handfree function will be enabled (HFO=1) or disabled (HFO=0).</p> <p>When the Handfree function is enable (HFO=1), after OFF-HOOK action, it can reset Handfree function and HFO pin return to "low" state.</p>
SDO	<p>Serial data output pin.</p> <p>NMOS open drain output structure.</p> <p>When there is a valid entry on keyboard, this pin will output a serial data.</p> <p>This serial data is designed to drive LCD driver to display dialing number on LCD screen or drive voice synthesizer to announce dialing number to speaker.</p>
KT	<p>Key tone output pin for key pad input. The key tone duration is the same as the key pressed time.</p> <p>No matter at Tone mode or pulse mode.</p> <p>Inverter output structure.</p>

## 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).  $\downarrow$  : Input level from low to high.
- d).  $\uparrow$  : Input level from high to low.
- e).  $D_1 \dots D_n$  : Digit key; 1,2,3,4,5,6,7,8,9,0,\*,# ( $C_1 \dots C_n$  is same as  $D_1 \dots D_n$ ).
- f).  $D_{P1} \dots D_{Pn}$  : Pulse digit ; 1,2,3,4,5,6,7,8,9,0, ( $C_{P1} \dots C_{Pn}$  is same as  $D_{P1} \dots D_{Pn}$ ).
- g).  $D_{t1} \dots D_{tn}$  : Tone digit ; 1,2,3,4,5,6,7,8,9,0,\*,# ( $C_{t1} \dots C_{tn}$  is same as  $D_{t1} \dots D_{tn}$ ).
- h).  $t_F$  : Flash time.
- i).  $t_P$  : Pause time.
- j).  $t_{PT}$  : Pulse to Tone wait time.
- k).  $t_{FP}$  : Pause time for flash.
- l).  $t_{RP}$  : Pause time for redial.
- m). LNB : Last number redial buffer.

## A. Normal Dialing

### 1. Digit Dialing

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

### 2. Dialing with flash key

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

### 3. Dialing with P $\rightarrow$ T key

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

## C. Redial

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

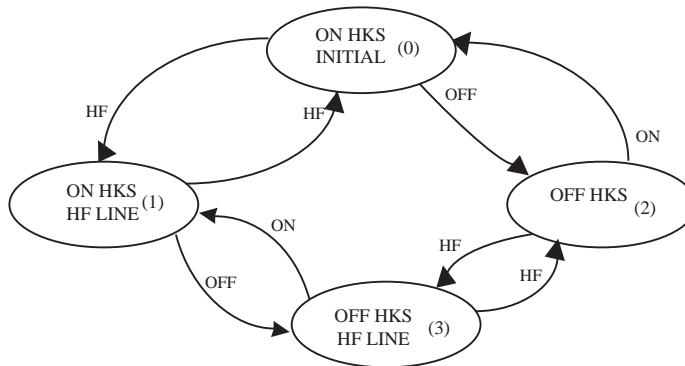
## E. Flash Function

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

**Handfree function operation:**

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

**Operating flow chart of Handfree**



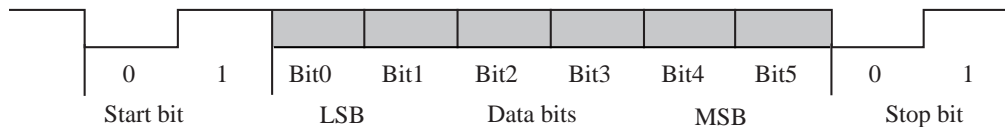
STATE NO.	$\overline{\text{PO}}$	$\overline{\text{XMUTE}}$	HFO
(0) INITIAL STATE	F	F	0
(1) ON HKS HF LINE	F	F	1
(2) OFF HKS LINE	F	F	0
(3) OFF HKS HF LINE	F	F	1

\* Note :  
ON : ON HKS  
OFF : OFF HKS  
HF : Depress HF key

\* F : Floating (Hi-impedance)

**SDO (Serial Data Output) function**

The SDO is serial data output which format is the same with UART protocol. SDO function is designed to drive LCD driver and voice synthesizer to display dialing number on LCD screen and announce it to speaker. The SDO signal consists of two start bits, six data bits and two stop bits.



The frequency of every bit is 256Hz (about 3.9 ms)

There are two categories of dialing data, and representation of serial data is as the following:

**(b5,b4=0,0) Digit key**

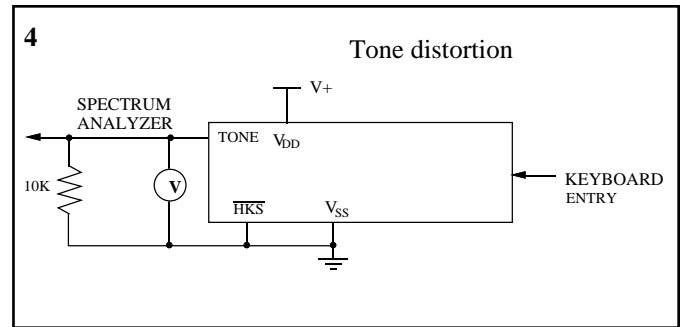
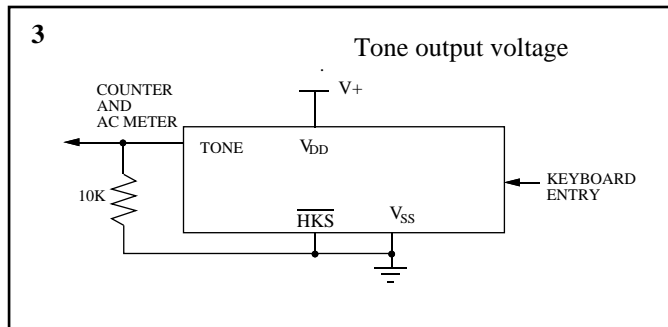
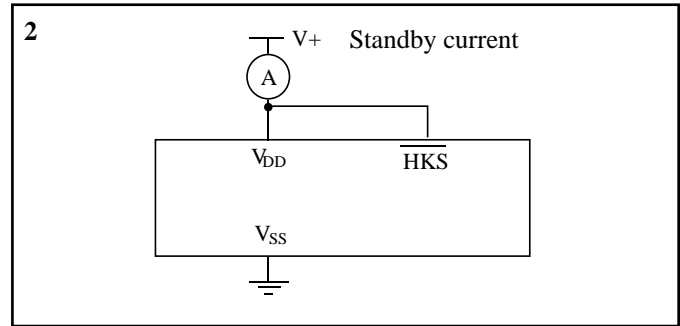
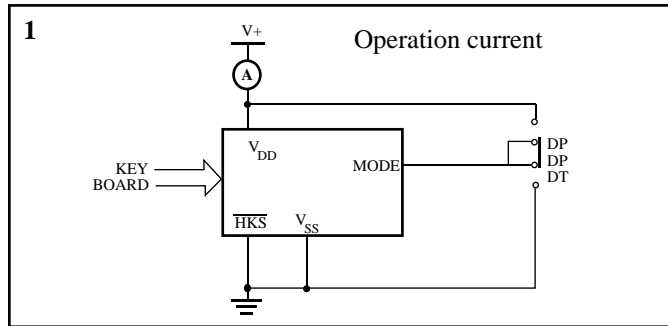
Key	1	2	3	4	5	6	7	8	9	0	*	#	P	P-T
b3b2b1b0	0001	0010	0011	0100	0101	0110	0111	1000	1001	1010	1011	1100	1101	1110
Display	1	2	3	4	5	6	7	8	9	0	└	┘	P	┘

