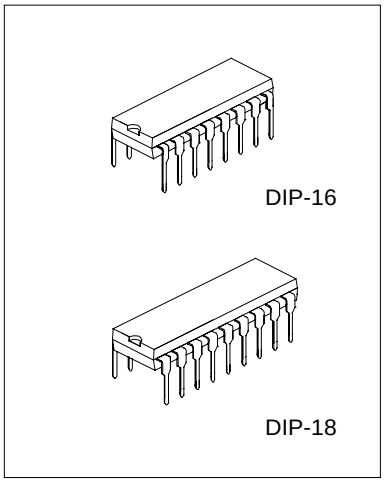
Silan
Semiconductors

SC91710A/B

TONE / PULSE SWITCHABLE DIALER WITH HANDFREE FUNCTION



DESCRIPTION

The SC91710A/B are Tone/Pulse switchable dialer which are fabricated in COMS technology with wide operating voltage for both tone and pulse mode, and consumes very low memory retention current in ON-HOOK state.

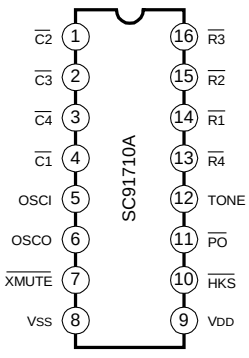
FEATURES

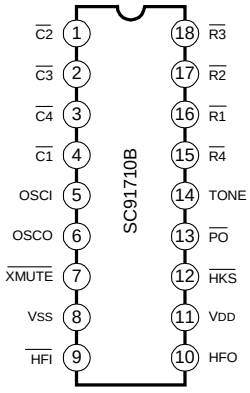
*Tone/Pulse switchable dialer
*One 32-digit last number redial memory
*Pulse-to-tone (P→T) is provided for PBX operation
*Flash key is available
*Minimum tone duration is 98ms or 83ms
*Minimum intertone pause is 98ms or 83ms
*Redial Pause time (0ms)
*Uses 3.579549MHz crystal or ceramic resonator
*Many options can be selected
  Mode (10PPS; 20PPS; 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
*Power on reset circuit is provided
*Handfree function is provided for speaker phone application
*Packaged in 16-DIP or 18-DIP

ORDERING INFORMATION

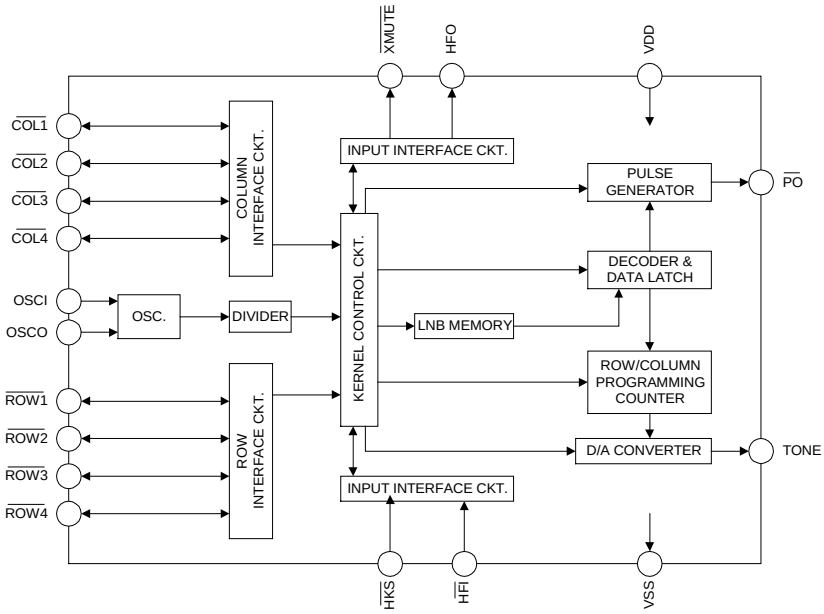
SC91710A	DIP-16 Packaged
SC91710B	DIP-18 Packaged

PIN CONFIGURATION





BLOCK DIAGRAM



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

DIALING SIGNAL OPTION

A: Flash time

$\overline{Row3}$	$\overline{Row4}$	Flash time(ms)
NR	NR	600
NR	R	300
R	NR	100
R	R	80

B:

$\overline{Row1}$	$\overline{Row2}$	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

$\overline{Col1}$	Tone Duration	Inter-Tone Pause
NR	98ms	98ms
R	83ms	83ms

D: Key type select

$\overline{Col2}$	*or */T select
NR	*
R	*/T

Note: NR: no resistance
R: A resistance connect to VSS (820kΩ typically)
UR: A resistance connect to VDD

