# Silan Semiconductors

SC9102C/D

TONE / PULSE DIALER WITH REDIAL FUNCTION

DESCRIPTION

The SC9102C/D 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 100ms

*Minimum intertone pause is 106ms

*Uses 3.579549MHz crystal or ceramic resonator

*Redial Pause time (0ms)

*Mixed dialing

*Power on reset circuit is provided

*Many options can be selected

  Mode (10PPS; 20PPS; Tone)

  M/B ratio (40:60;33:66)

  Pause time (3.6ms)

*Flash function (RESET)

  (P→T) pause time (3.6ms)

  Flash time (600/100ms)
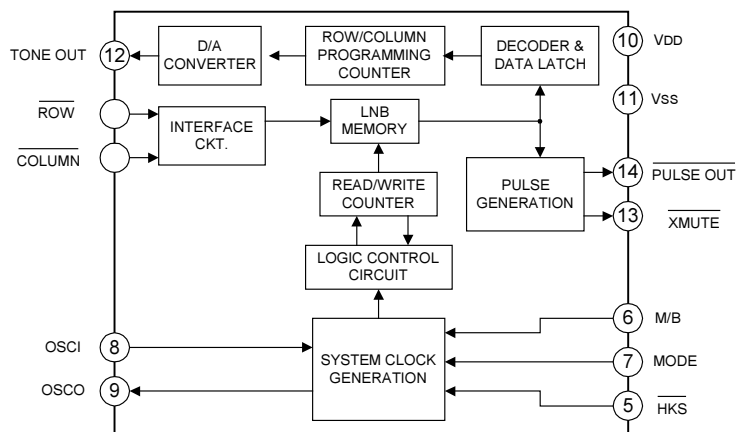
  Flash pause time (0ms)

*Packaged in 18-pin plastic DIP
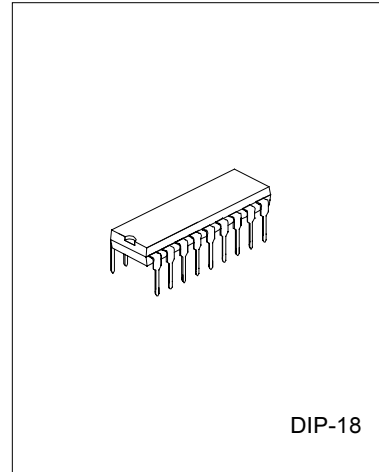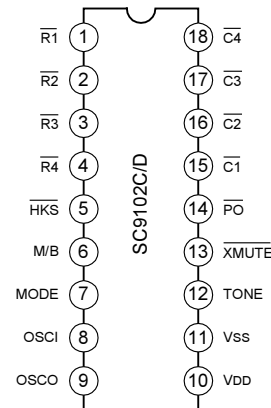
DIP-18

ORDERING INFORMATION

SC9102C	DIP-18 Packaged
SC9102D	DIP-18 Packaged

PIN CONFIGURATIONS

	SC9102C/D	
$\overline{R1}$ (1)		(18) $\overline{C4}$
$\overline{R2}$ (2)		(17) $\overline{C3}$
$\overline{R3}$ (3)		(16) $\overline{C2}$
$\overline{R4}$ (4)		(15) $\overline{C1}$
$\overline{HKS}$ (5)		(14) $\overline{PO}$
M/B (6)		(13) $\overline{XMUTE}$
MODE (7)		(12) TONE
OSCI (8)		(11) Vss
OSCO (9)		(10) VDD

BLOCK DIAGRAM

KEYBOARD ASSIGNMENT

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

Note: 1) P→T: Execute P→T function.

2) P: Pause key.