**(b5,b4=1,0) Function key**

Key	HF	F
b3b2b1b0	1010	1111
Display		F

Note : \*/T key at pulse mode display "┘"  
at tone mode display "└"

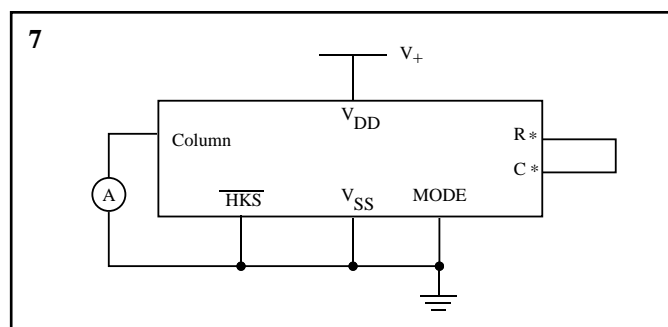
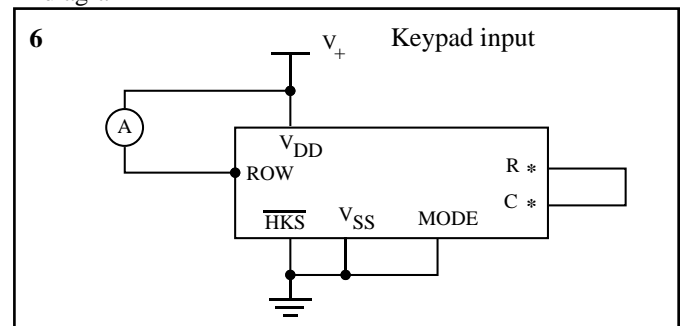
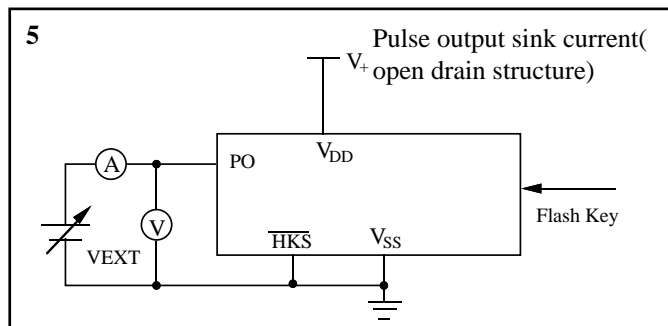
TEST CIRCUIT



\*\*

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

- a. V1....Vn are extraneous frequencies (ie, inter modulation and harmonic) components in the 500Hz to 3400Hz band.
- b. VL, VH are the individual frequency components of the DTMF signal
- c. 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 amper 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,  $f_{osc} = 3.579545$  MHz)

Parameter	Sym.	Conditions	Min.	Typ.	Max.	Unit
Operating Voltage	$V_{DD}$	Tone	2.5	-	5.5	
		Pulse	2.0	-	5.5	V
		Memory retention	1.0	-	5.5	
Operating Current	$I_{op}$	Tone	-	0.6	2	mA
		Pulse OFF-HOOK, Keypad entry	-	0.2	0.5	mA
Standby Current	$I_s$	ON-HOOK, No Keypad entry	-	0.1	1	$\mu A$
Memory retention current	$I_{mr}$	ON-HOOK, $V_{DD} = 1.0V$	-	0.1	0.2	$\mu A$
Control pin input voltage	$V_{il}$		$V_{SS}$	-	$0.3V_{DD}$	V
	$V_{ih}$		$0.7V_{DD}$	-	$V_{DD}$	V
$\overline{XMUTE}$ pin leakage current	$I_{mth}$	$\overline{V_{xmute}} = 6.0V$	-	-	1	$\mu A$
		$V_{xmute} = 0.5V$	0.2	0.5	-	mA
$\overline{HKS}$ pin input current	$I_{hks}$	$V_{hks} = 2.5V$	-	-	0.1	$\mu A$
Keyboard scanning pin drive current	$I_{kbd}$	* $V_n = 0V$ ,	4	10	30	$\mu A$
		* $V_n = 2.5V$ ,	200	400	800	$\mu A$
Key-in debounce time	$t_{DB}$		-	20	-	ms
$\overline{HFI}$ pin input resistor	$R_{hfi}$	$V_{hfi} = 0$	-	200	-	K $\Omega$
HFO pin drive current	$I_{hdoh}$	$V_{hfo} = 2.0V$	0.5	-	-	mA
		$V_{hfo} = 0.5V$	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, fosc. = 3.579545 MHz)

Parameter	Sym.	Conditions	Min.	Typ.	Max.	Unit
Pulse output pin, SDO pin leakage current sink current	I <sub>poh</sub>	V <sub>po</sub> = 2.5V	-	-	0.1	uA
	I <sub>pol</sub>	V <sub>po</sub> = 0.5V	0.5	-	-	mA
Pulse rate	f <sub>pr</sub>		-	10	-	pps
			-	20	-	pps
Make/Break ratio	TM:TB		-	40:60	-	%
			-	33:66	-	%
Pre-digit Pause	t <sub>PDP</sub>	M/B ratio = 40:60	-	40	-	ms
		M/B ratio = 33:66	-	33	-	ms
Inter-digit Pause	t <sub>IDP</sub>	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, fosc. = 3.579545 MHz)

Parameter	Sym.	Conditions	Min.	Typ.	Max.	Unit
TONE output pin DC level sink current	V <sub>dc</sub>	V <sub>DD</sub> = 2.0V~5.5V	0.5V <sub>DD</sub>	-	0.7V <sub>DD</sub>	V
	I <sub>tl</sub>	V <sub>dtmf</sub> = 0.5V	0.2	-	-	mA
AC level Load resistor	V <sub>dtmf</sub>	Row group, R <sub>L</sub> = 10KΩ	130	155	170	mV <sub>rms</sub>
	R <sub>l</sub>	Dist. ≤ -23dB	10	-	-	KΩ
DTMF signal: pre-emphasis *distortion	twist	V <sub>DD</sub> = 2.0~5.5V, Column-Row group	1	2	3	dB
	Dist.	R <sub>L</sub> = 10KΩ	-	-30	-23	dB
Minimum tone duration	t <sub>TD</sub>	Auto redial	-	98/83	-	ms
Minimum intertone pause	t <sub>ITP</sub>	Auto redial	-	98/83	-	ms

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

$V_L, V_H$ : Row group and Column group signal.