ABSOLUTE MAXIMUM RATINGS

(Tamb=25°C, All voltage referenced to VSS, unless otherwise specified)

Characteristic	Symbol	Value	Unit
Power Supply Voltage	VDD	6.0	V
Input Voltage	VIN	-0.3~VDD+0.3	V
Power Dissipation	PD	500	mW
Operating Temperature	Topr	-25~+70	°C
Storage Temperature	Tstg	-55~+150	°C

ELECTRICAL CHARACTERISTICS

(Tamb=25°C, VDD=2.5V, fosc=3.579545MHz, unless otherwise specified)

Parameter		Symbol	Conditions		Min	Typ	Max	Unit
DC Characteristics								
Operating Voltage		VDD	Tone		2.5	--	5.5	V
			Pulse		2.0	--	5.5	
			Memory retention		1.0		5.5	
Operating Current		IOP	Tone	OFF-HOOK,	--	0.6	2	mA
			Pulse	Keypad entry	--	0.2	0.5	
Standby Current		IS	ON-HOOK，No keypad entry		--	0.1	1	μA
Memory Retention Current		Imr	ON-HOOK，VDD=1.0V		--	0.1	0.2	μA
Control Pin Input Low Voltage		Vil	--		VSS		0.3VDD	V
Control Pin Input High Voltage		Vih	--		0.7VDD		VDD	
$\overline{XMUTE}$ Pin Leakage Current		Imth	$V_{\overline{XMUTE}}$ =6.0V		--	--	1	μA
$\overline{XMUTE}$ Pin Sink Current		Imtl	$V_{\overline{XMUTE}}$ =0.5V		0.2	0.5	--	mA
$\overline{HKS}$ Pin Input Current		Ihks	Vhks=2.5V		--	--	0.1	μA
Keyboard Scanning Pin	Drive Current	Ikbd	Vn=0V（note1）		4	10	30	μA
	Sink Current	Ikbs	Vn=2.5（note1）		200	400	800	
Key-in Debounce Time		tDB	--		--	20	--	ms

(to be continued)

(continued)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
HFI pin input resistor	Rhfi	V_{DD}=2.5	--	200	--	kΩ
HFO pin drive current	Ihdoh	Vhfo=2.0V	0.5	--	--	mA
HFO pin sink current	Ihdol	Vhfo=2.5V	0.5	--	--	mA
Pulse Mode						
Pulse Output Pin Leakage Current	Ipoh	Vpo=2.5V	0.1	--	--	μA
Pulse Output Pin Sink Current	Ipol	Vpo=0.5V	0.5	--	--	mA
Pulse Rate	fpr		--	10	--	pps
			--	20	--	
Make/Break Ratio	t_M：t_B		--	40:60	--	%
			--	33:66	--	
Pre-digit Pause	tPDP	M/B ratio=40:60	--	40	--	ms
		M/B ratio=33:66	--	33	--	
Inter-digit Pause	tIDP	Pulse rate=10pps	--	800	--	ms
		Pulse rate=20pps	--	500	--	
Tone Mode						
Tone Output Pin	DC Level	Vdc	V_{DD}=2.0V~5.5V	0.5V_{DD}	--	0.7V_{DD}	V
	Sink Current	Itl	Vdtmf=0.5V	0.2	--	--	mA
	AC level	Vdtmf	Row group，R_L=10KΩ	130	155	170	mVrms
	Load Resistor	Rl	Dist.≤ -23dB	10	--	--	KΩ
DTMF Signal	Pre-emphasis	twist	V_{DD}=2.0~5.5 V, Column-Row group	1	2	3	dB
	Distortion(note 2)	Dist.	R_L=10KΩ	--	-30	-23	dB
Minimum tone duration Time		tTD	Auto redial	--	98/83	--	ms
Minimum Intertone Pause Time		tITP	Auto redial	--	98/83	--	ms

Note: 1. Vn: Input voltage of any keyboard scanning pin (Row group, Column group)

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

V_L,V_H: Row group and Column group signal , V1，V2…，Vn: Harmonic signal (BW = 300Hz~3500Hz）

ACTUAL FREQUENCY OUTPUT (fosc=3.579545MHz)

Keyboard Scanning Pin		Standard(Hz)	Output	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

