

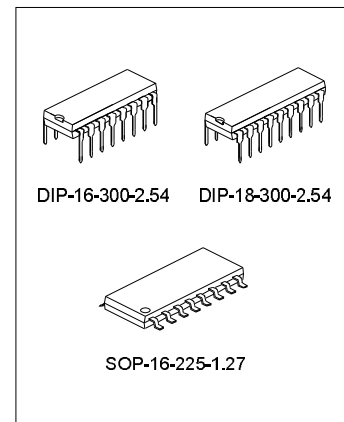
T/P SWITCHABLE DIALER WITH REDIAL HANDFREE FUNCTION

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

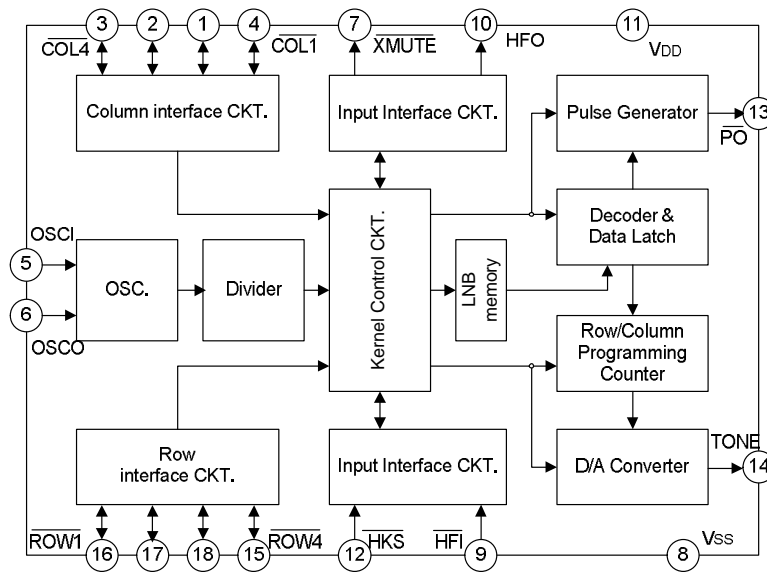
- * Tone/Pulse switchable dialer
- * One 32-digit last number redial memory
- * Pulse-to-tone (P→T) is provided for PBX operation
- * Flash key is available
- * Minimum tone duration is 98ms or 83ms
- * Minimum intertone pause is 98ms or 83ms
- * Redial Pause time (0ms)
- * Uses 3.579549MHz crystal or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



ORDERING INFORMATION

Device	Package
SC91710A	DIP-16-300-2.54
SC91710AS	SOP-16-225-1.27
SC91710B	DIP-18-300-2.54

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	*	0	#	RD

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

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	98ms	98ms
R	83ms	83ms

Note: NR: no resistance

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

UR: A resistance connect to VDD

ABSOLUTE MAXIMUM RATING($T_{amb}=25^{\circ}C$, All voltage referenced to V_{SS} , unless otherwise specified)

Characteristics	Symbol	Ratings	Unit
Power Supply Voltage	V_{DD}	6.0	V
Input Voltage	V_{IN}	-0.3~ $V_{DD}+0.3$	V
Power Dissipation	P_D	500	mW
Operating Temperature	T_{opr}	-25~+70	$^{\circ}C$
Storage Temperature	T_{stg}	-55~+150	$^{\circ}C$

ELECTRICAL CHARACTERISTICS($T_{amb}=25^{\circ}C$, $V_{DD}=2.5V$, $f_{osc}=3.579545MHz$, unless otherwise specified)

Characteristics	Symbol	Conditions	Min.	Typ.	Max.	Unit	
DC Characteristics							
Operating Voltage	V_{DD}	Tone	2.5	--	5.5	V	
		Pulse	2.0	--	5.5		
		Memory retention	1.0	--	5.5		
Operating Current	I_{OP}	Tone	OFF-HOOK, Keypad entry	0.6	2	mA	
		Pulse		0.2	0.5		
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 Low Voltage	V_{il}	--	V_{SS}	--	$0.3V_{DD}$	V	
Control Pin Input High Voltage	V_{ih}	--	$0.7V_{DD}$	--	V_{DD}		
\overline{XMUTE} Pin Leakage Current	I_{mth}	$V_{\overline{XMUTE}}=6.0V$	--	--	1	μA	
\overline{XMUTE} Pin Sink Current	I_{mtl}	$V_{\overline{XMUTE}}=0.5V$	0.2	0.5	--	mA	
\overline{HKS} Pin Input Current	I_{hks}	$V_{hks}=2.5V$	--	--	0.1	μA	
Keyboard	Drive Current	I_{kbd}	$V_n=0V$ (note1)	4	10	30	μA
Scanning Pin	Sink Current	I_{kbs}	$V_n=2.5$ (note1)	200	400	800	
Key-in Debounce Time	t_{DB}	--	--	20	--	ms	
HFI pin input resistor	R_{hfi}	$V_{DD}=2.5$	--	200	--	$k\Omega$	
HFO pin drive current	I_{hdoh}	$V_{hfo}=2.0V$	0.5	--	--	mA	
HFO pin sink current	I_{hdol}	$V_{hfo}=2.5V$	0.5	--	--	mA	
Pulse Mode							
Pulse Output Pin Leakage Current	I_{poh}	$V_{po}=2.5V$	0.1	--	--	μA	
Pulse Output Pin Sink Current	I_{pol}	$V_{po}=0.5V$	0.5	--	--	mA	
Pulse Rate	f_{pr}		--	10	--	pps	
			--	20	--		
Make/Break Ratio	$t_m: t_b$		--	40:60	--	%	
			--	33:66	--		
Pre-digit Pause	t_{PDP}	M/B ratio=40:60	--	40	--	ms	
		M/B ratio=33:66	--	33	--		