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

\* **Actual frequency output (fosc. = 3.579545 MHz)**

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

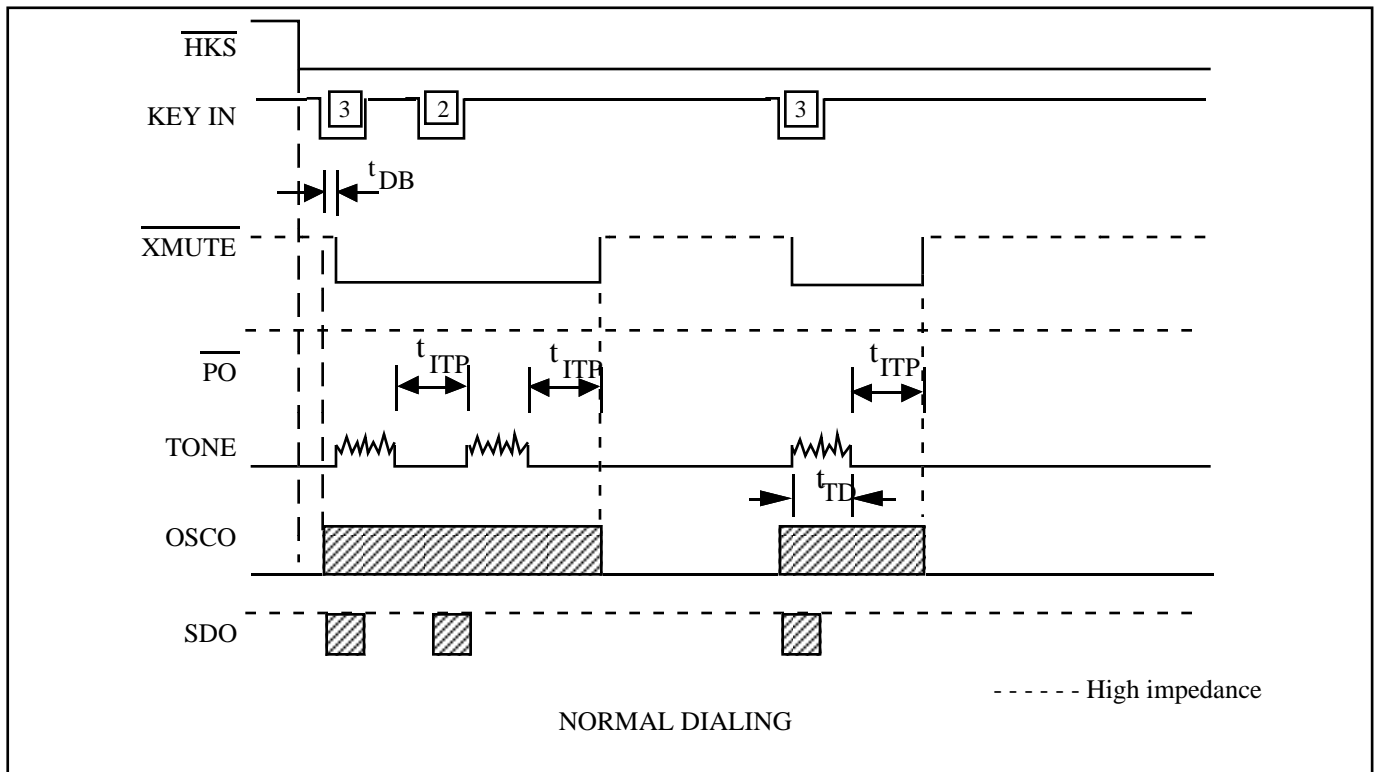


Figure 2: Tone Mode Timing Diagram

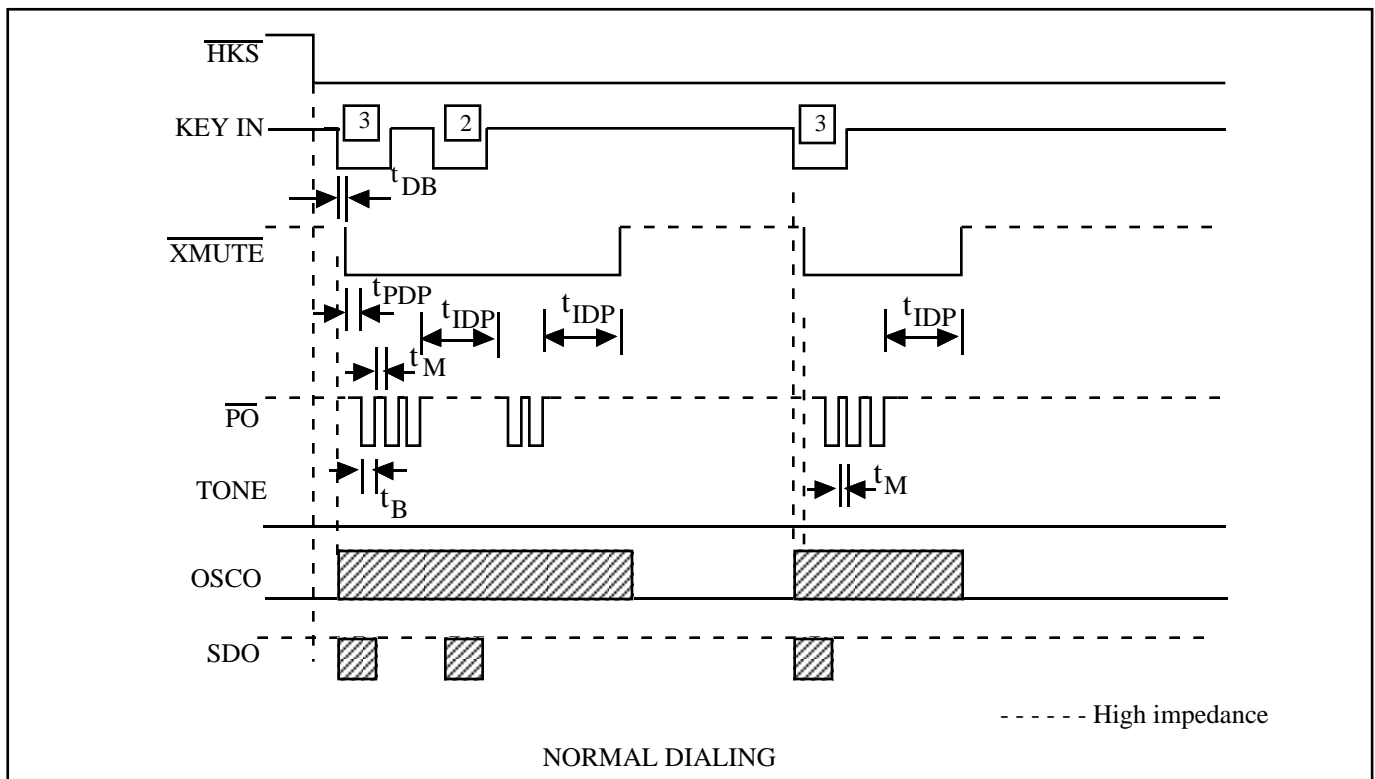


Figure 3: Pulse Mode Timing Diagram

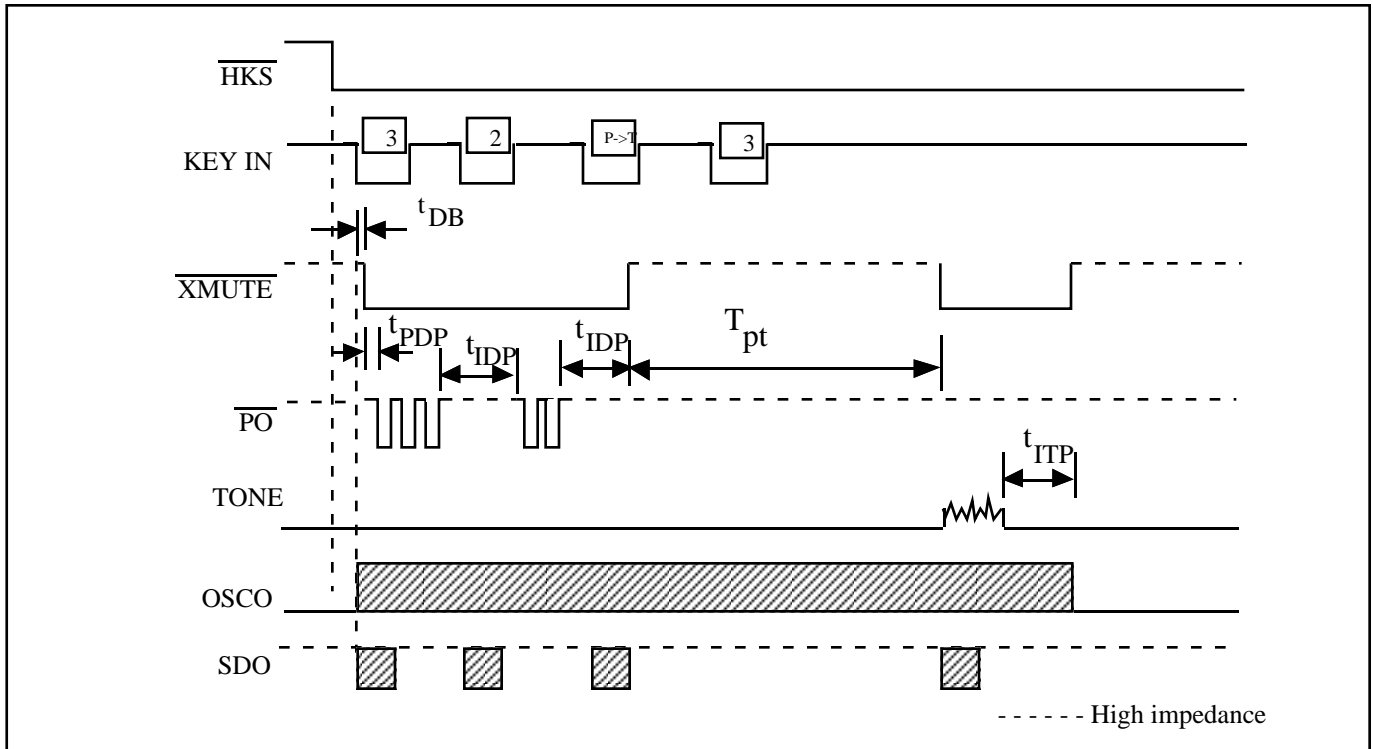


Figure 4: Timing Waveform for mixed dialing Operation (by P→T key entry)