PIN DESCRIPTION

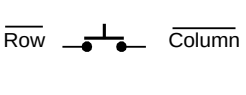
<table>
<tr><th colspan="2">Pin No.</th><th rowspan="2">Pin Name</th><th rowspan="2">Description</th></tr>
<tr><th>SC91710A</th><th>SC91710B</th></tr>
<tr><td>4</td><td>4</td><td>$\overline{C1}$</td><td rowspan="8">*Provides keyboard scanning.
* $\overline{HKS}$ pin is LOW, the column group stays in “HIGH” state and row group stays in “LOW” state.
*The keypad is compatible with the standard dual contact matrix keyboard (as figure1b), the inexpensive single contact keyboard (as figure 1a), and electronic input (as figure 1c).
*When $\overline{HKS}$ is “LOW”, a valid key entry is defined by related Row & Column connection or by electronic input (as shown 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 = 20ms)
 

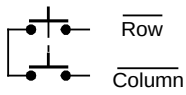
Figure1a: Single contact form keyboard configuration
 

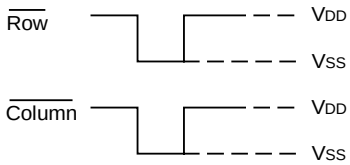
Figure1b: Dual contact form keyboard configuration
 

Figure1c: Electronic signal input keyboard configuration</td></tr>
<tr><td>1</td><td>1</td><td>$\overline{C2}$</td></tr>
<tr><td>2</td><td>2</td><td>$\overline{C3}$</td></tr>
<tr><td>3</td><td>3</td><td>$\overline{C4}$</td></tr>
<tr><td>14</td><td>16</td><td>$\overline{R1}$</td></tr>
<tr><td>15</td><td>17</td><td>$\overline{R2}$</td></tr>
<tr><td>16</td><td>18</td><td>$\overline{R3}$</td></tr>
<tr><td>13</td><td>15</td><td>$\overline{R4}$</td></tr>
<tr><td>5</td><td>5</td><td>OSCI</td><td rowspan="2">*Oscillator input & output pins.
*The 3.579545MHz oscillator is formed by a built-in inverter inside of this chip and by connecting a 3.579545MHz crystal or a ceramic resonator across the OSCI and OSCO pins. (built-in feedback resistor and capacitor)
*When $\overline{HKS}$ is “LOW”, a valid key-in may turn on this oscillator and generates a 3.579545 MHz clock.</td></tr>
<tr><td>6</td><td>6</td><td>OSCO</td></tr>
</table>

(to be continued)

(continued)

Pin No.		Pin Name	Description
SC91710A	SC91710B		
7	7	$\overline{\text{XMUTE}}$	*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.
8	8	VSS	*Negative power supply pin.
9	11	VDD	*Positive power supply pin.
10	12	$\overline{\text{HKS}}$	*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 $\overline{\text{HKS}}$ pin must be pulled “low” state for all function operation.
11	13	$\overline{\text{PO}}$	*Pulse output signal pin. *NMOS open drain output structure. *The output is “LOW” during pulse dialing and Flash operation, otherwise this output is “floating”.
12	14	TONE	*Dual Tone Multi-frequency output pin. *In TONE mode, when an entry of digit key (include *, # key), this pin will send out a corresponding DTMF signal. *The TONE pin provides minimum tone duration and minimum intertone pause time to support rapid key-in. If key-in time is less than 100ms, DTMF signal will last for 100ms; otherwise the tone duration will last as long as the key is pressed.
	9	$\overline{\text{HFI}}$	* Handfree input control pin. * Toggle input structure, 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 down resistor is 200k typical.
	10	HFO	* Handfree output control pin. * Inverter output structure (normally ‘low’, active ‘high’). * When a HFI pin is active, Handfree function will be enabled (HFO=1) or disable (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.

KEYBOARD OPERATION

Symbol definitions:

a)	↑	:	OFF-HOOK or enable Hand Free function.
b)	↓	:	ON-HOOK or disable Hand Free function.
c)		:	Input level from low to high.
d)		:	Input level from high to low.
e)	D1~Dn	:	Digit key：1, 2, 3, 4, 5, 6, 7, 8, 9, 0, *, #, (C1~Cn is same as D1~Dn).
f)	Dp1~Dpn	:	Pulse digit：1, 2, 3, 4, 5, 6, 7, 8, 9, 0, (Cp1~Cpn is same as Dp1~Dpn).
g)	Dt1~Dtn	:	Tone digit：1, 2, 3, 4, 5, 6, 7, 8, 9, 0, *, #, (Ct1~Ctn is same as Dt1~Dtn).
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	:	↑ D1, D2…, Dn↓
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	:	↑ F, D1, D2…, Dn ↓
Dial out	:	t_F, t_{FP}, Dt1, Dt2…, Dtn (in Tone mode)
Dial out	:	t_F, t_{FP}, Dp1, Dp2, …, Dpn (in Pulse mode)
LNB	:	D1, D2…, Dn

3. Dialing with P→T key

Procedure	:	↑ D1, D2 …, P→T , …, Dn ↓
Dial out	:	Dp1, Dp2, …, t_{PT}, …, Dpn (in Pulse mode)
LNB	:	D1, D2 …, P→T , …, Dn

Note: If key in digit over maximum digit stored in LNB, then RD is inhibit even after on/off hook.