(To be continued)

(Continued)

Characteristics	Symbol	Conditions	Min.	Typ.	Max.	Unit	
Inter-digit Pause	tIDP	Pulse rate=10pps	--	800	--	ms	
		Pulse rate=20pps	--	500	--		
Tone Mode							
Tone	DC Level	V _{dc}	V _{DD} =2.0V~5.5V	0.5V _{DD}	--	0.7V _{DD}	V
	Sink Current	I _{tl}	V _{dtmf} =0.5V	0.2	--	--	mA
Output Pin	AC level	V _{dtmf}	Row group, R _L =10KΩ	130	155	170	mV _{rms}
	Load Resistor	R _L	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	t _{TD}	Auto redial	--	98/83	--	ms	
Minimum Intertone Pause Time	t _{ITP}	Auto redial	--	98/83	--	ms	

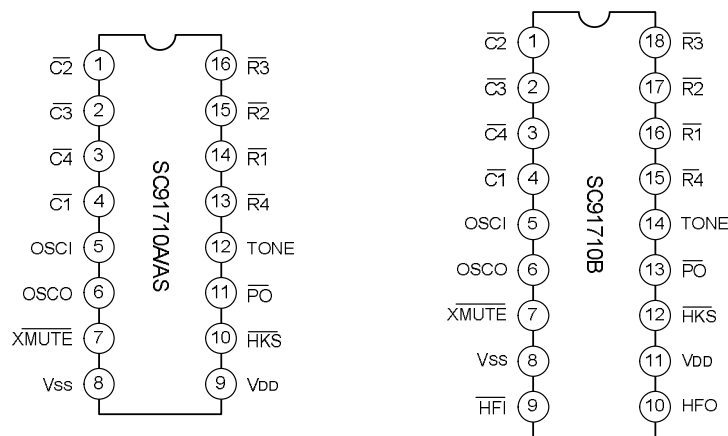
 Note: 1. V_n: Input voltage of any keyboard scanning pin (Row group, Column group)

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

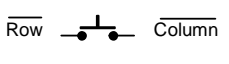
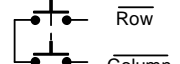
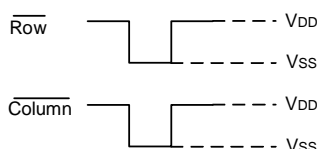
 V_L, V_H: Row group and Column group signal, V₁, V₂..., V_n: Harmonic signal (BW = 300Hz~3500Hz)

ACTUAL FREQUENCY OUTPUT (f_{osc}=3.579545MHz)

Keyboard Scanning Pin	Standard(Hz)	Output	Deviation(%)
R1	f1	699	+0.28
R2	f2	766	-0.52
R3	f3	848	-0.47
R4	f4	948	+0.74
C1	f5	1216	+0.57
C2	f6	1332	-0.30
C3	f7	1472	-0.34

PIN CONFIGURATION


PIN DESCRIPTION

Pin No.		Pin Name	Description
SC91710A/AS	SC91710B		
4	4	$\overline{C1}$	<ul style="list-style-type: none"> * 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)
1	1	$\overline{C2}$	
2	2	$\overline{C3}$	
3	3	$\overline{C4}$	
14	16	$\overline{R1}$	  <p>Figure1a: Single contact form keyboard configuration Figure1b: Dual contact form keyboard configuration</p>  <p>Figure1c: Electronic signal input keyboard configuration</p>
15	17	$\overline{R2}$	
16	18	$\overline{R3}$	
13	15	$\overline{R4}$	
5	5	OSCI	<ul style="list-style-type: none"> * 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.
6	6	OSCO	
7	7	\overline{XMUTE}	<ul style="list-style-type: none"> * 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.

(To be continued)

(Continued)

Pin No.		Pin Name	Description
SC91710A	SC91710B		
10	12	$\overline{\text{HKS}}$	<ul style="list-style-type: none"> * 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	$\overline{\text{PO}}$	<ul style="list-style-type: none"> * 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	<ul style="list-style-type: none"> * 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	$\overline{\text{HFI}}$	<ul style="list-style-type: none"> * 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	<ul style="list-style-type: none"> * 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) \uparrow : OFF-HOOK or enable Hand Free function.
- b) \downarrow : ON-HOOK or disable Hand Free function.
- c) \uparrow (with horizontal line) : Input level from low to high.
- d) \downarrow (with horizontal line) : 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 : \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 , 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 : \uparrow D1, D2 ..., P→T, ..., Dn \downarrow
- 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) Redial

- LNB : D1, D2..., Dn
- Procedure : \uparrow RD \downarrow
- 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.