3) F: Flash key

4) RD: Redial key

5) */P: In Tone mode, execute * function; In pulse mode, execute pause function

6) #/RD: In Tone mode, execute # function; In pulse mode, execute redial function

DIALING SIGNAL OPTION

M/B	Pulse Rate	M/B Ratio	Flash Time	
			SC9102D	SC9102C
Vss	10PPS	40:60	600ms	100ms
VDD	10PPS	33:66	100ms	600ms
Open	20PPS	33:66	600ms	600ms

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ABSOLUTE MAXIMUM RATINGS

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

Characteristic	Symbol	Value	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	Topr	-25~+70	°C
Storage Temperature	Tstg	-55~+150	°C

ELECTRICAL CHARACTERISTICS

(Tamb=25°C , V_{DD}=2.5V, fosc=3.579545MHz, unless otherwise specified)

Parameter		Symbol	Conditions	Min	Typ	Max	Unit
Operating Voltage		V_{DD}	Tone/Pulse	2.0		5.5	V
			Memory retension	1.0		5.5	
Operating Current		IOP	Tone		0.6	2	mA
			Pulse, OFF-HOOK, Keypad entry, no load		0.2	0.6	
Standby Current		IS	ON-HOOK，No keypad entry ,no load V_{DD}=1.0V		0.1	5	μA
Memory Retension Current		Imr			0.1	0.1	μA
Control Pin Input Low Voltage		Vil		VSS		0.3V_{DD}	V
Control Pin Input High Voltage		Vih		0.7V_{DD}		V_{DD}	
$\overline{XMUTE}$ Pin Leakage Current		Imth	V$_{\overline{XMUTE}}$ =12.0V			1	μA
$\overline{XMUTE}$ Pin Sink Current		Imtl	V$_{\overline{XMUTE}}$ =0.5V	1			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		
Key-in Debounce Time		tDB			20		ms
Pulse Mode							
Pulse Output Pin Leakage Current		Ipoh	Vpo=12V	--	--	1.0	μA
Pulse Output Pin Sink Current		Ipol	Vpo=0.5V	1. 0	3.0	--	mA
Pulse Rate		fpr		--	10	--	pps
				--	20	--	
Make/Break Ratio		t_M: t_B		--	40:60	--	%
				--	33:66	--	

(continued)

Parameter		Symbol	Conditions	Min	Typ	Max	Unit
Pre-digit Pause （Pulse rate=10pps）		t_{PDP}	M/B ratio=40:60	--	40	--	ms
			M/B ratio=33:66	--	33	--	
Pre-digit Pause （Pulse rate=20pps）		t_{PDP}	M/B ratio=40:60	--	20	--	ms
			M/B ratio =33:66	--	16.5	--	
Inter-digit Pause		t_{IDP}	Pulse rate=10pps	--	800	--	ms
			Pulse rate=20pps	--	600	--	
Tone Mode							
Tone Output Pin	DC Level	Vdc	VDD=2.0V~5.5V	0.45VDD	0.55VDD	0.7VDD	V
	Sink Current	Itl	Vdtmf=0.5V	0.15	--	--	mA
	AC level	Vdtmf	Row group，R_L=10KΩ	120	150	180	mVrms
	Load Resistor	R1	Dist.<=-23dB	10	--	--	KΩ
DTMF Signal	Pre-emphasis	twist	VDD=2.0~5.5 V	1	2	3	dB
	Distortion(note 2)	Dist.	R_L=10KΩ	--	-30	-23	dB
Minimum tone duration Time		t_{TD}	Auto redial	--	100	--	ms
Minimum Intertone Pause Time		t_{TTP}	Auto redial	--	106	--	ms

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

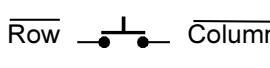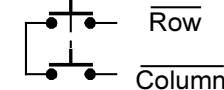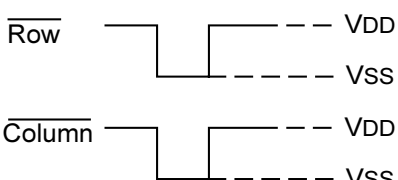2. Distortion (dB) = $20\log\{[V_1{}^2+V_2{}^2+V_3{}^2+…Vn^2)^{1/2}]/[(V_L{}^2+V_H{}^2)^{1/2}]\}$