B）Mixed dialing

Procedure	:	↑D1, D2…, P→T , D9, D10 …, Dn↓
Dial out	:	Dp1, Dp2, …, t_{PT}, Dt9, Dt10…, Dtn
LNB	:	D1, D2…, P→T , D9, D10 …, Dn

C）Redial

LNB	:	D1, D2…, Dn
Procedure	:	↑ RD ↓
Dial out	:	t_{RP}, Dt1, Dt2…, Dtn (in Tone mode)
Dial out	:	t_{RP}, Dp1, Dp2,…, Dpn (in Pulse mode)

Note: If key in digit over maximum digit stored in LNB, then RD is inhibit.

D）Pause Function

Procedure	:	↑ D1, D2…, Dn, P, C1 …, Cn ↓
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	:	↑ D1, D2…, Dn, F, C1 …, Cn ↓
Dial out	:	Dt1, Dt2,…, Dtn , t_F, t_{FP}, Ct1 …, Ctn (in Tone mode)
Dial out	:	Dp1, Dp2,…, Dpn , t_F, t_{FP}, Cp1 …, Cpn (in Pulse mode)
LNB	:	C1, C2 …, Cn

Handfree Function operation:

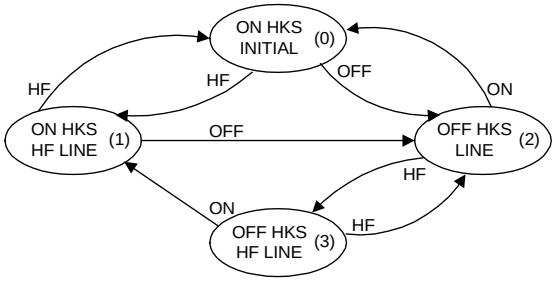
A) To execute Handfree function: When HFO = 'low', HFI pin is active, the Handfree function will be enabled (HFO = 'high')

B) Reset Handfree function:

a. OFF-HOOK action.

b. When HFO = 'high', a HFI pin is active again, the Handfree function will be reset (HFO='low').

Operating flow chart of Handfree

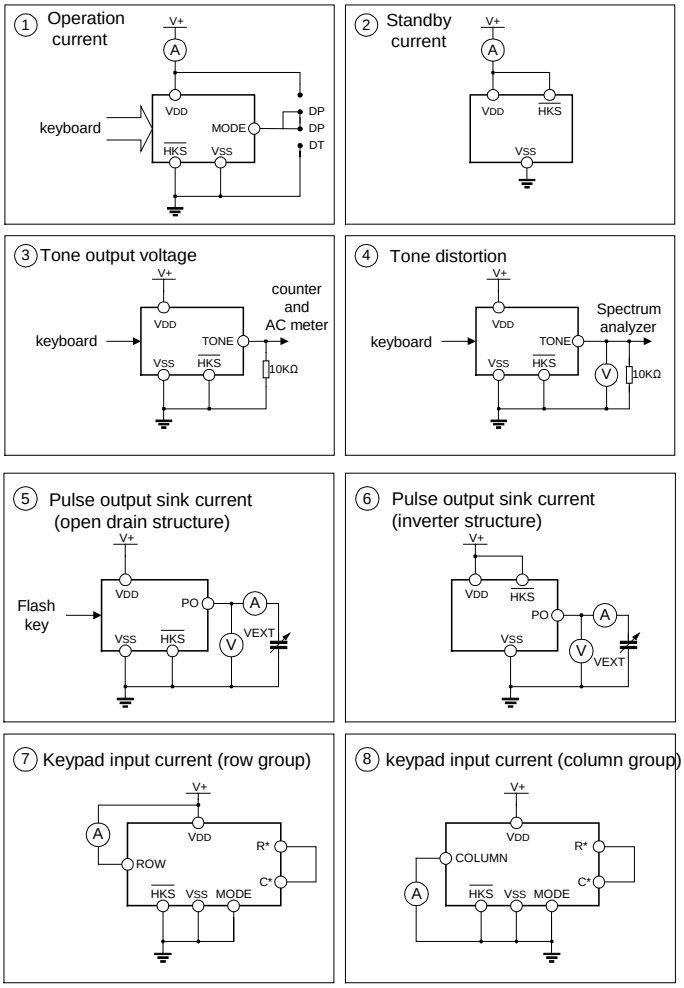


Note: ON: ON HKS; OFF: OFF HKS; HF: Pressed HF key

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)

TEST CIRCUIT



Note: 1. Dist. (dB)=20log{$[V_1^2+V_2^2+V_3^2+\ldots V_n^2)^{1/2}]/[(V_L^2+V_H^2)^{1/2}]$}

a. V1…Vn are extraneous frequencies (ie, inter modulation and harmonic), components in the 500Hz to 3400Hz band.

