

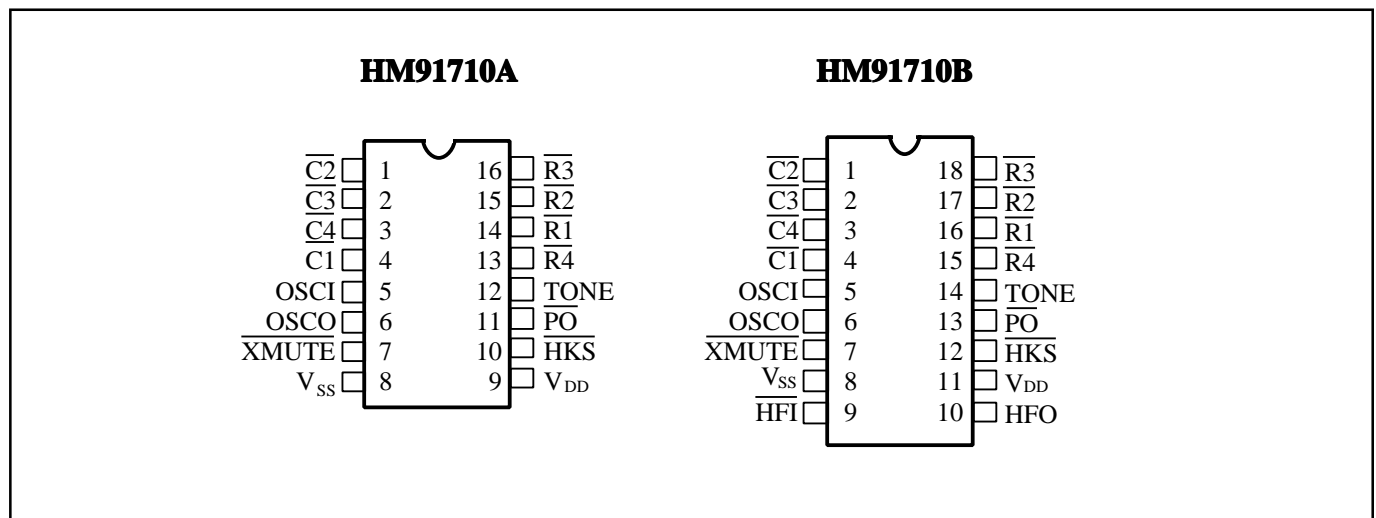
GENERAL DESCRIPTION

The HM91710A/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

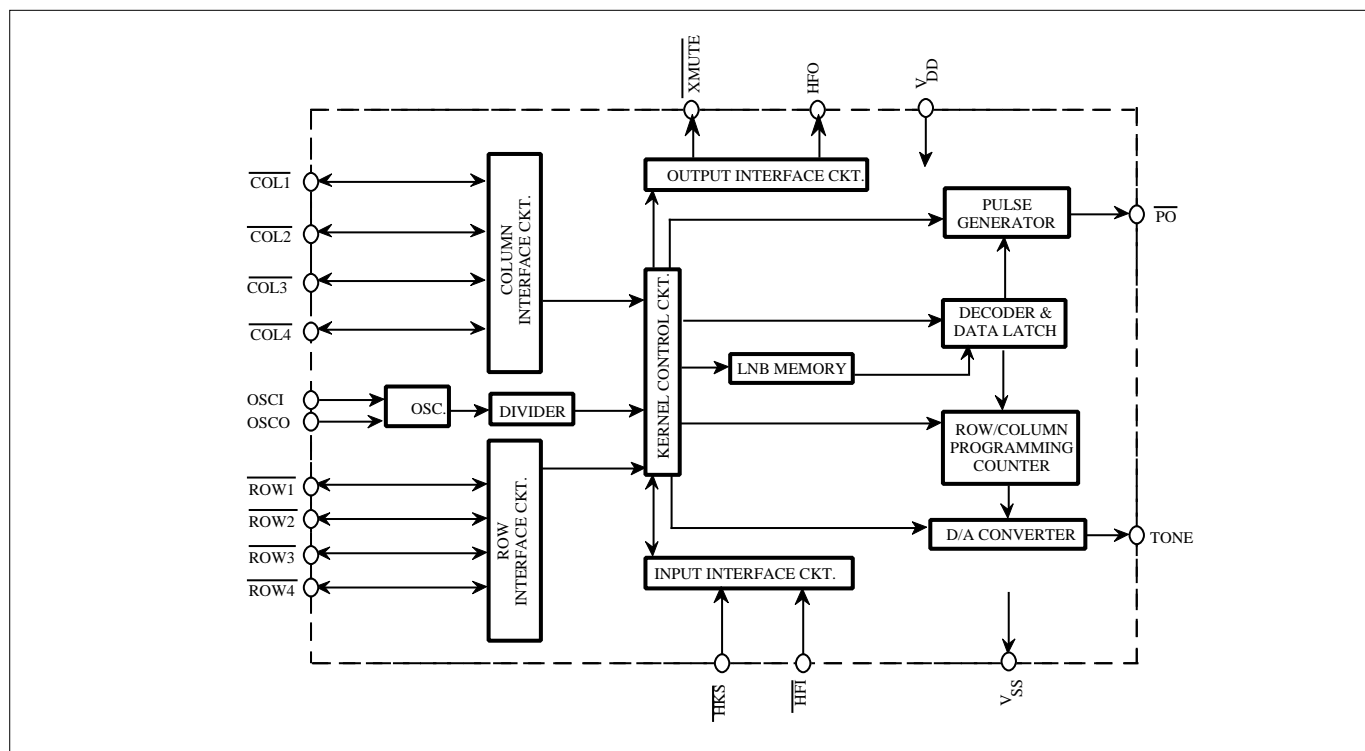


KEYBOARD ASSIGNMENT

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

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


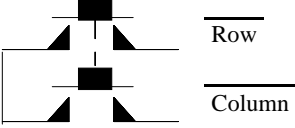
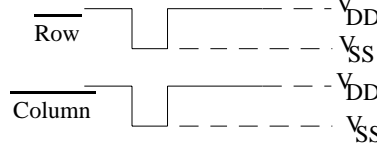
Col1	Tone Duration	inter-Tone Pause
NR	98 ms	98 ms
R	83 ms	83 ms

Note: NR:no resistance.

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

UR: A resistance connect to V DD

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>a. Keyboard scanning:</p> <p>HKS pin is LOW, the column group stays in "HIGH" state and row group stays in "LOW" state.</p> <p>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.).</p> <p>When HKS is "low", a valid key entry is defined by related Row & 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.</p> <p>To avoid keyboard bouncing error, this chip provides built-in debounce circuit. (The debounce time = 20 ms.)</p> <div style="text-align: center;">  </div> <p style="text-align: center;">Figure 1a : Single contact form keyboard configuration</p> <div style="text-align: center;">  </div> <p style="text-align: center;">Figure 1b : Dual contact form keyboard configuration</p> <div style="text-align: center;">  </div> <p style="text-align: center;">Figure 1c : Electronic signal input keyboard configuration</p>
OSCI OSCO	<p>Oscillator input & 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.
\overline{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>

* This specification are subject to be changed without notice.