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

Pin No.	Pin Name	Description
15	$\overline{C1}$	*Provides keyboard scanning. * $\overline{HKS}$ pin is LOW, the column group stays in "HIGH" and row group stays in "LOW" state.
16	$\overline{C2}$	*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).
17	$\overline{C3}$	*When $\overline{HKS}$ is "LOW", a valid key entry is defined by related Row & Column connection or by electronic input.
18	$\overline{C4}$	*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	$\overline{R1}$	
2	$\overline{R2}$	Figure1a: Single contact form keyboard configuration Figure1b: Dual contact form keyboard configuration
3	$\overline{R3}$	
4	$\overline{R4}$	Figure1c: Electronic signal input keyboard configuration
8	OSCI	*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)
9	OSCO	*When $\overline{HKS}$ is "LOW", a valid key-in may turn on this oscillator and generates a 3.579545 MHz clock.

(to be continued)

(continued)

Pin No.	Pin Name	Description		
13	X̄M̄Ū̄T̄Ē̄	*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.		
11	VSS	*Negative power supply pin.		
10	VDD	*Positive power supply pin.		
5	H̄K̄S̄	*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 H̄K̄S̄ pin must be pulled "low" state for all function operation.		
14	P̄Ō	*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	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.		
7	MODE	*Mode selection pin. *Three-state input structure. *This pin can select the three modes shown on the right.	**MODE** VDD Open Vss	**Dialing mode** Pulse mode Pulse mode Tone mode
6	M/B	*M/B ration selection pin. (The function seeing the Dialing signal option table)		

KEYBOARD OPERATION

Symbol definitions:

a) $\uparrow$: OFF-HOOK or enable Hand Free function.

b) $\downarrow$: 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	:	$\uparrow$ 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$\rightarrow$T key

Procedure	:	$\uparrow$ D1，D2 …, P$\rightarrow$T , …, Dn $\downarrow$
Dial out	:	Dp1，Dp2, …, t_{PT}, …, Dpn (in Pulse mode)
LNB	:	D1，D2 …, P$\rightarrow$T , …, Dn

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

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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	:	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	:	$\uparrow$ 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

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

TEST CIRCUIT

① Operation current

keyboard

② Standby current

③ Tone output voltage

keyboard — counter and AC meter — 10KΩ

④ Tone distortion

keyboard — Spectrum analyzer — 10KΩ

⑤ Pulse output sink current (open drain structure)

Flash key

⑥ Pulse output sink current (inverter structure)

⑦ Keypad input current (row group)