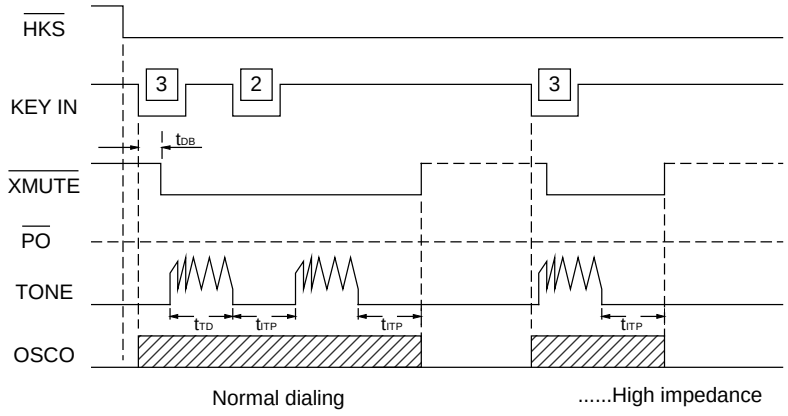
b. V_L,V_H are the individual frequency components of DTMF signal.

c. Whether keyboard is pushed refer to the TONE mode time diagram.

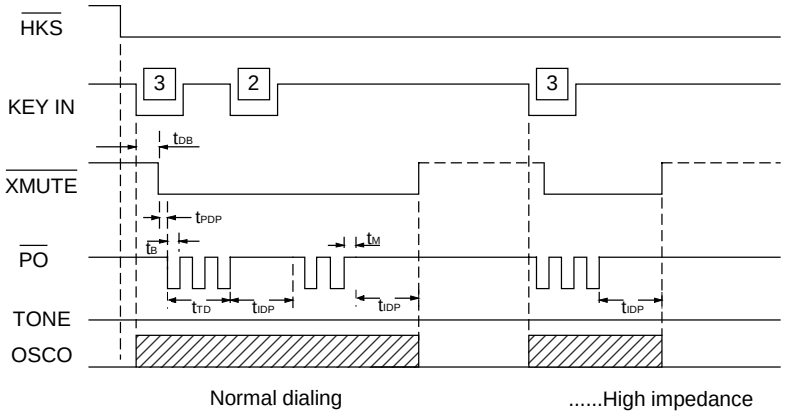
2. Sink current Isink=I/(1-Duty Cycle), I is the net DC current measured from ampere meter.