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 (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.</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>

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

2. Dialing with flash key

Procedure : \uparrow F,D1,D2 , Dn \downarrow
Dial out : t_p , Dt1,Dt1 , Dtn in tone mode
Dial out : t_p ,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, C1Cn \downarrow
Dial out : Dt1, Dt2, Dtn , t_p , Ct1 Ctn in tone mode
Dial out : Dp1, Dp2, Dpn, t_p , Cp1Cpn in pulse mode
LNB : D1, D2 Dn, P, C1, C2Cn

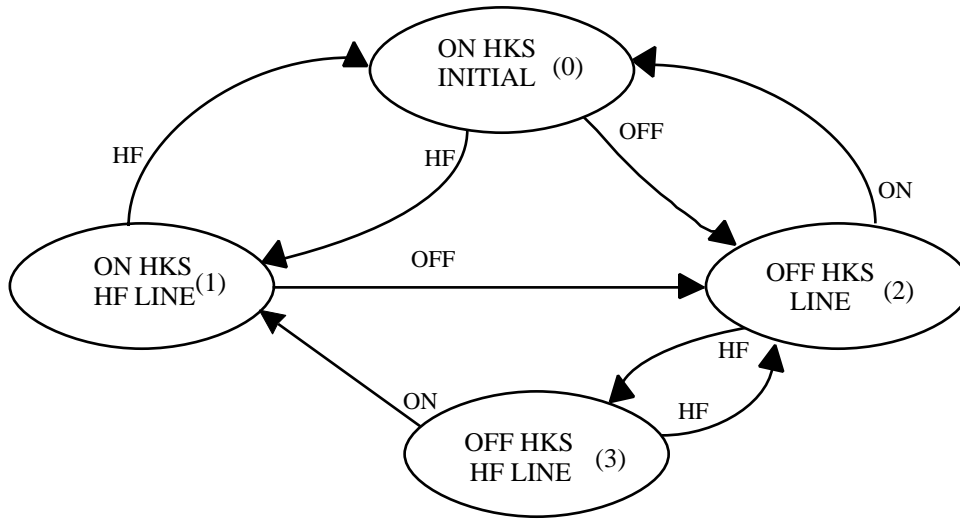
E. Flash Function

1. Reset
Procedure : \uparrow D1, D2,Dn, F, C1Cn \downarrow
Dial out : Dt1, Dt2, Dtn , t_p ,Ct1 Ctn in tone mode
Dial out : Dp1, Dp2, Dpn, t_p ,Cp1Cpn 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

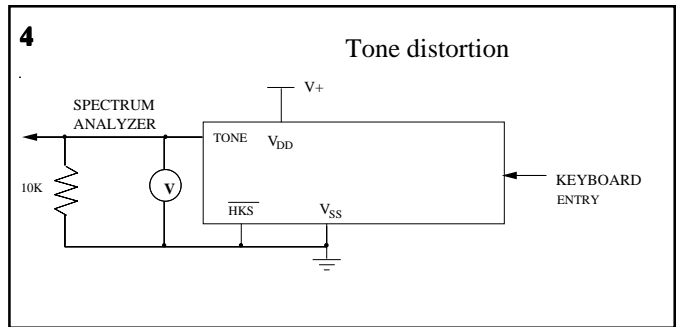
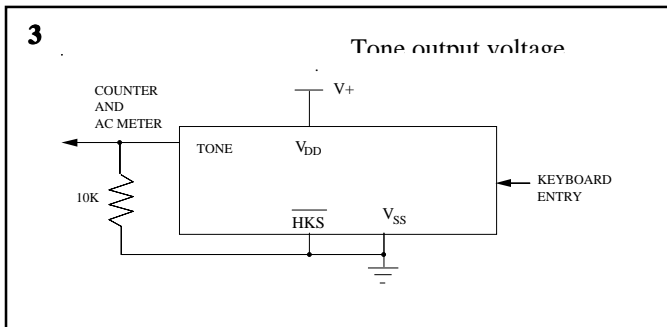
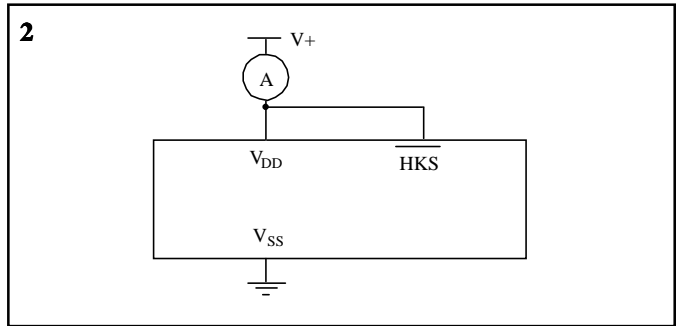
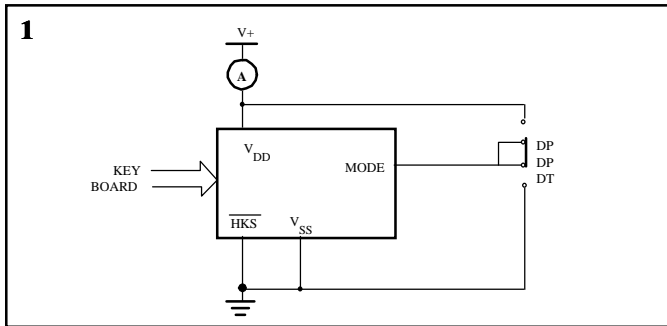


STATE NO.	\overline{PO}	\overline{XMUTE}	HFO
(0) INITIAL STATE	F	F	0
(1) ON HKS HF LINE	F	F	1
(2) OFF HKS LINE	F	F	0
(3) OFF HKS HF LINE	F	F	1

* F : Floating (Hi-impedance)