C) 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

D) Flash Function

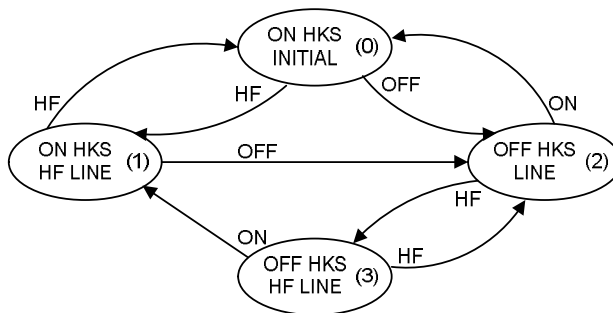
1. Reset

Procedure : \uparrow D1, D2..., Dn, F, C1 ..., Cn \downarrow
 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

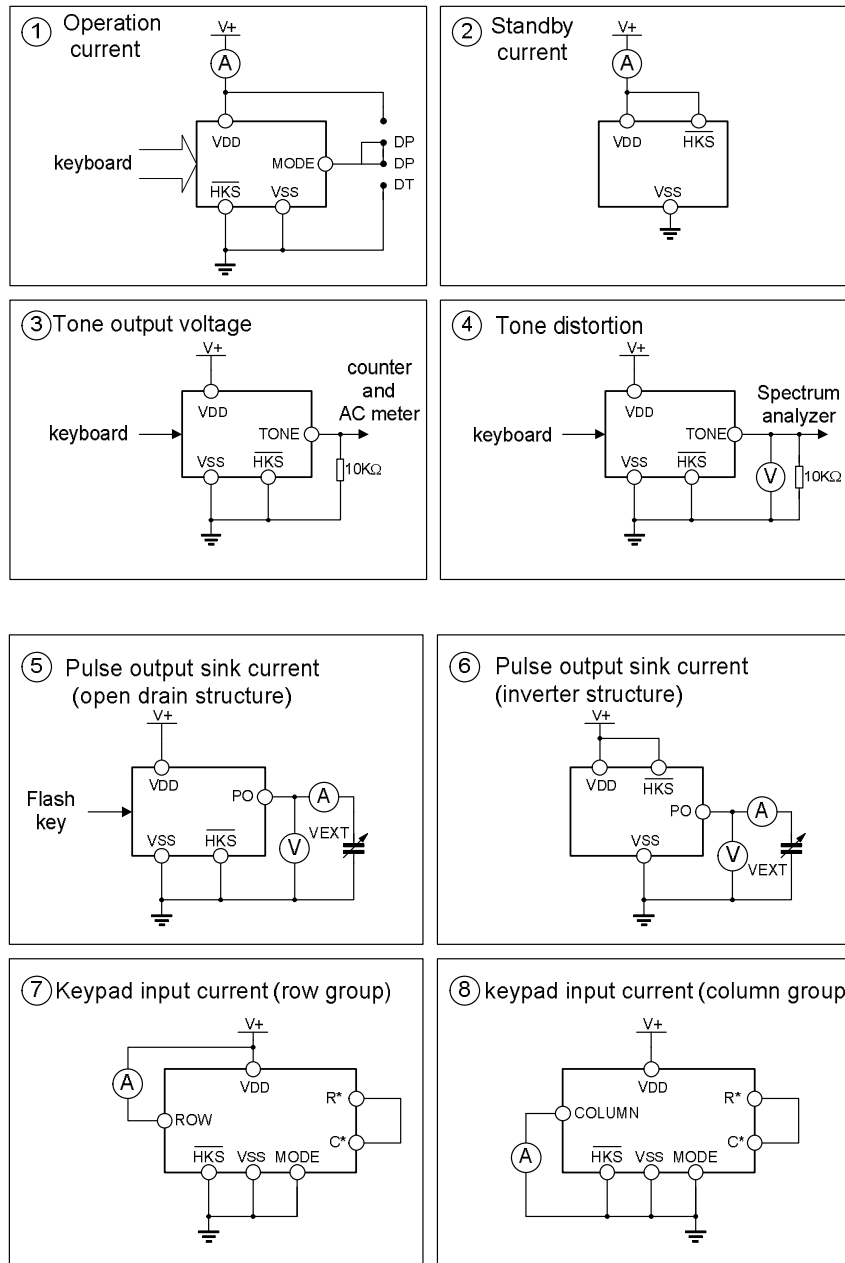


Note: ON: ON HKS; OFF: OFF HKS; HF: Pressed HF key

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)