⑧ keypad input current (column group)
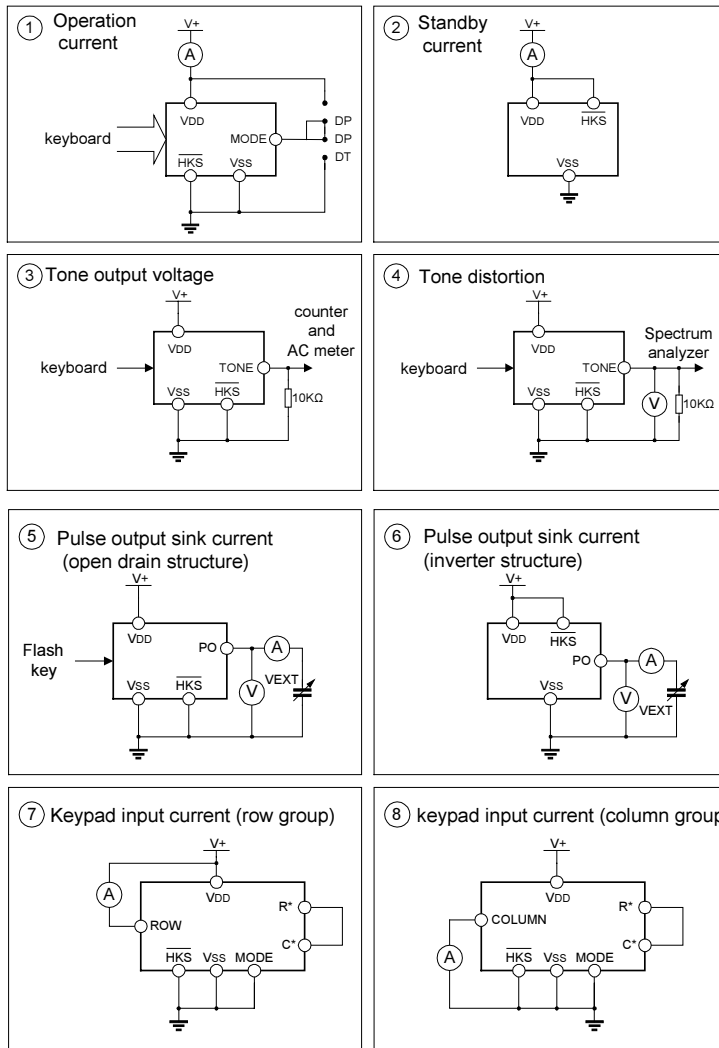
Note: 1. Dist. (dB)=$20\log\{[V_1^2+V_2^2+V_3^2+\ldots V_n^2)^{1/2}]/[(V_L^2+V_H^2)^{1/2}]\}$

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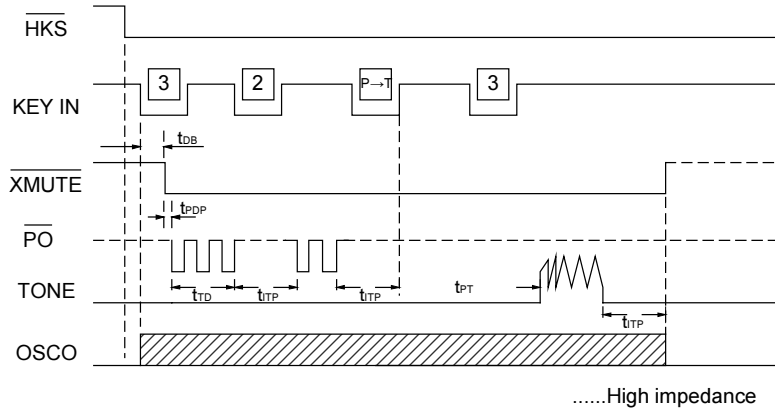
  3. R*, C* mean other column and row.