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

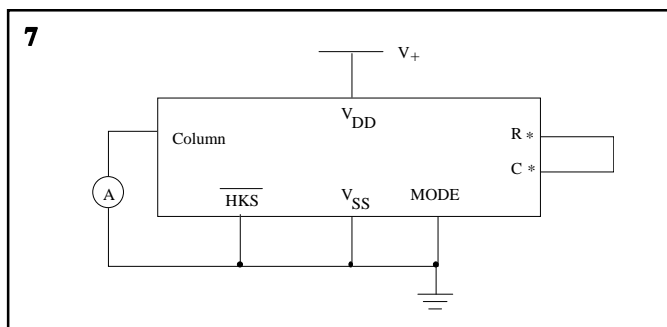
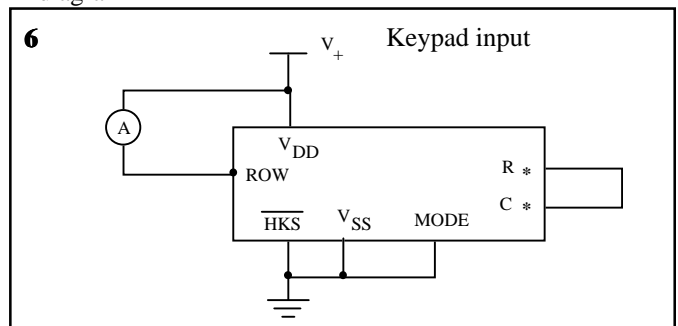
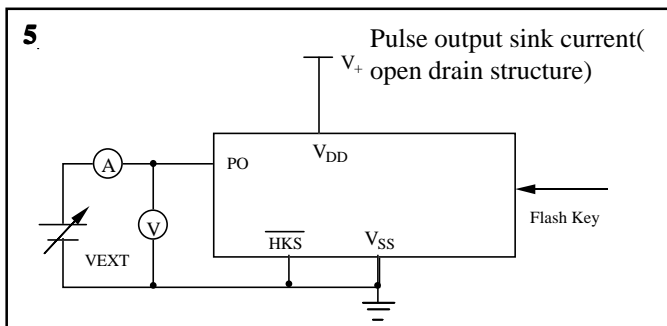
TEST CIRCUIT



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$$\text{DIST. (dB)} = 20 \log \frac{\sqrt{\tilde{A}(V_1)^2 + (V_2)^2 + \dots + (V_n)^2}}{\sqrt{\tilde{A}(V_L)^2 + (V_H)^2}}$$

- 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	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	I_{mth}	$V_{xmute} = 2.5V$	-	-	1	μA
		$V_{xmute} = 0.5V$	0.2	0.5	-	mA
HKS pin input current	I_{hks}	$V_{hks} = 2.5V$	-	-	0.1	μA
Keyboard scanning pin drive current	I_{kbd}	* $V_n = 0V$,	4	10	30	μA
		* $V_n = 2.5V$,	200	400	800	μA
Key-in debounce time	t_{DB}		-	20	-	ms
HFI pin input resistor	R_{hfi}	$V_{hfi} = 0$	-	200	-	K Ω
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 _{poh}	V _{po} = 2.5V	-	-	0.1	uA
	I _{pol}	V _{po} = 0.5V	0.5	-	-	mA
Pulse rate	f _{pr}		-	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, fosc. = 3.579545 MHz)

Parameter	Sym.	Conditions	Min.	Typ.	Max.	Unit
TONE output pin DC level sink current	V _{dc}	V _{DD} = 2.0V~5.5V	0.5V _{DD}	-	0.7V _{DD}	V
	I _{tl}	V _{dtmf} = 0.5V	0.2	-	-	mA
AC level Load resistor	V _{dtmf}	Row group, R _L = 10KΩ	130	155	170	mV _{rms}
	R _l	Dist. ² -23dB	10	-	-	KΩ
DTMF signal: pre-emphasis *distortion	twist	V _{DD} = 2.0~5.5V, Column-Row group	1	2	3	dB
	Dist.	R _L = 10KΩ	-	-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 { [(V₁² + V₂² + V₃² + ... + V_n²)^{1/2}] / [(V_L² + V_H²)^{1/2}] }.

V_L, V_H: Row group and Column group signal.

V₁, V₂, ..., 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

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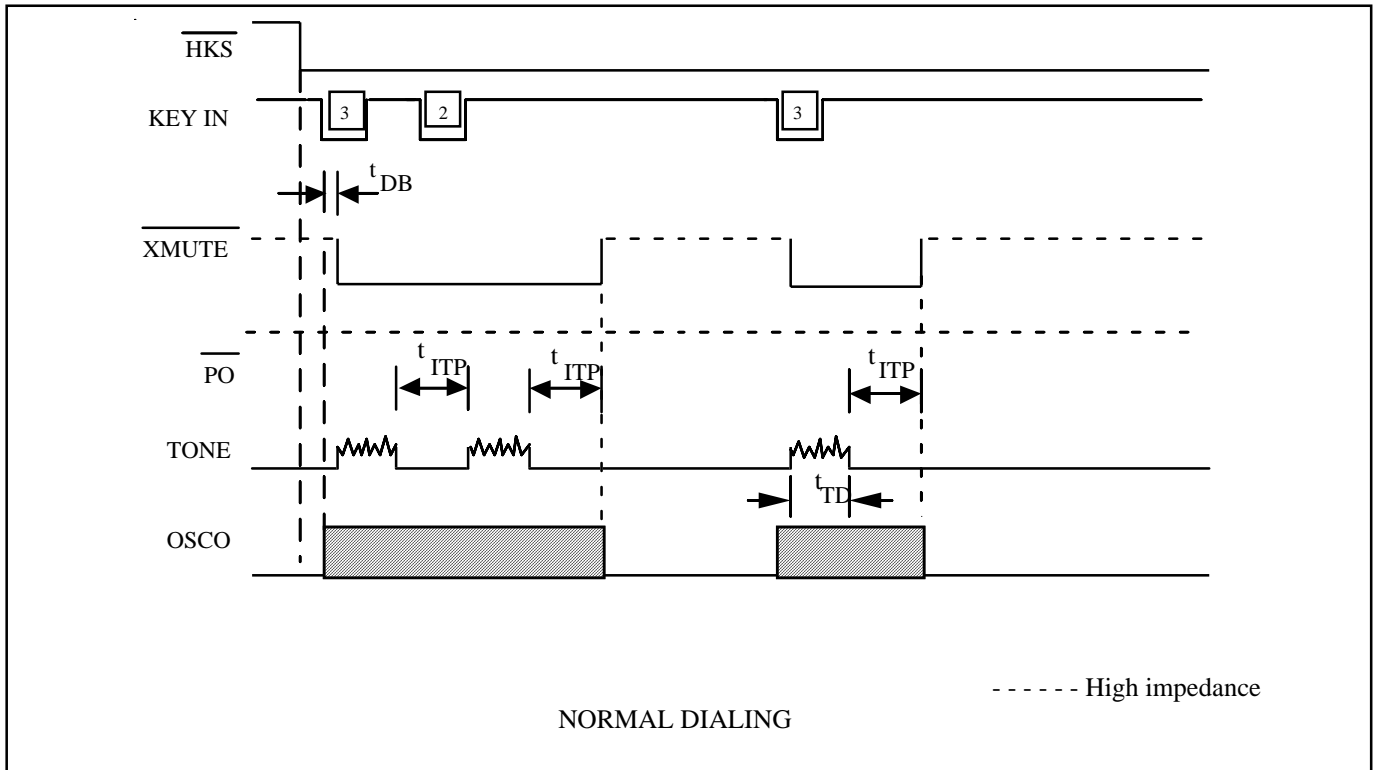