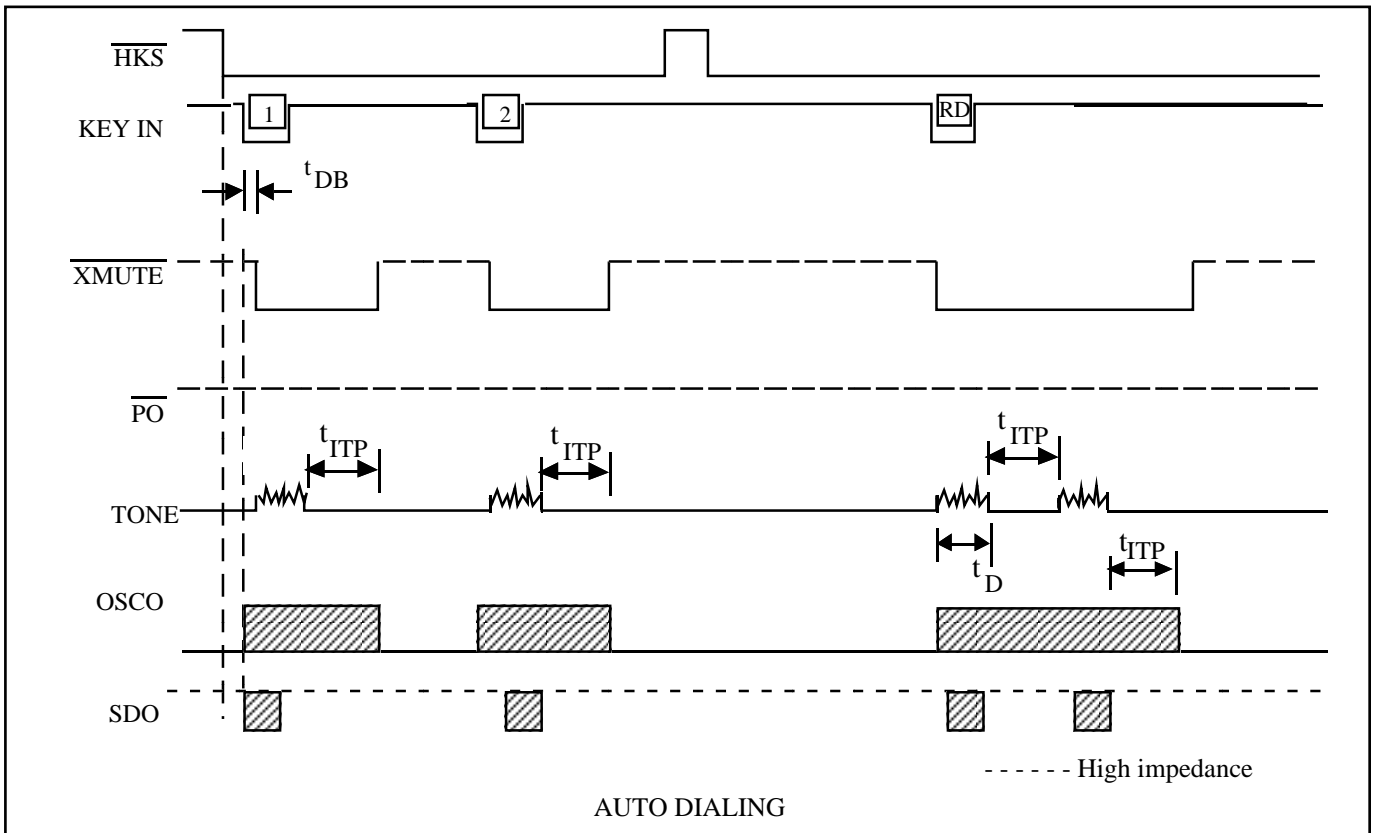


Figure 5: Tone Mode Redial Timing Diagram

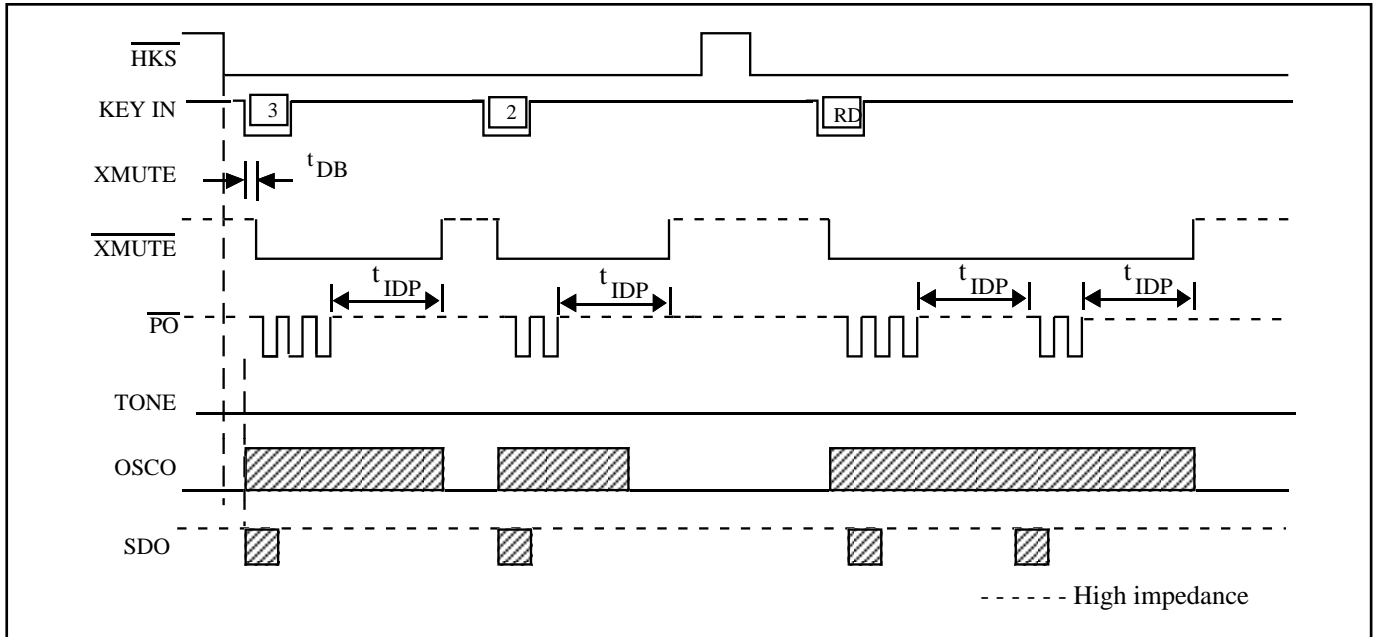