3. R*, C* mean other column and row.

TIMING DIAGRAMS

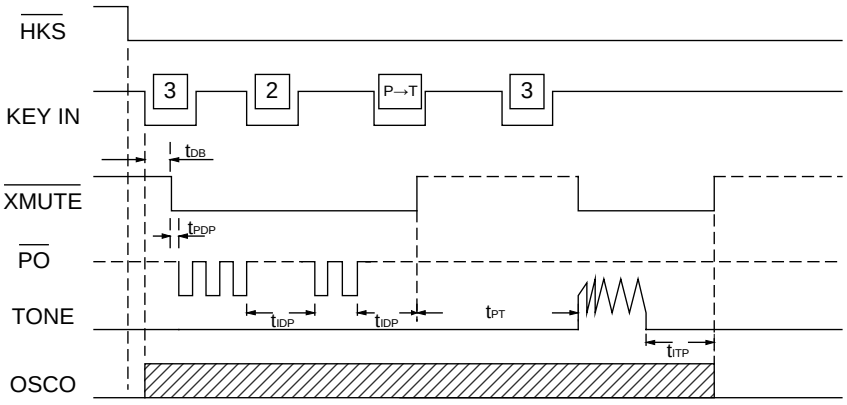


Tone Mode Timming Diagram



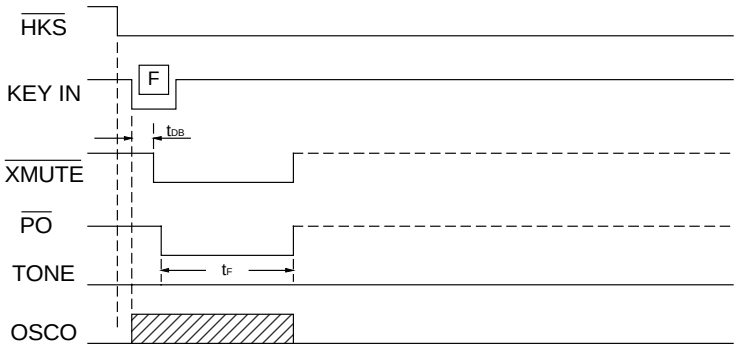
Pusle Mode Timming Diagram

TIMING DIAGRAMS (continued)



.....High impedance

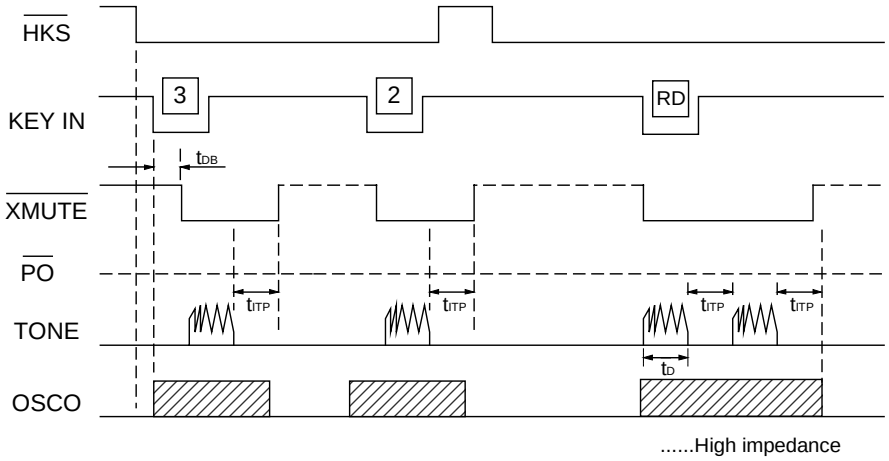
Timming Waveform for mixed dialing Operation
(by P→T key entry)



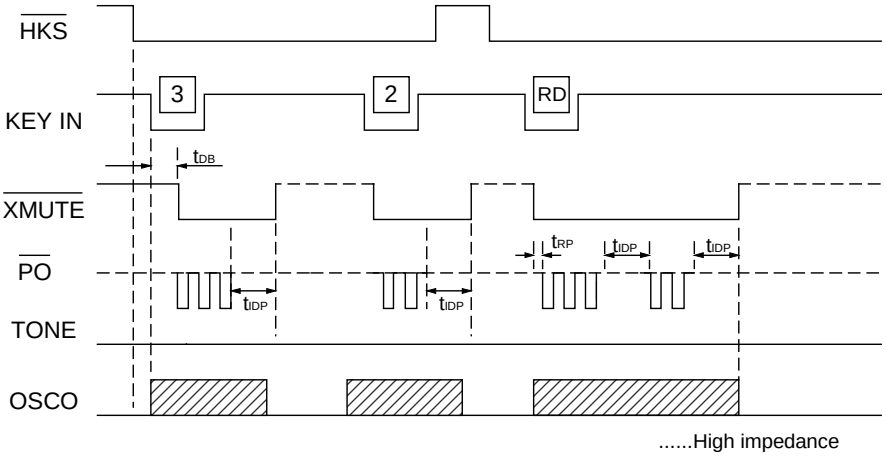
.....High impedance

Flash key operating timming

TIMING DIAGRAMS(continued)