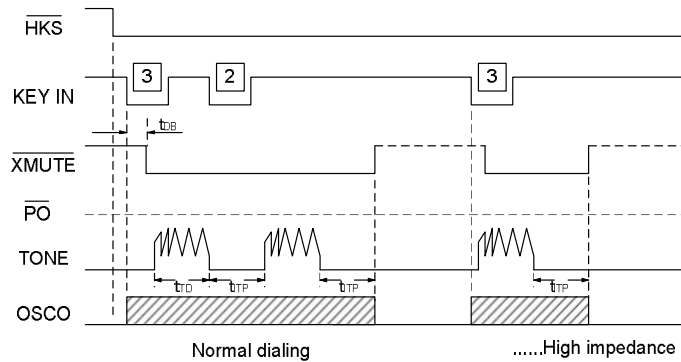
TEST CIRCUIT



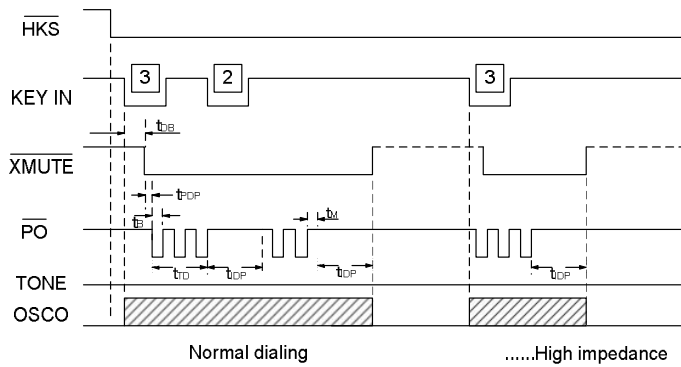
Note: 1. $\text{Dist. (dB)} = 20 \log \left\{ \frac{[V_1^2 + V_2^2 + V_3^2 + \dots + V_n^2]^{1/2}}{[(V_L^2 + V_H^2)^{1/2}]} \right\}$

- a. $V_1 \dots V_n$ 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 $I_{\text{sink}} = I / (1 - \text{Duty Cycle})$, I is the net DC current measured from ampere meter.
 3. R^*, C^* mean other column and row.