Figure 6: Pulse Mode Redial Timing Diagram

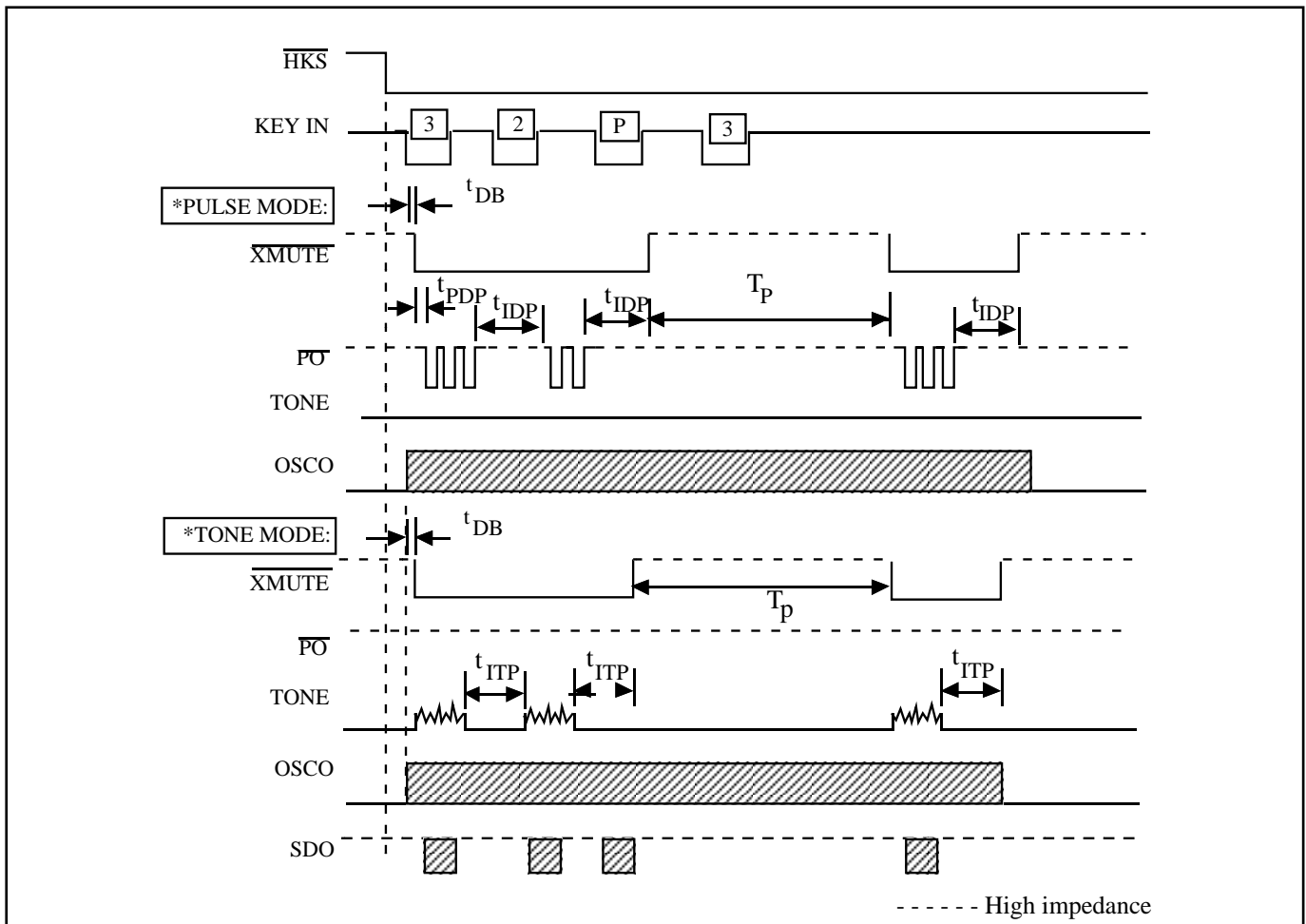


Figure 7: Pause key operating timing

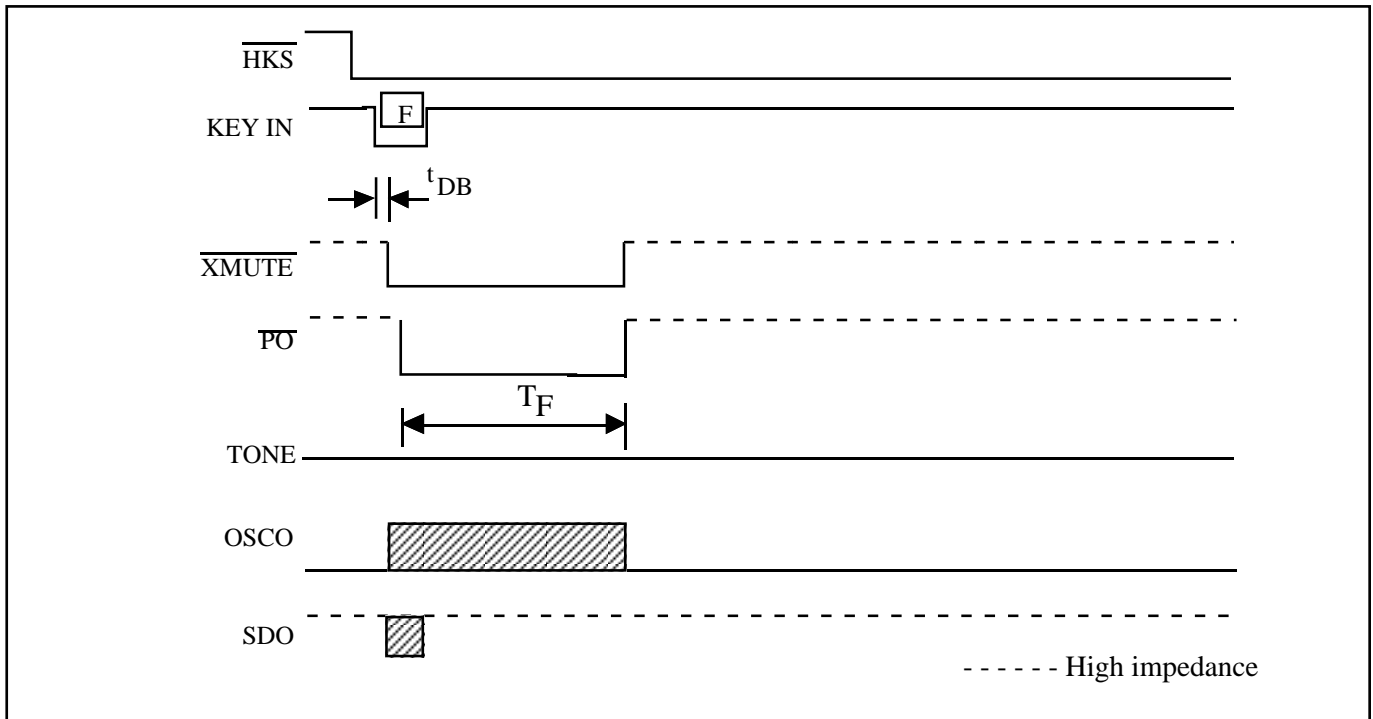