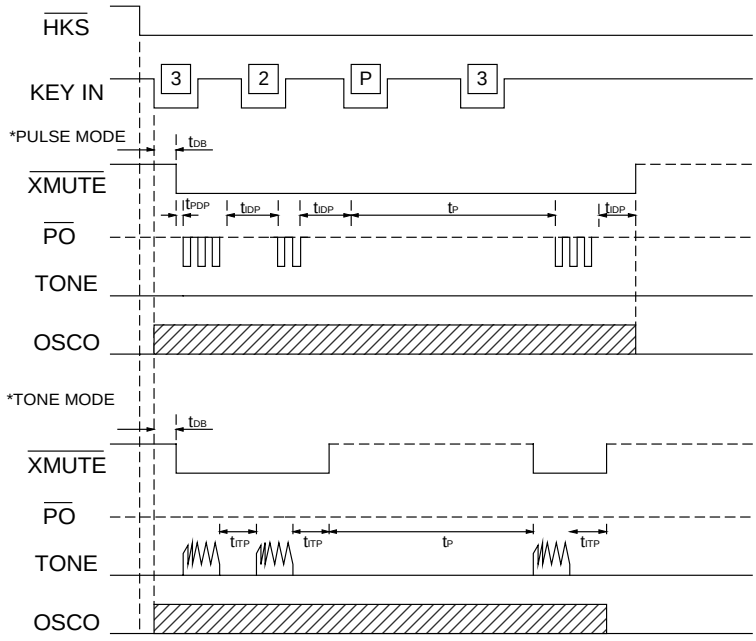


Tone Mode Redial Timming Diagram



Pulse Mode Redial Timming Diagram

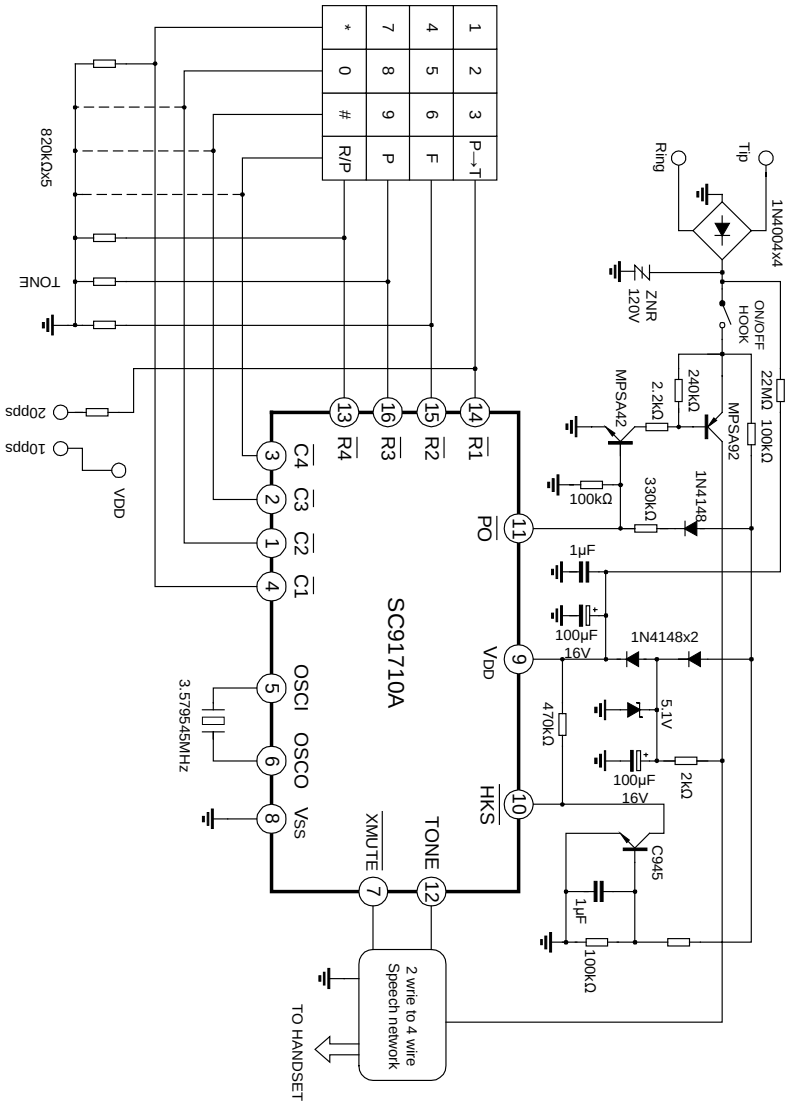
TIMING DIAGRAMS(continued)