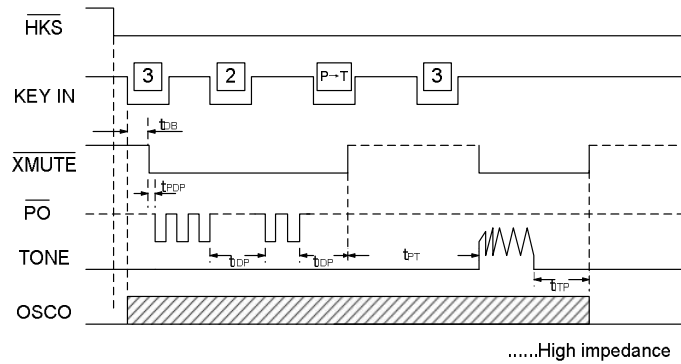
TIMING DIAGRAMS



Tone Mode Timing Diagram

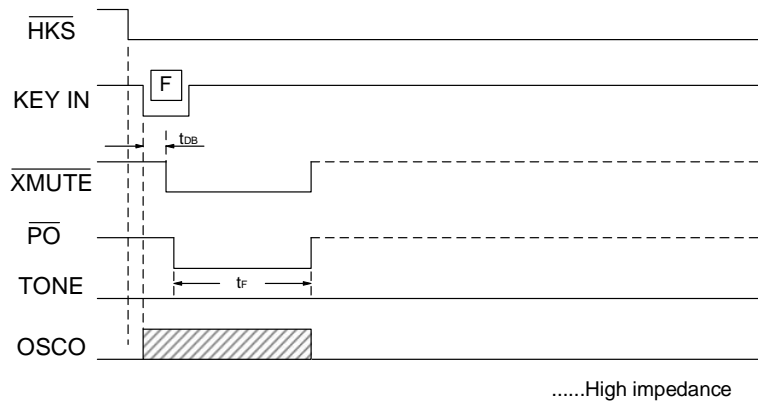


Pulse Mode Timing Diagram

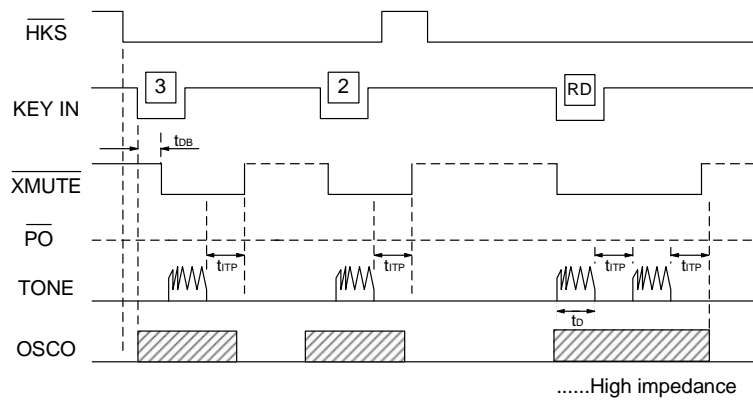


Timing Waveform for P→T key operation

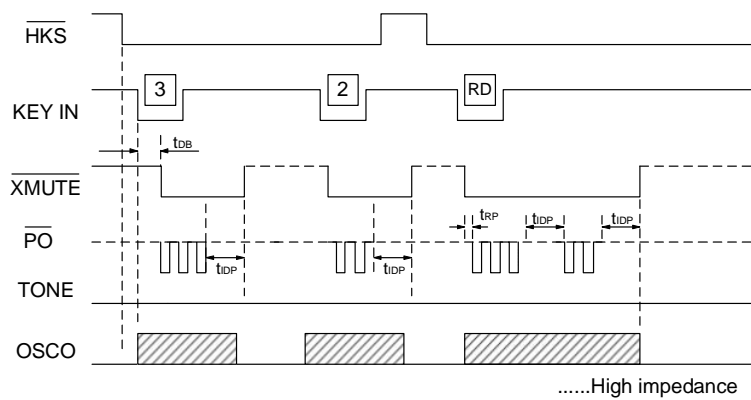
TIMING DIAGRAMS(continued)