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TIMING DIAGRAMS

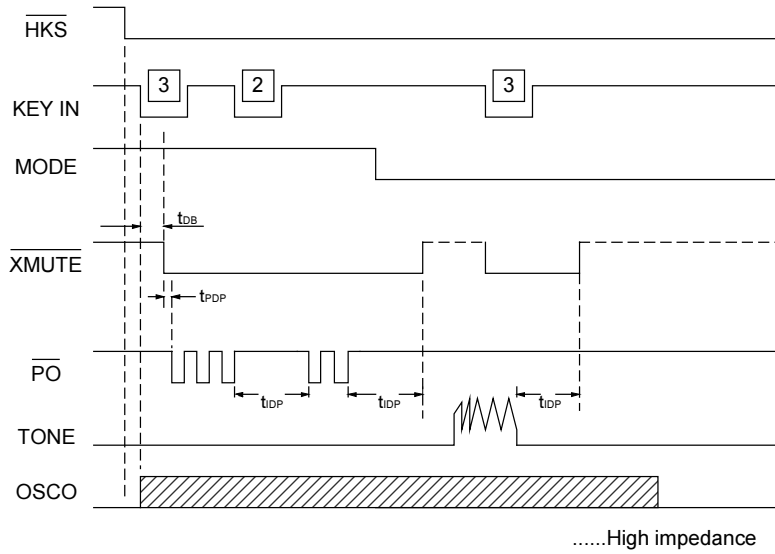Tone Mode Timming Diagram

Pusle Mode Timming Diagram
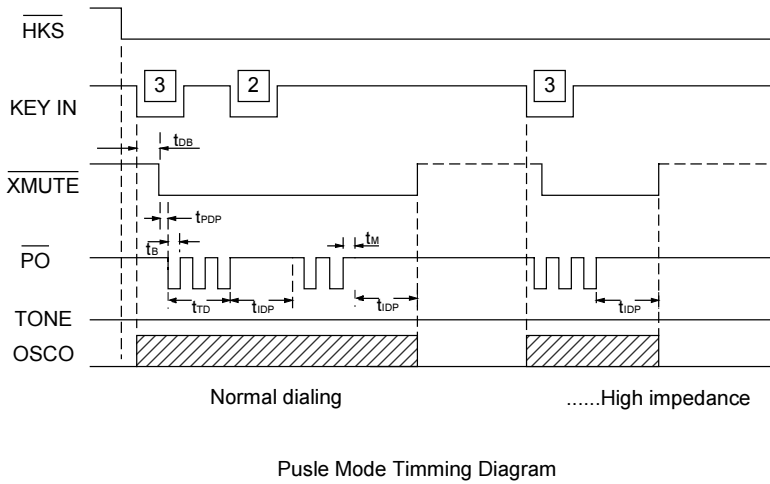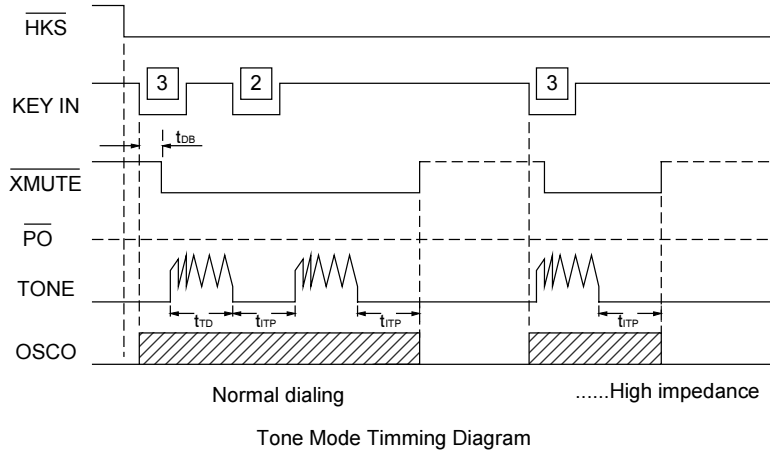
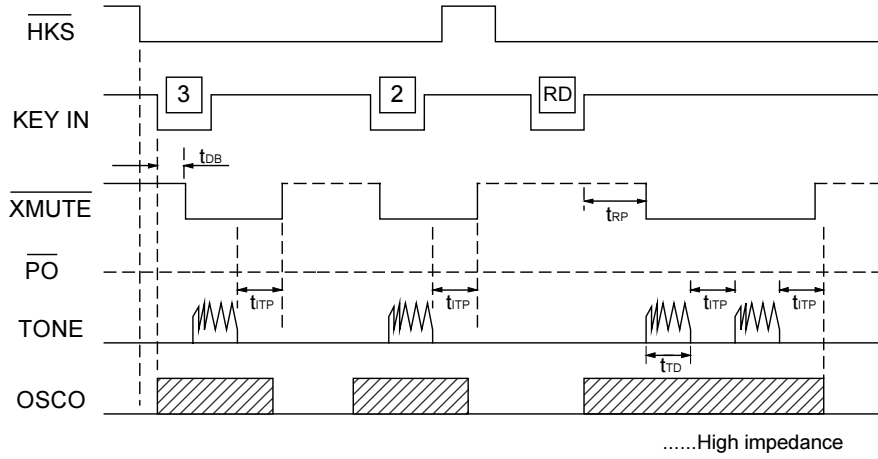**TIMING DIAGRAMS** (continued)