Figure 2: Tone Mode Timing Diagram

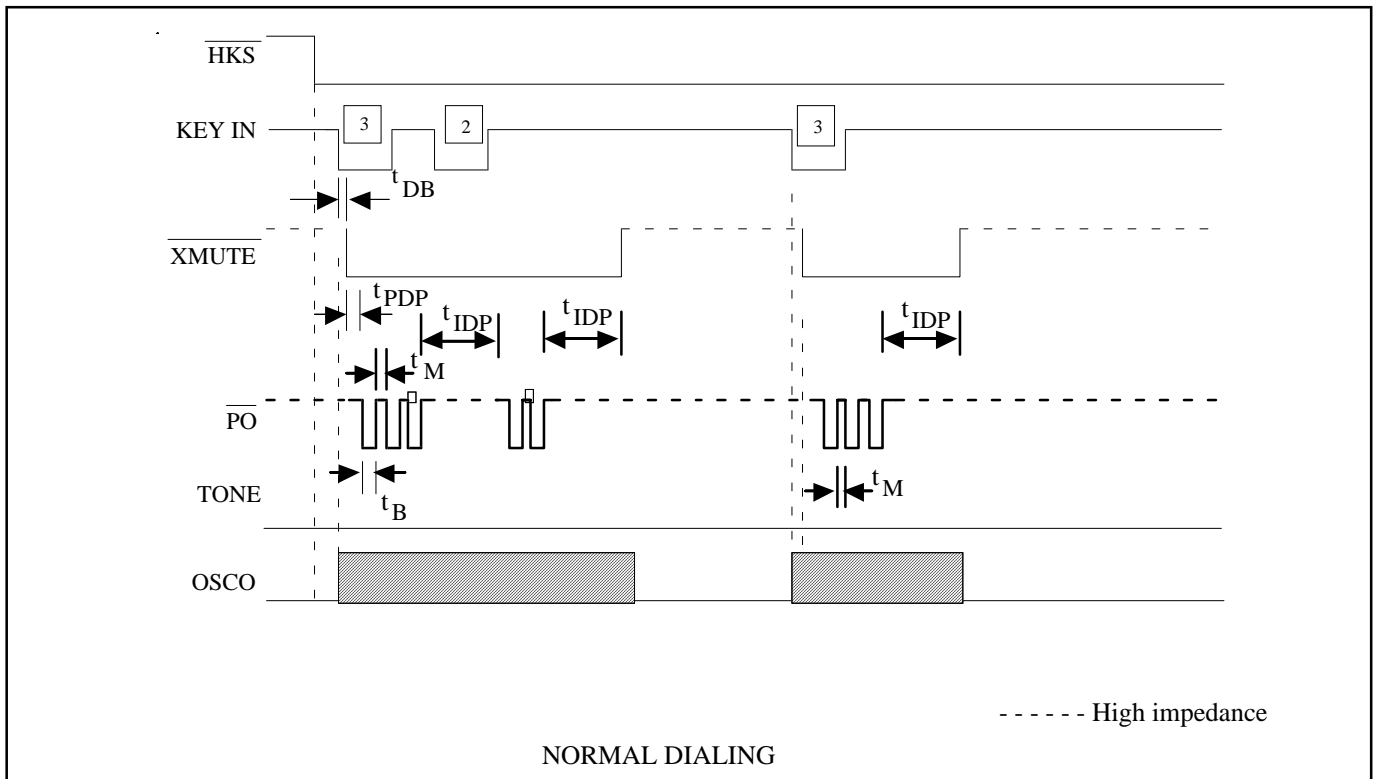


Figure 3: Pulse Mode Timing Diagram

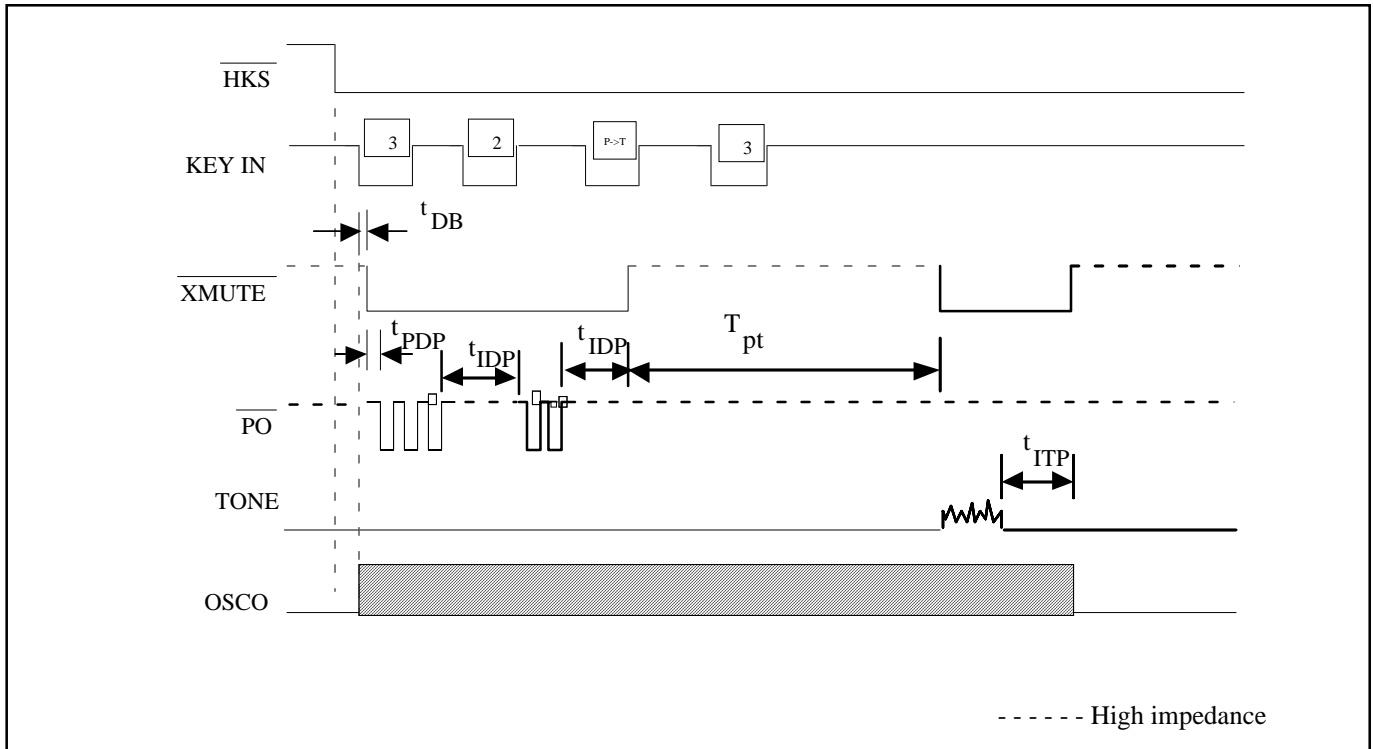


Figure 4: Timing Waveform for mixed dialing Operation (by P→T key entry)