Flash key operating timing

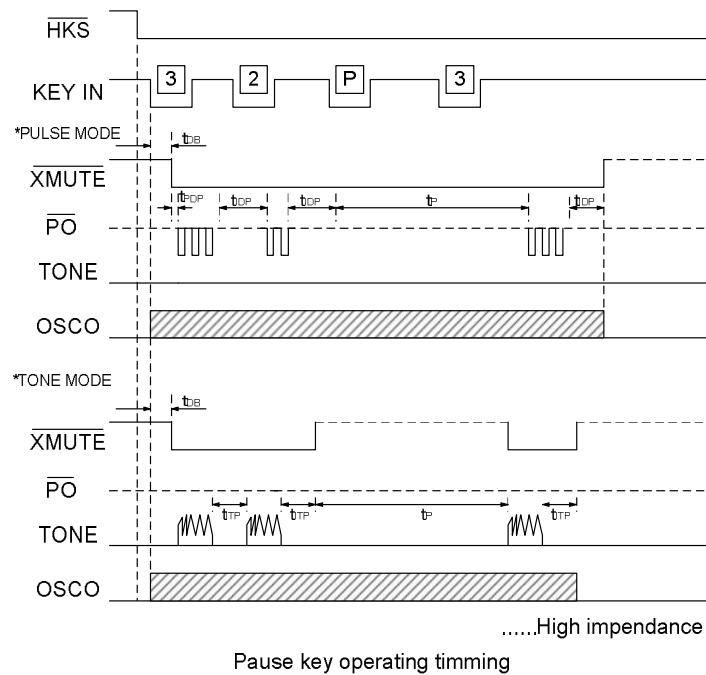


Tone Mode Redial Timing Diagram

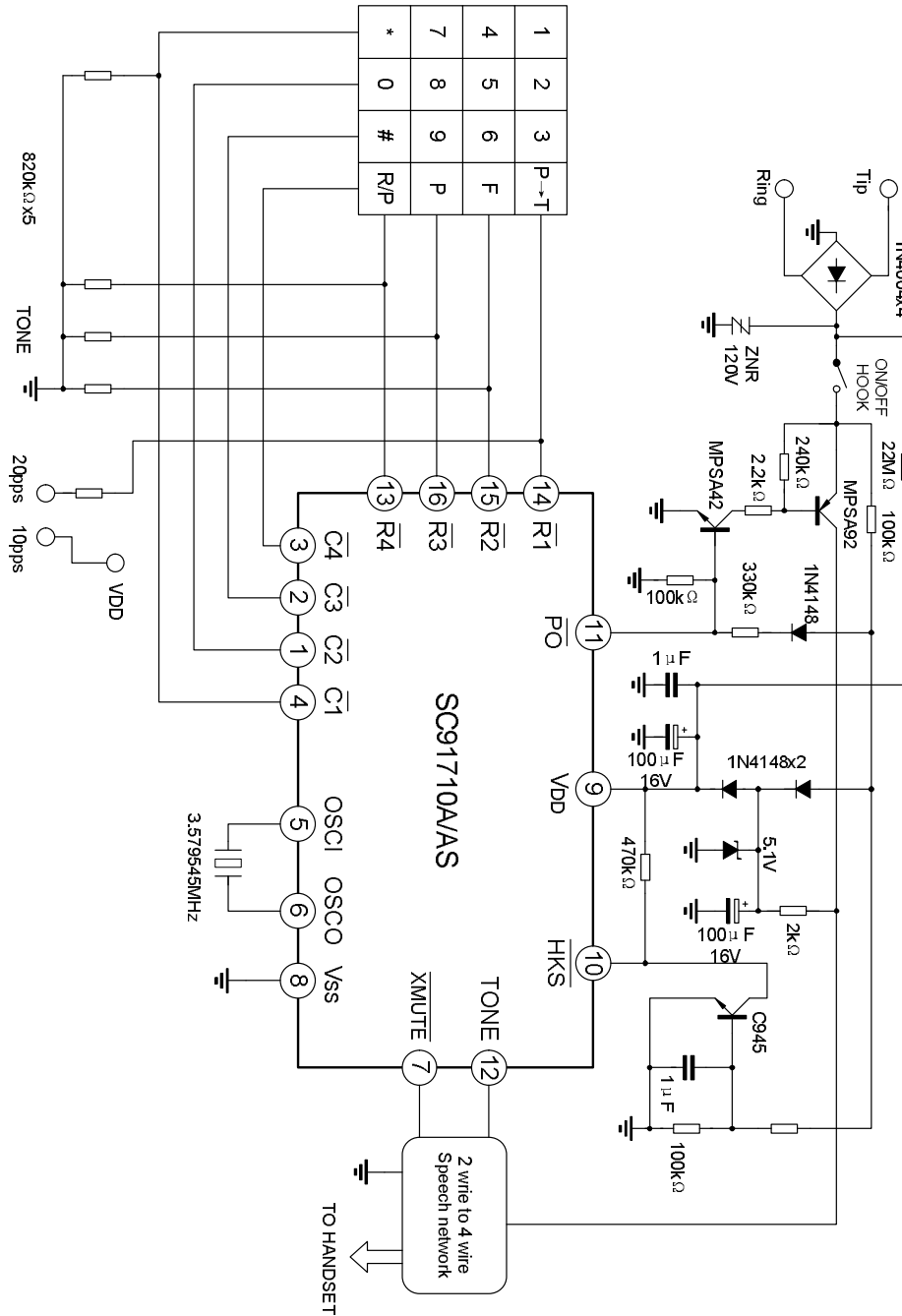


Pulse Mode Redial Timing Diagram

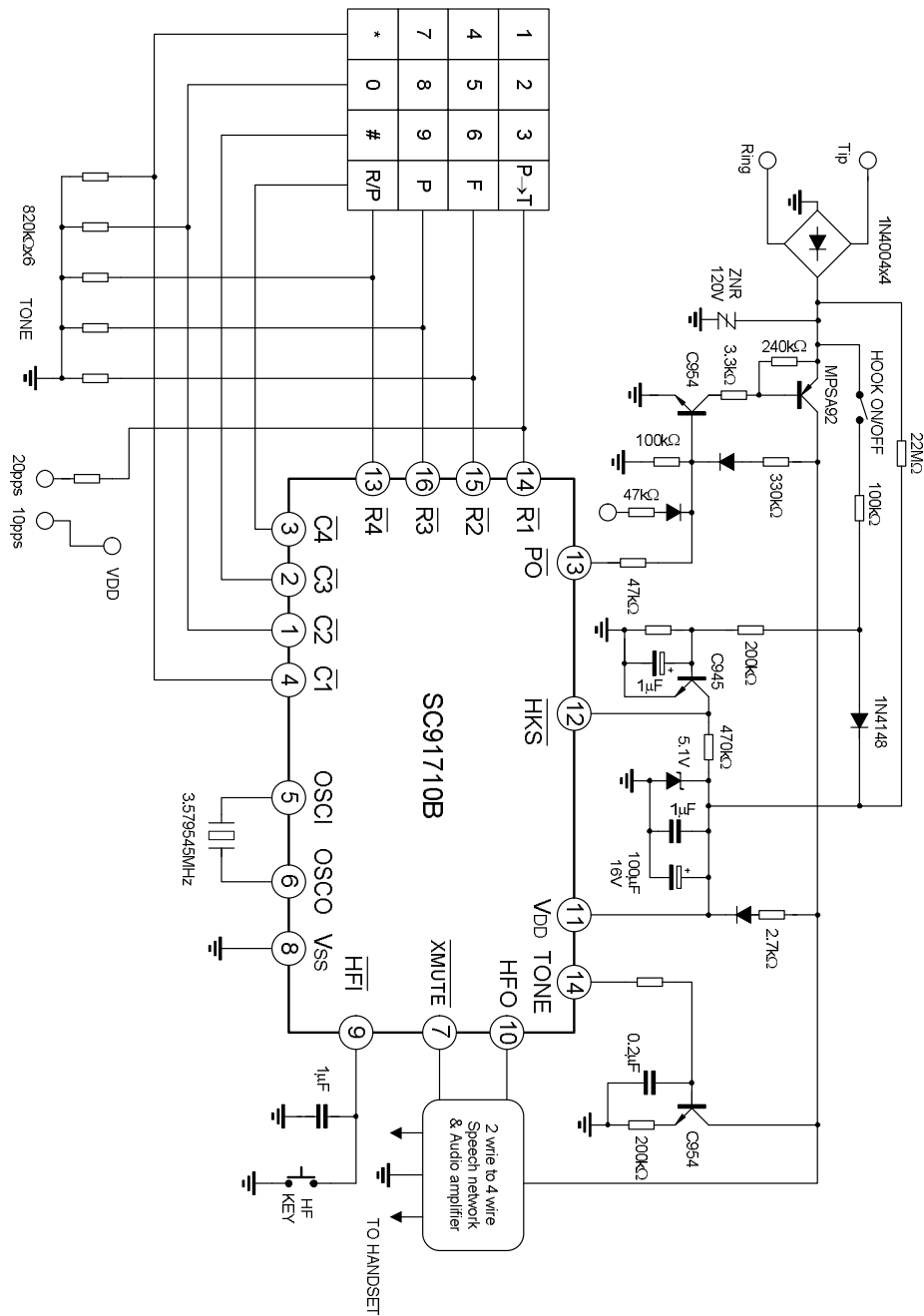
TIMING DIAGRAMS(continued)