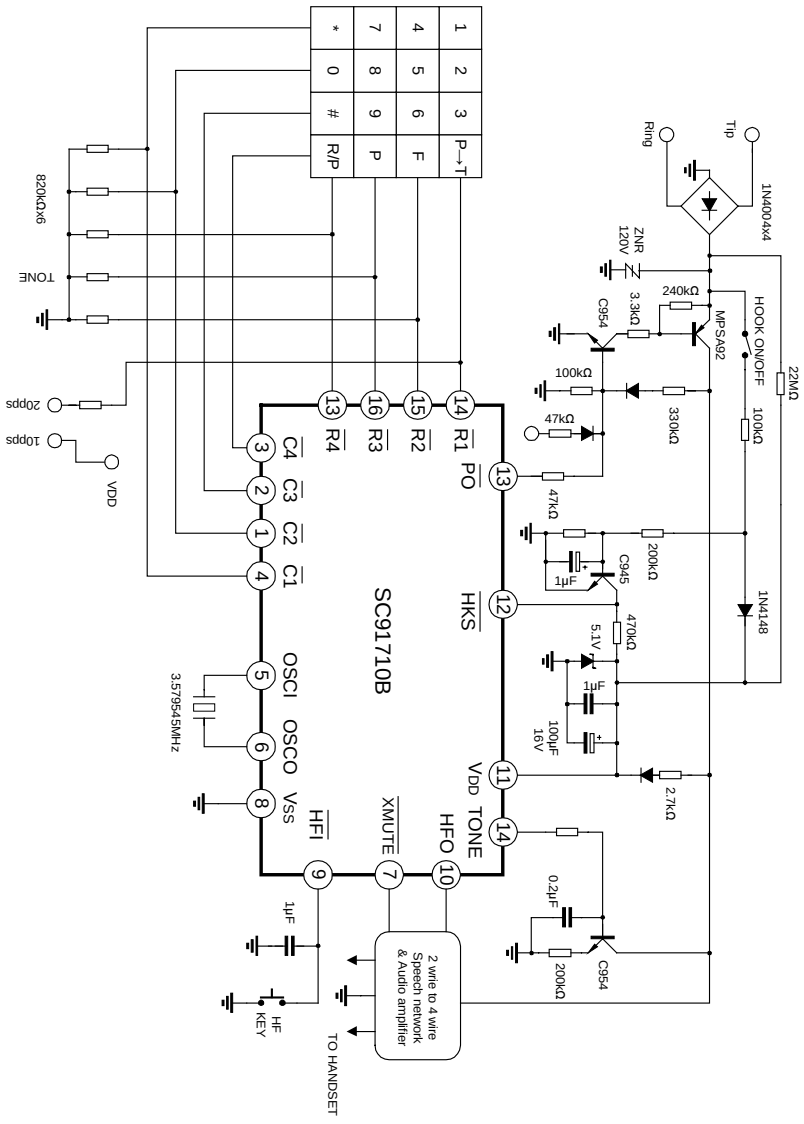
.....High impendance

Pause key operating timming

TYPACAL APPLICATION CIRCUIT



TYPACAL APPLICATION CIRCUIT



CHIP TOPOGRAPHY

Size: 1.45 x 1.54 mm^2

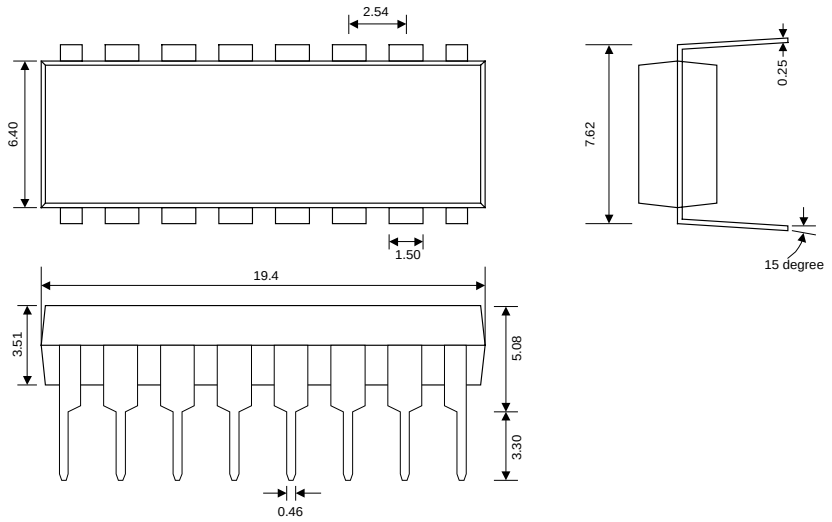
PAD COORDINATES (Unit: μm)

No.	Symbol	X	Y	No.	Symbol	X	Y
1	P1	-542.6	-238.0	10	P10	562.4	88.5
2	P2	-542.6	-468.1	11	P11	562.4	252.4
3	P3	-542.6	-602.5	12	P12	562.4	445.8
4	P4	-315.0	-602.5	13	P13	562.4	603.8
5	P5	-134.8	-602.5	14	P14	148.6	603.8
6	P6	85.5	-602.5	15	P15	-22.4	603.8
7	P7	562.4	-439.1	16	P16	-251.0	603.8
8	P8	562.4	-277.6	17	P17	-542.6	124.7
9	P9	562.4	-93.6	18	P18	-542.6	-102.9

Note: The original point of the coordinate is the die center.

PACKAGE OUTLINE

DIP-16-300-2.54 UNIT: mm



DIP-18-300-2.54 UNIT: mm