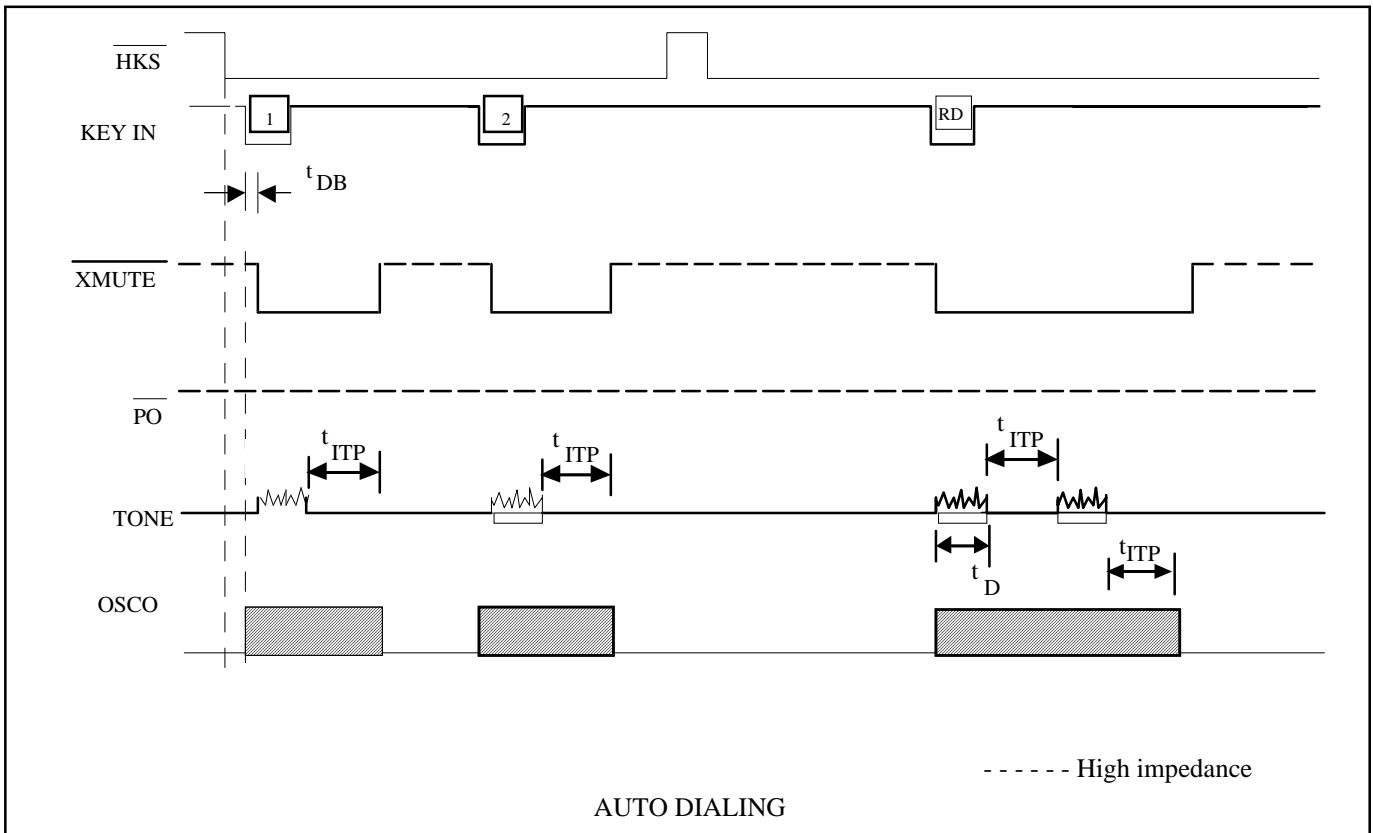


Figure 5: Tone Mode Redial Timing Diagram

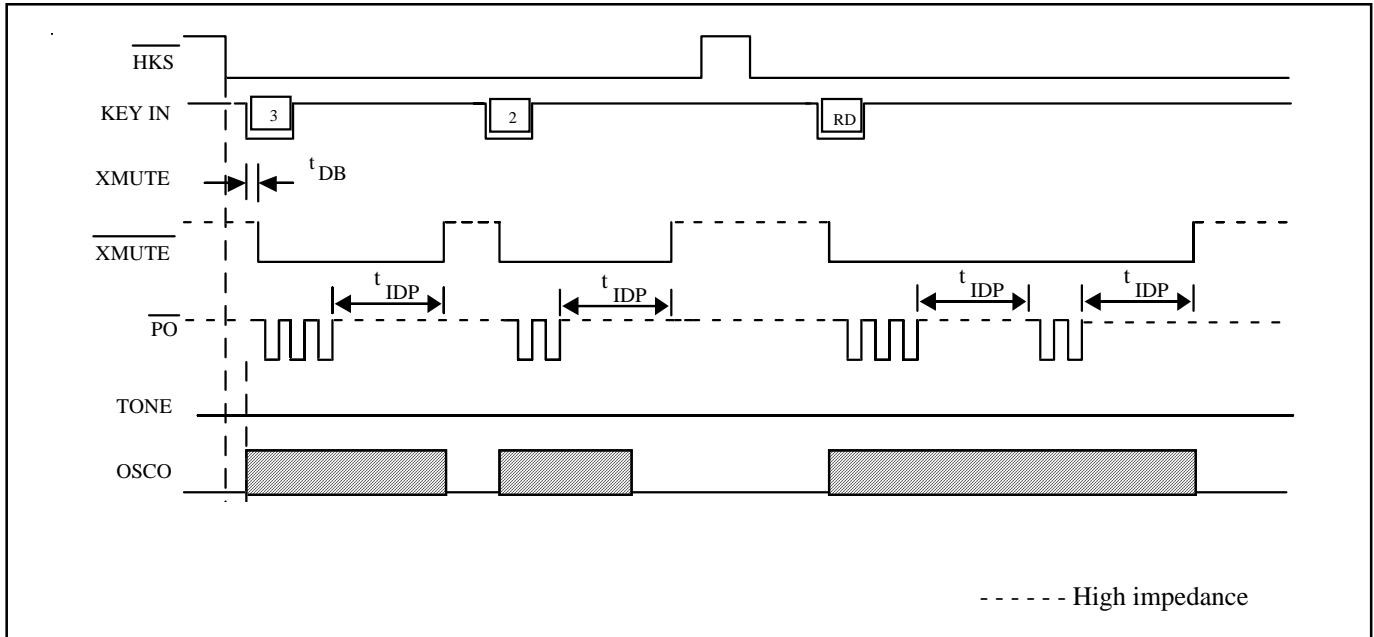


Figure 6: Pulse Mode Redial Timing Diagram