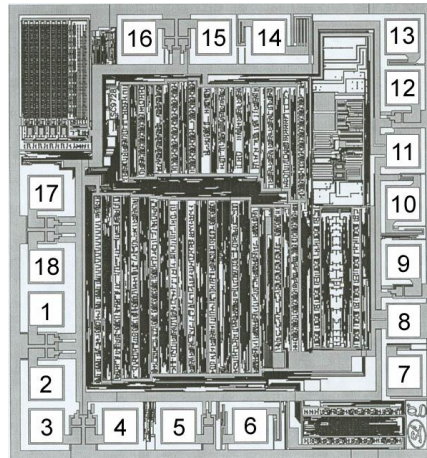
TYPICAL APPLICATION CIRCUIT



TYPICAL APPLICATION CIRCUIT



CHIP TOPOGRAPHY



Size: 1.45 x 1.54 mm²

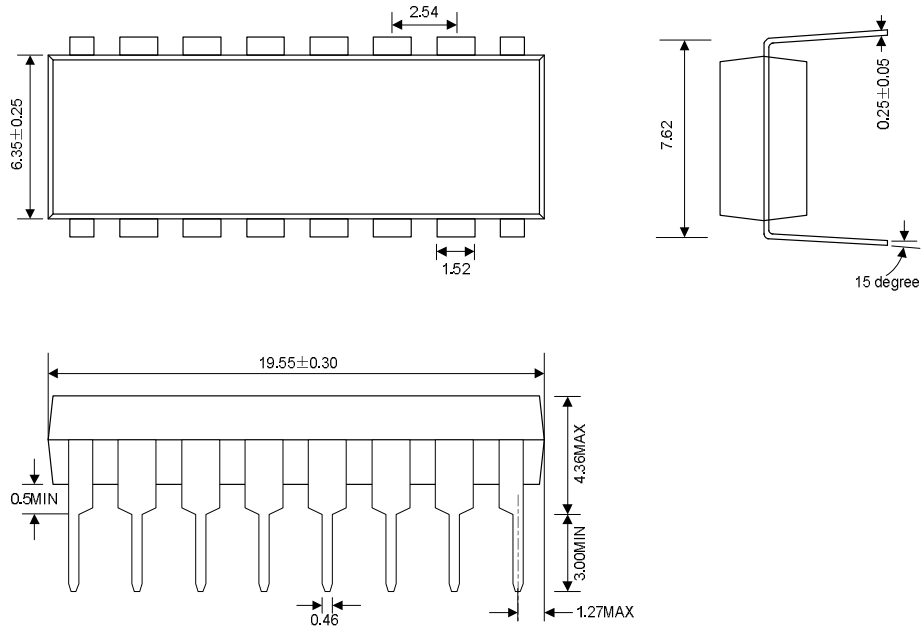
PAD COORDINATES (Unit: μm)

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

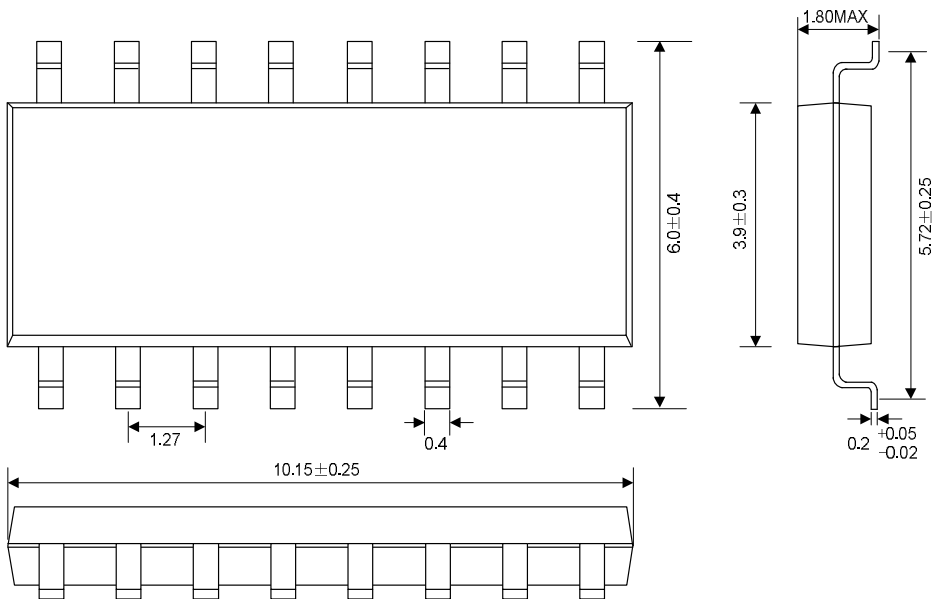
Note: The original point of the coordinate is the die center.