Figure 8: Flash key operation timing

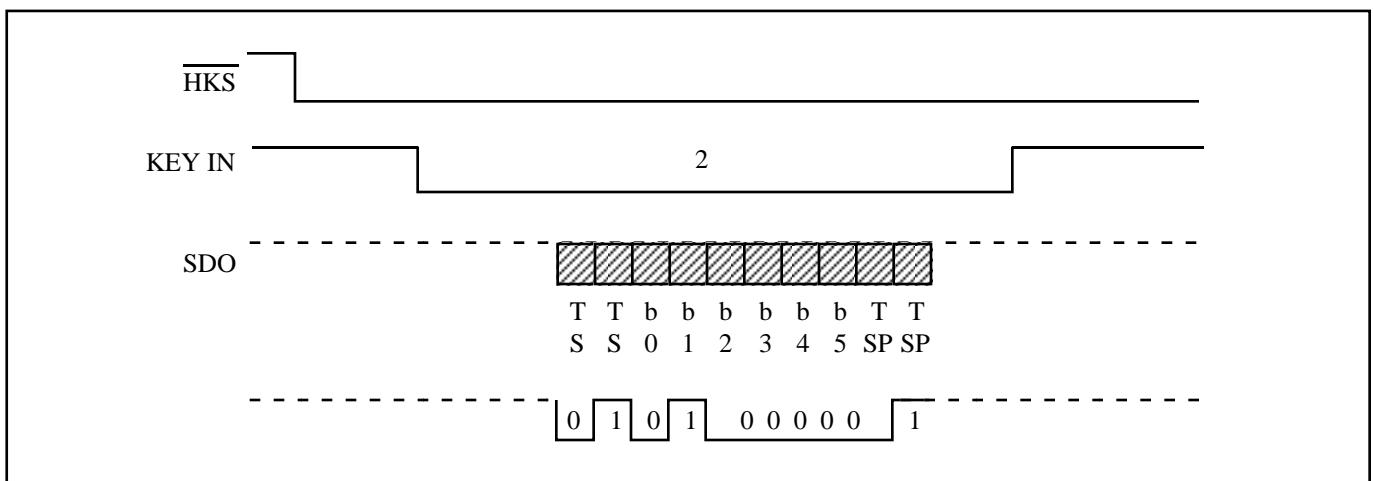
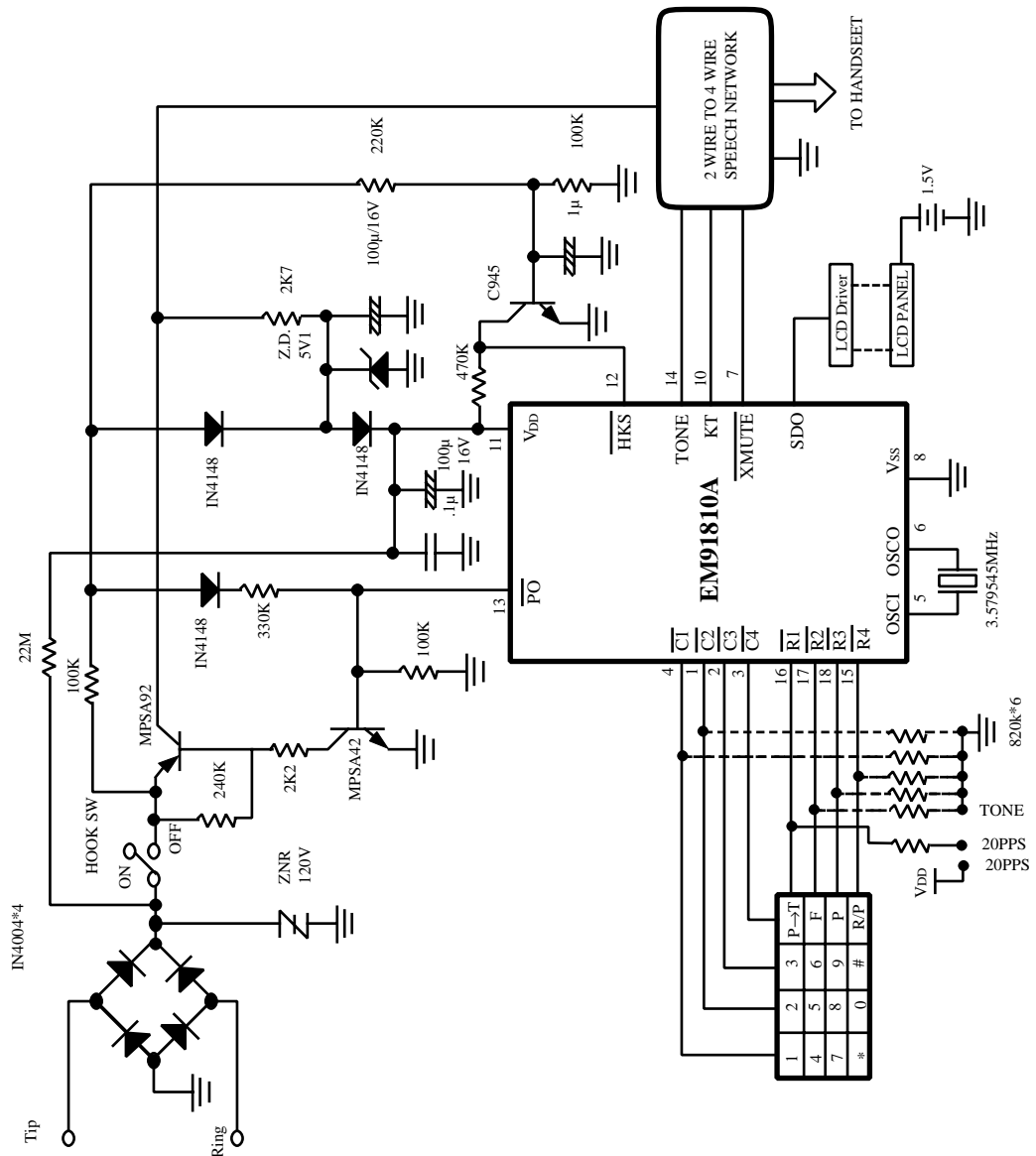