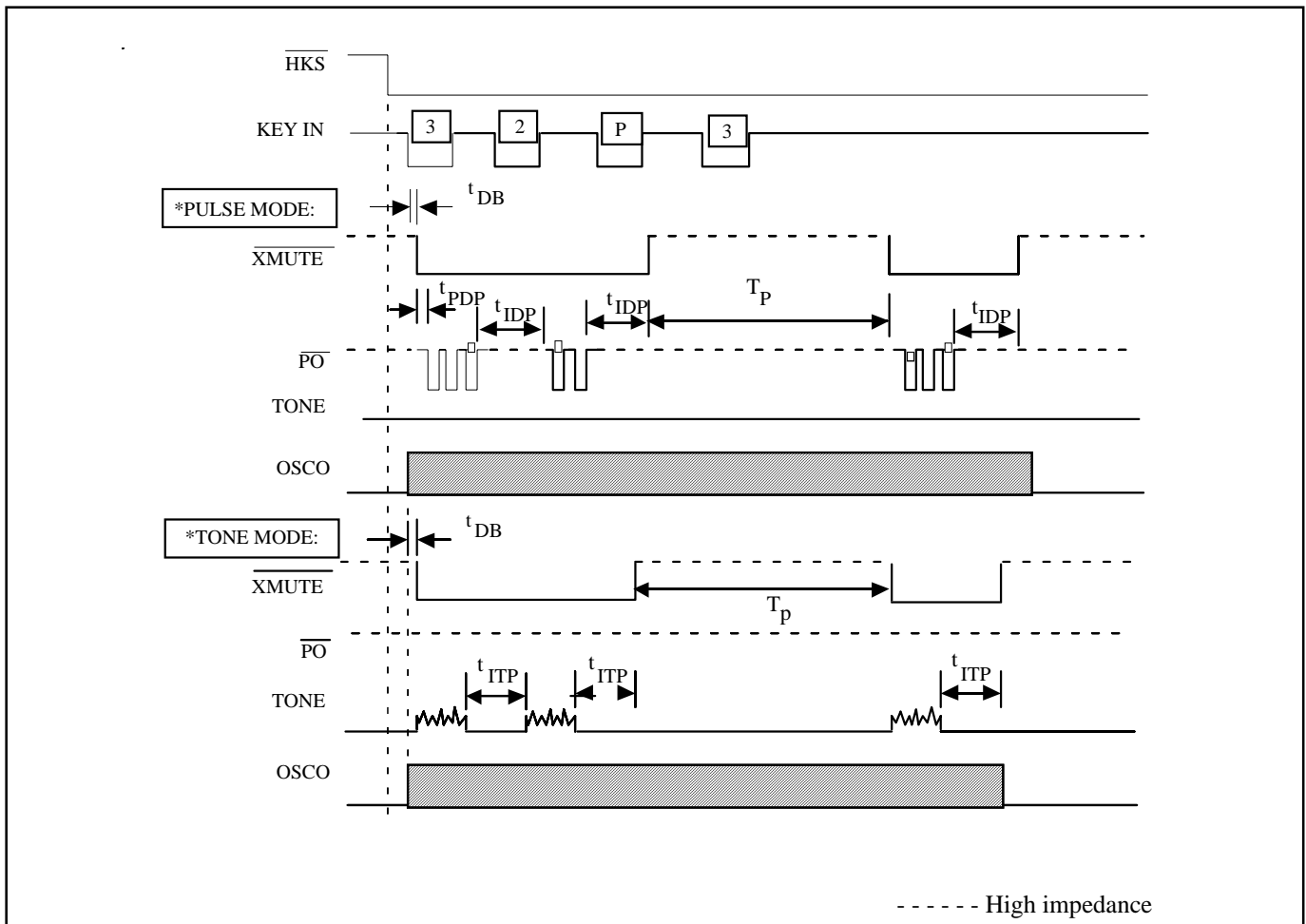


Figure 7: Pause key operating timing

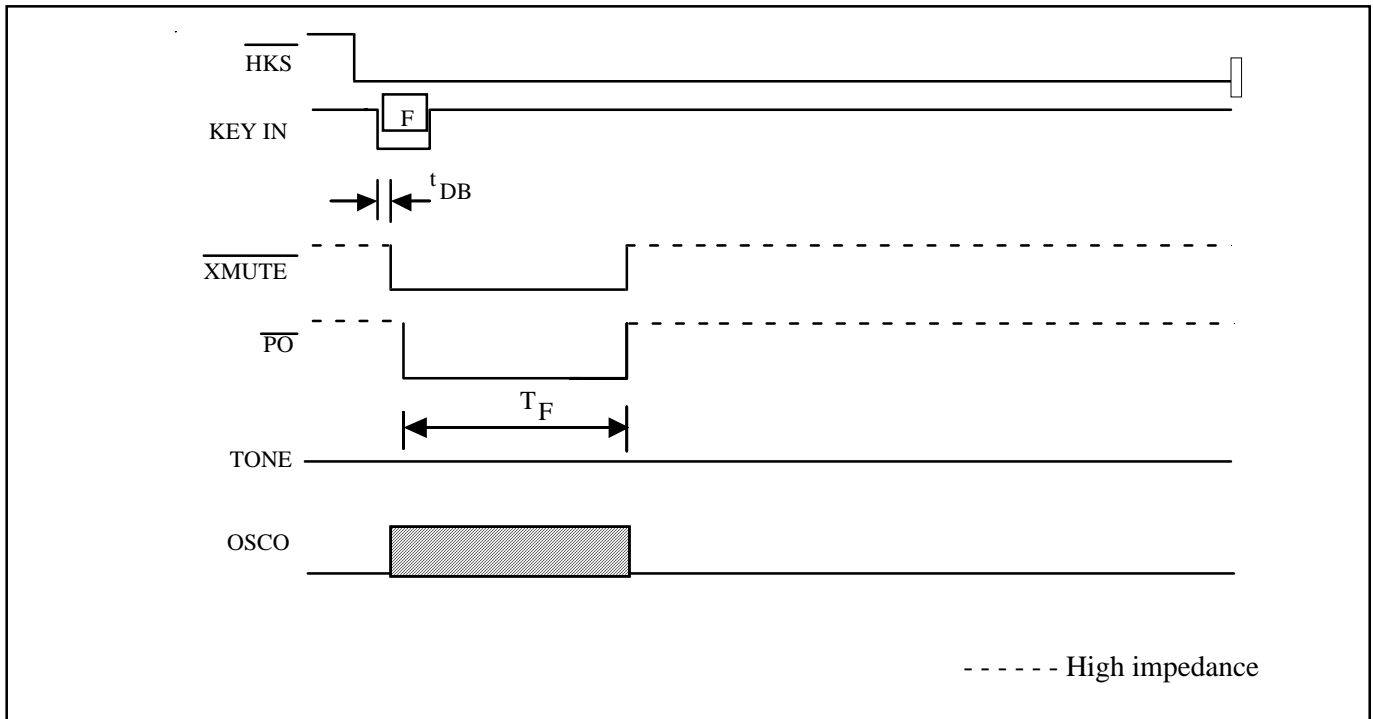
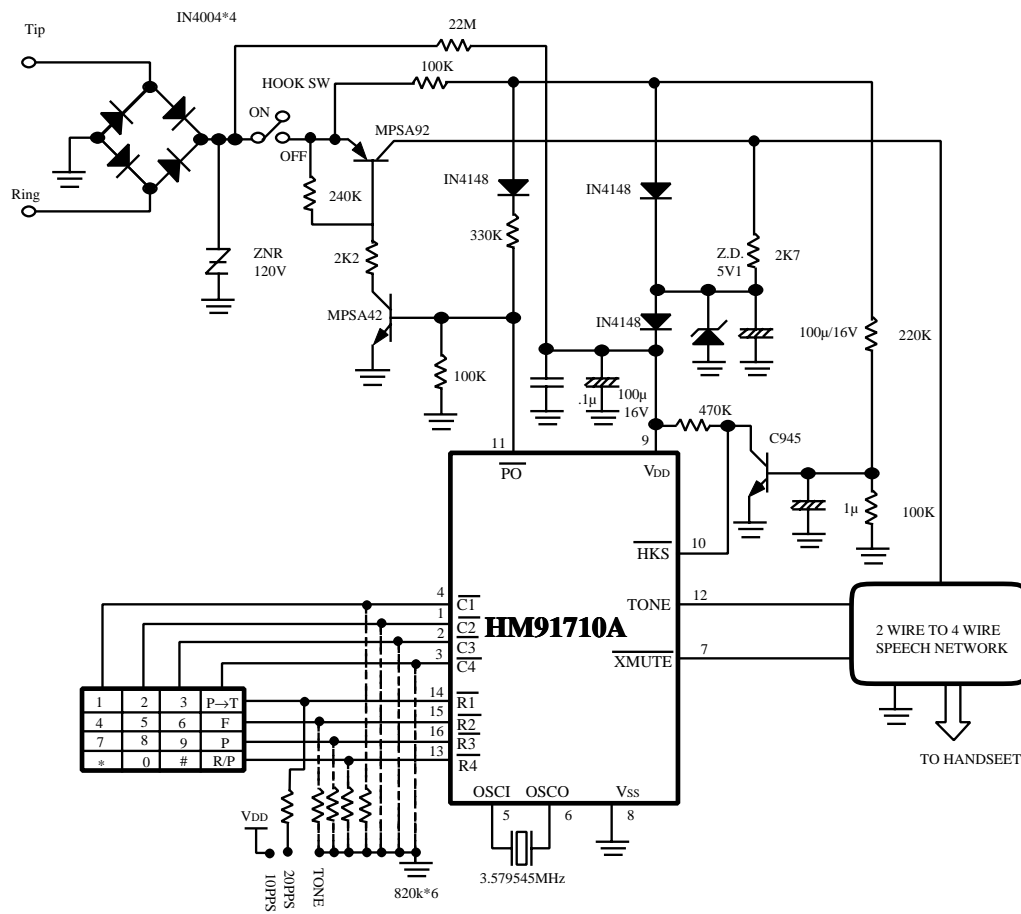