PACKAGE OUTLINE

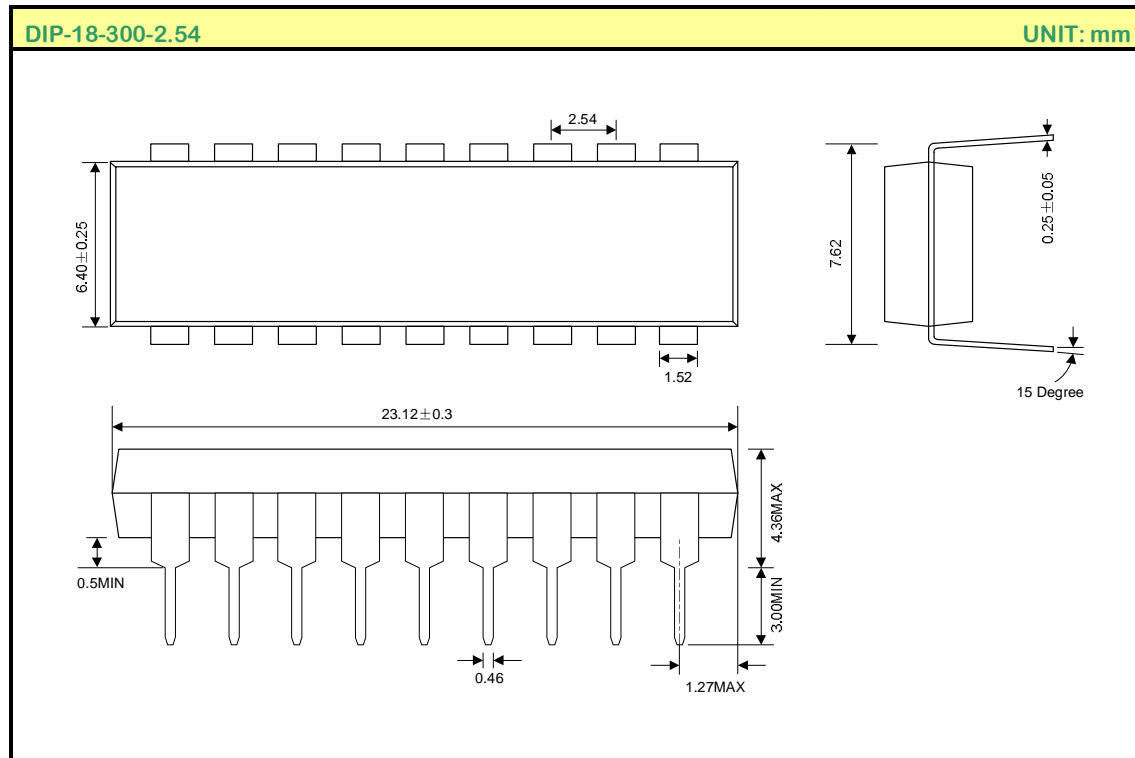
DIP-16-300-2.54 UNIT: mm



SOP-16-225-1.27 UNIT: mm



PACKAGE OUTLINE(Continued)



HANDLING MOS DEVICES:

Electrostatic charges can exist in many things. All of our MOS devices are internally protected against electrostatic discharge but they can be damaged if the following precautions are not taken:

- Persons at a work bench should be earthed via a wrist strap.
- Equipment cases should be earthed.
- All tools used during assembly, including soldering tools and solder baths, must be earthed.
- MOS devices should be packed for dispatch in antistatic/conductive containers.

ATTACHMENT
Revision History

Data	REV	Description	Page
2000.12.31	1.0	Original	
2001.11.13	2.0		
2002.04.19	2.1	Delete the "or */T" and the "5)....." of the "KEYBOARD ASSIGNMENT"	2
		Delete the " * Mixed dialing"	1
		Delete the "D: Key type select"	3
		Delete the "B) Mixed dialing" of the "KEYBOARD OPERATION" and modify the "C) Redial " and "D) Pause Function" ,"E) Flash Function	8
		The "Timing waveform for mixed dialing operation (by P→T key entry) change to "Timing waveform for P→ T key operation " of the "TIMING DIAGRAMS"	12
		Modify the "TYPICAL APPLICATION CIRCUIT"	15
		Modify the "PACKAGE OUTLINE"	18
2007.03.07	2.2	Add the package of "SOP-16-225-1.27"	1,16