Timming Waveform for mixed dialing Operation
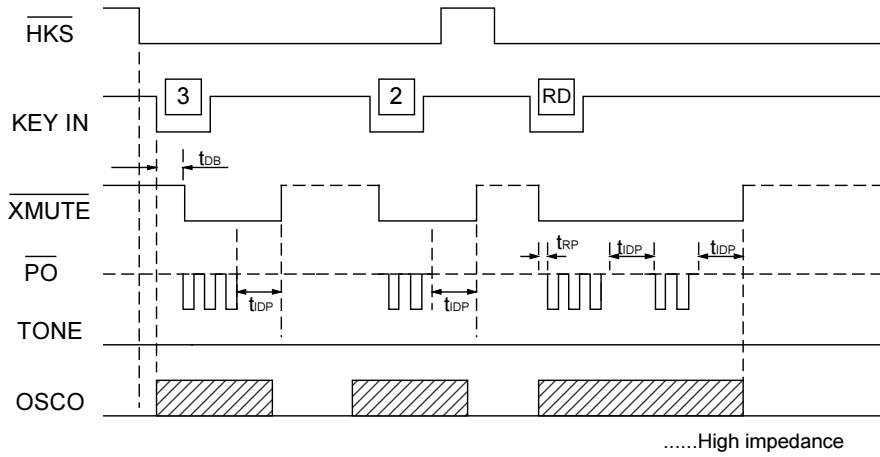(by */T key entry)

Timming Waveform for mixed dialing Operation
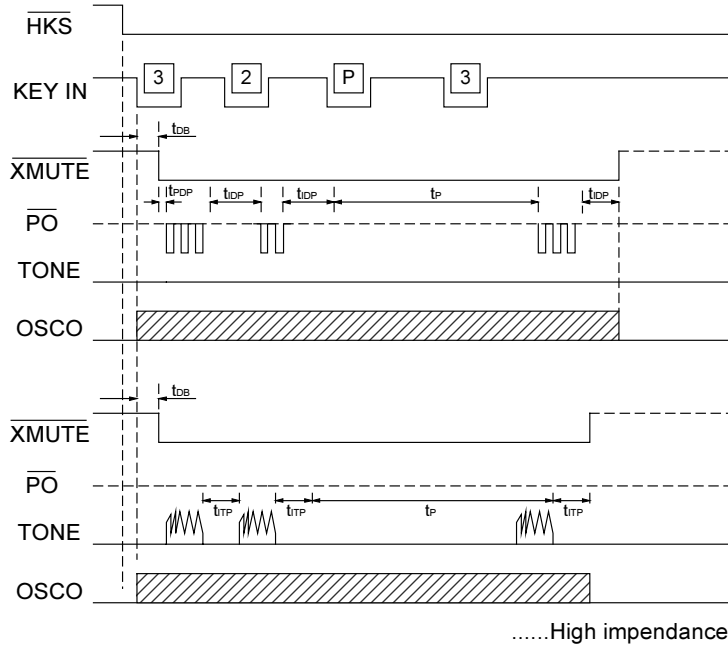(by MODE pin entry)