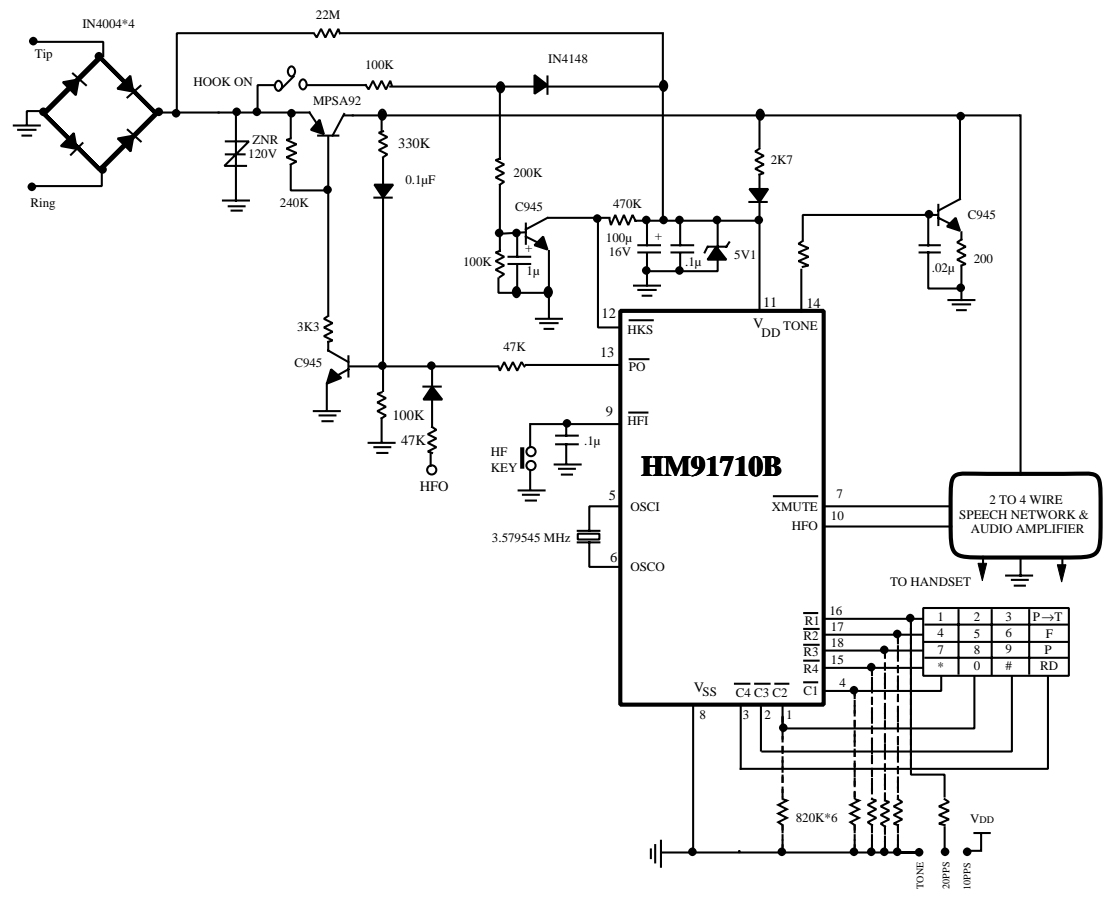
Figure 8: Flash key operation timing

APPLICATION CIRCUIT
HM91710A Application Example




APPLICATION CIRCUIT

HM91710B Application Example



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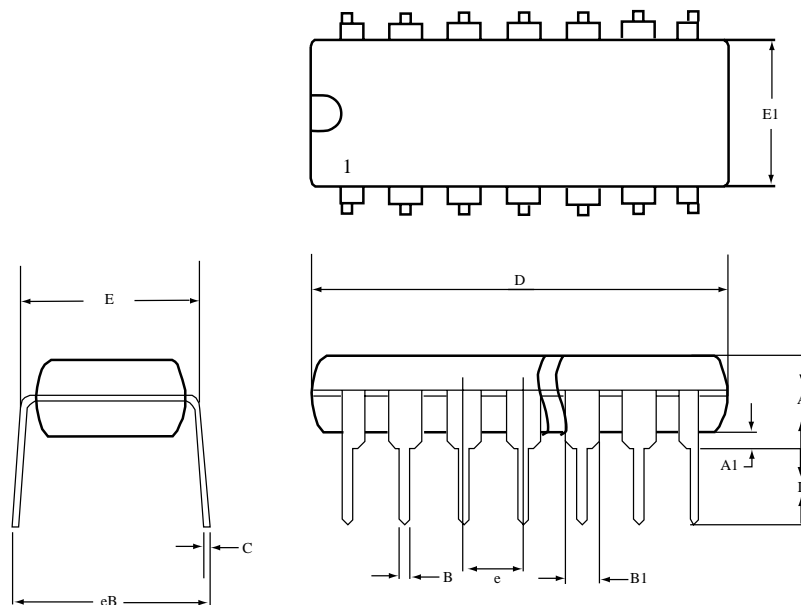
PACKAGE INFORMATION