Figure 9: SDO operation timing

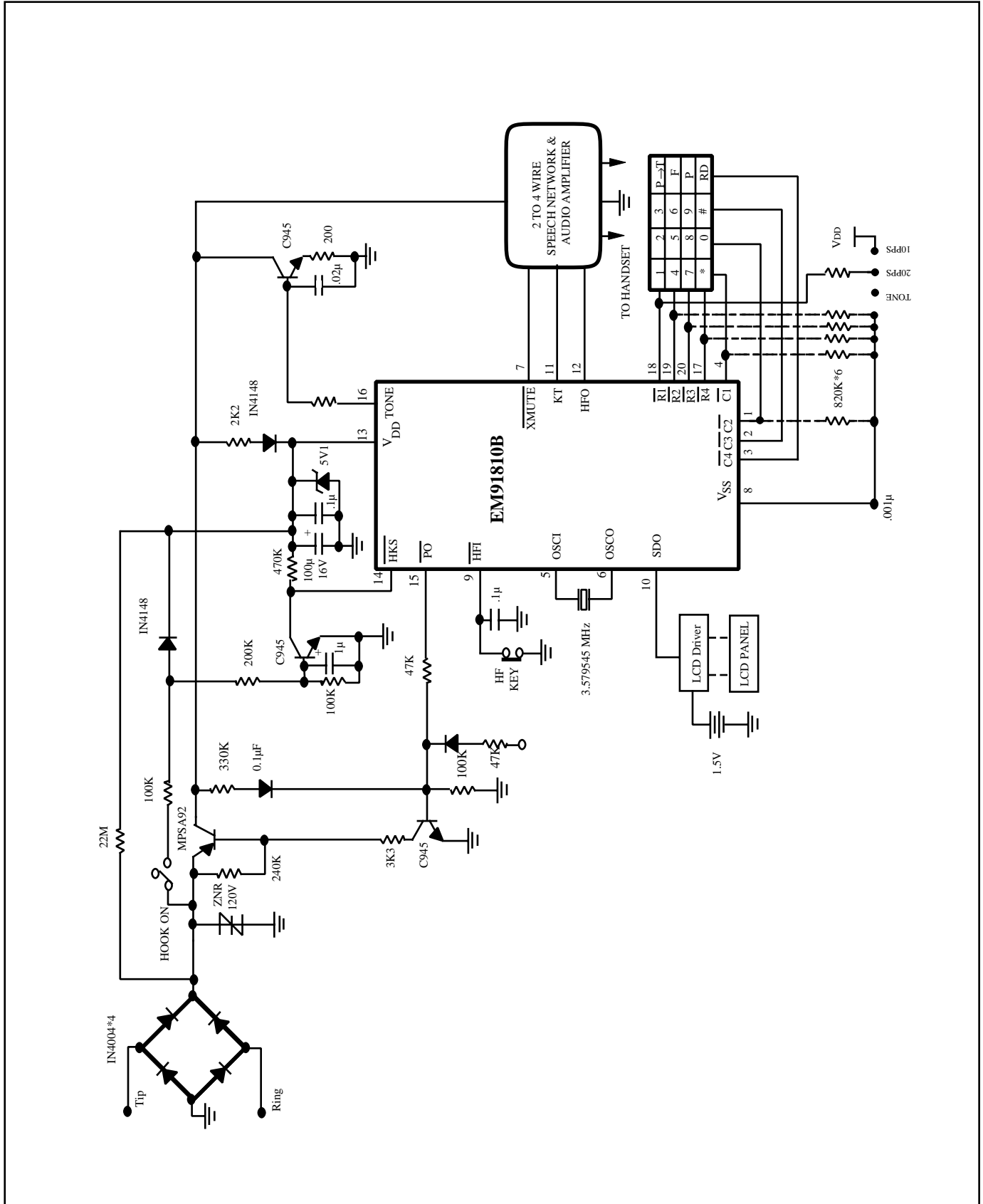
APPLICATION CIRCUIT

EM91810A Application Example



\* This specification are subject to be changed without notice.