TIMING DIAGRAMS(continued)
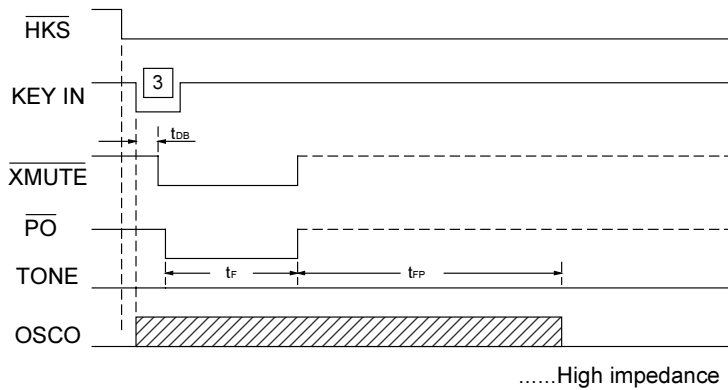

Tone Mode Redial Timming Diagram
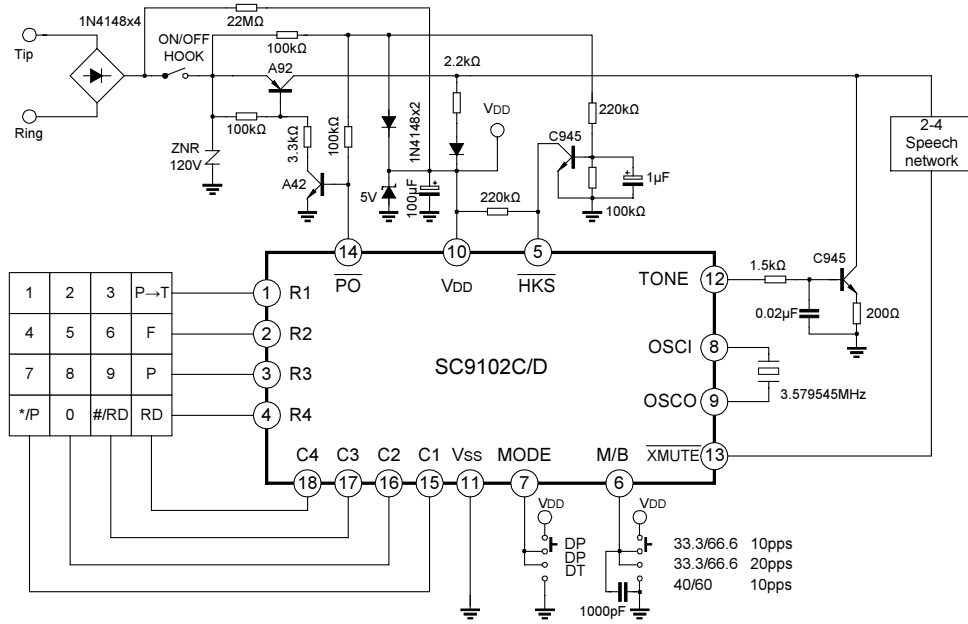

Pulse Mode Redial Timming Diagram

TIMING DIAGRAMS(continued)

Pause key operating timming

Flash key operating timming

TYPACAL APPLICATION CIRCUIT

CHIP TOPOGRAPHY

Chip size: 1.35 x 1.33 mm^2

PAD COORDINATES (Unit: μm)

Pad No.	Symbol	X	Y	Pad No.	Symbol	X	Y
1	P1	-545.0	276.0	10	P10	542.2	176.4
2	P2	-545.0	109.0	11	P11	541.3	349.5
3	P3	-539.0	-266.0	12	P12	541.0	530.5
4	P4	539.0	-453.5	13	P13	324.3	531.5
5	P5	21.2	-528.0	14	P14	131.0	533.0
6	P6	191.0	-528.0	15	P15	-27.0	531.5
7	P7	362.5	-381.5	16	P16	-199.5	531.5
8	P8	529.5	8.5	17	P17	-373.0	531.5
9	P9	540.5	176.4	18	P18	-545.0	463.5

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

PACKAGE OUTLINE

DIP-18-300-2.54	UNIT: mm

2.54

6.40

7.62

0.25

1.50

22.95

3.51

5.08

3.30

0.46

15 degree