Example :

HM 91710 P
 (1) (2) (3)

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

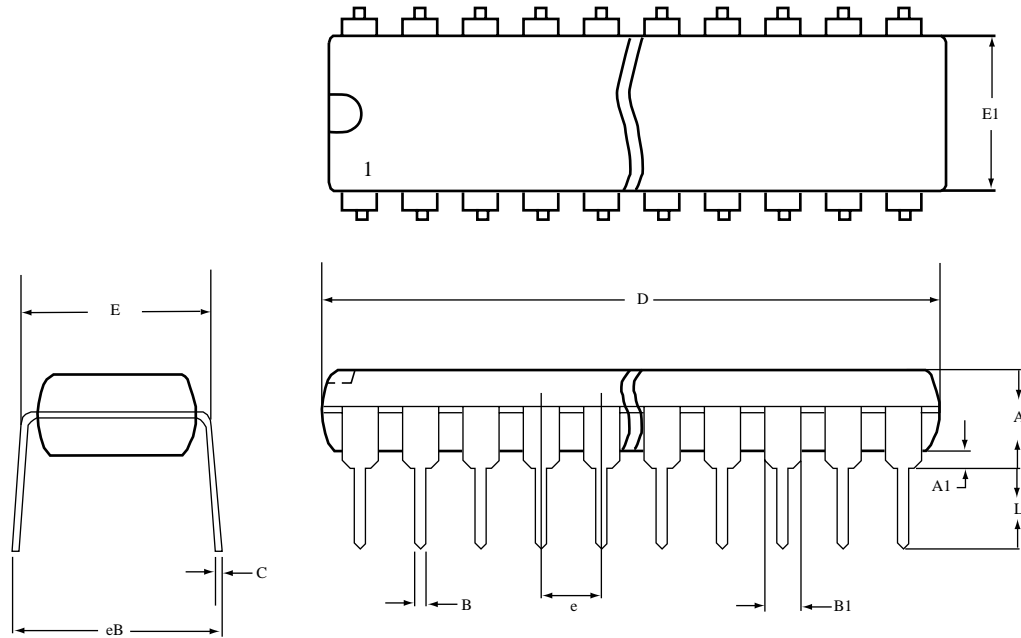
16 Lead Plastic Package



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

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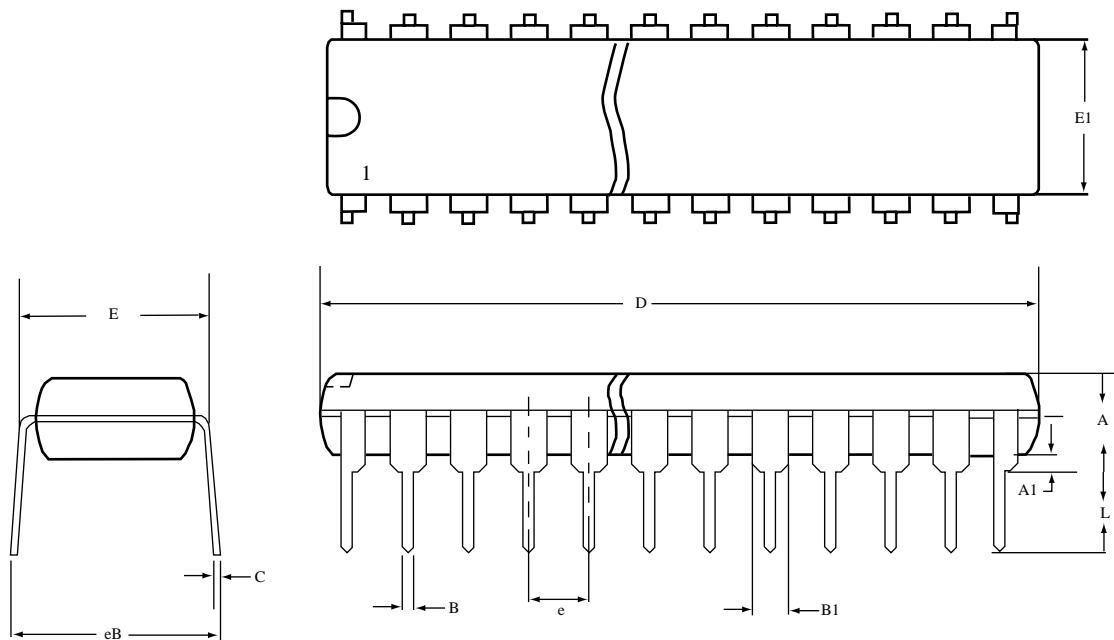
18/20/28 Lead Plastic Package



DIM	18 PDIP				20 PDIP					28 PDIP				
	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

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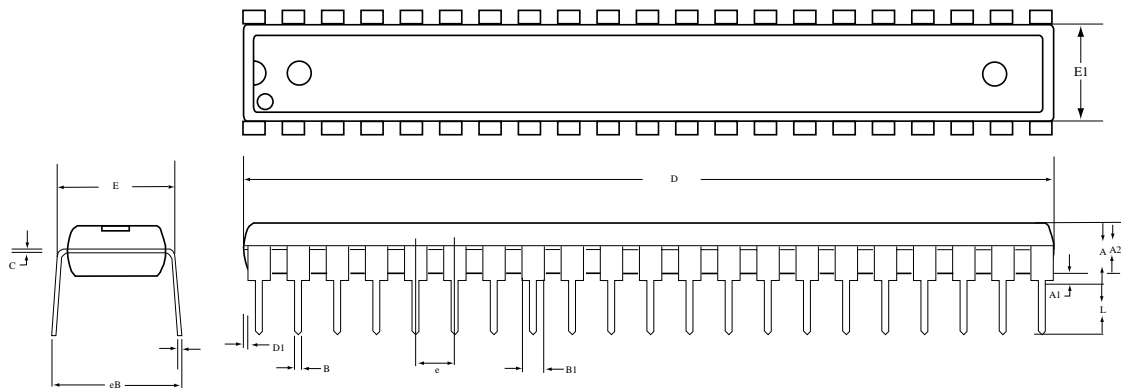
22/24 Lead Plastic Package-Skinny



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

* This specification are subject to be changed without notice.

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