APPLICATION CIRCUIT



\* This specification are subject to be changed without notice.

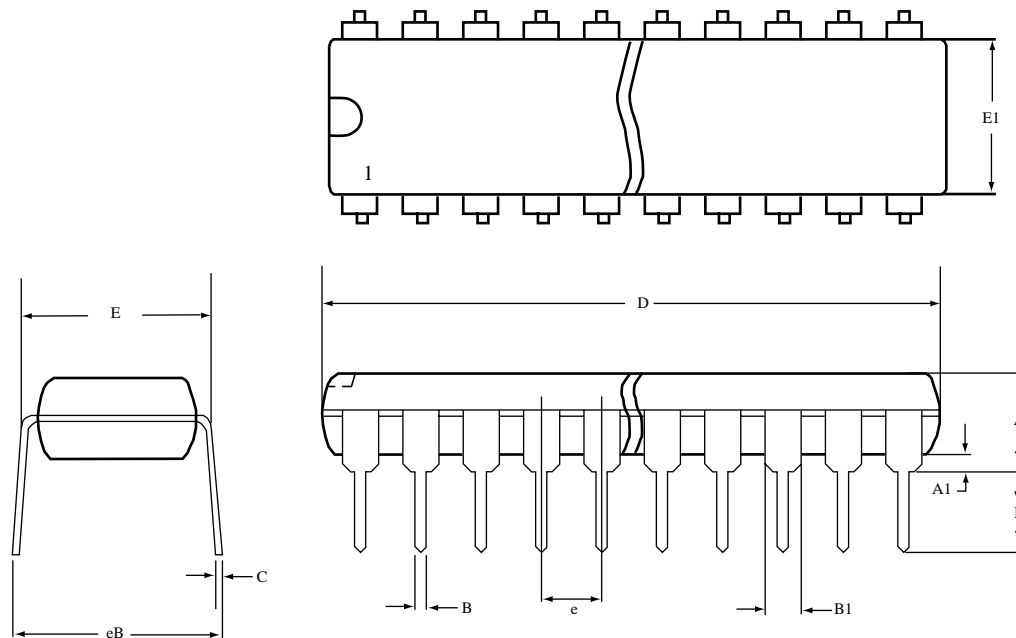
**PACKAGE INFORMATION**

Example :

EM    91215   P  
 (1)        (2)    (3)

- (1) ELAN MICRO. pefix
- (2) Type number
- (3) Package code:  
     P→PDIP  
     K→Skinny  
     R→SDIP

**18/20/28 Lead Plastic Package**

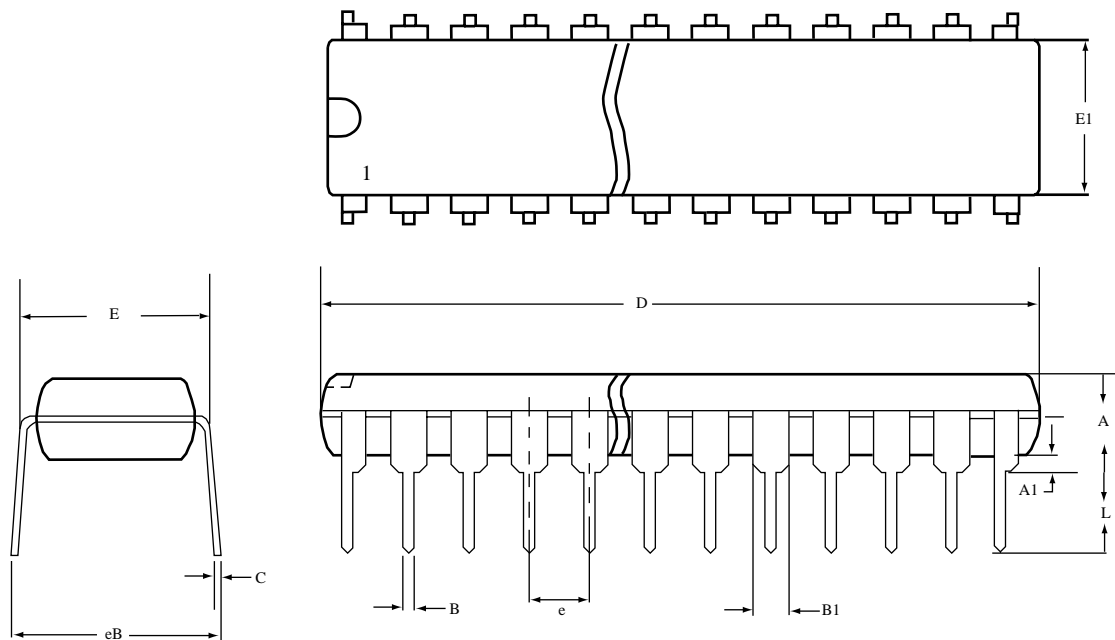


DIM	18 PDIP				20 PDIP				28 PDIP					
	MILIMETERS		INCHES		MILIMETERS		INCHES		MILIMETERS		INCHES			
	MIN.	MAX.	MIN.	MAX.	DIM	MIN.	MAX.	MIN.	MAX.	DIM	MIN.	MAX.	MIN.	MAX.
A	-	5.334	-	.210	A	-	5.334	-	.210	A	-	6.350	-	.250
A1	0.381	-	.015	-	A1	0.381	-	.015	-	A1	0.381	-	.015	-
B	0.356	0.558	.014	.022	B	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

\* This specification are subject to be changed without notice.

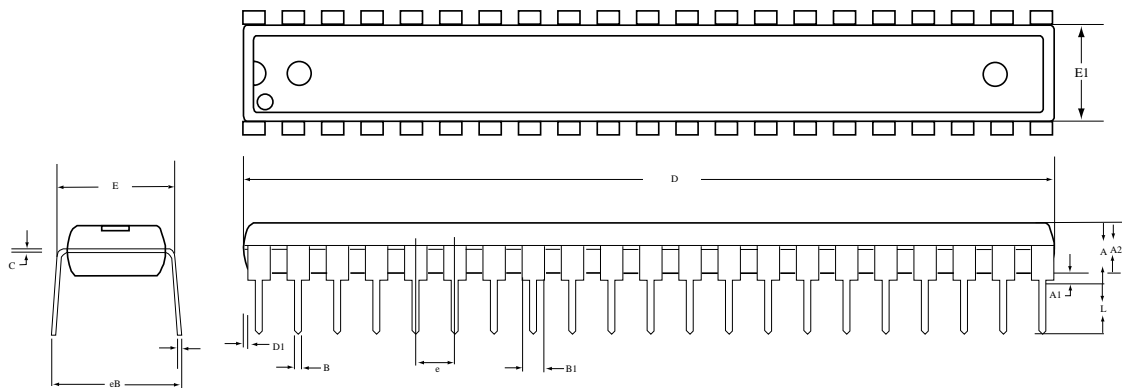


**22/24 Lead Plastic Package-Skinny**



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