



DESCRIPTION

The PT2329 is a 2-ch electronic volume with tone and surround IC for Mini Combo. It has a 6-input selector, Bypass/tone/tone & surround, input gain control and 2ch master volume. It can control all of these functions with I²C Interface.

FEATURES

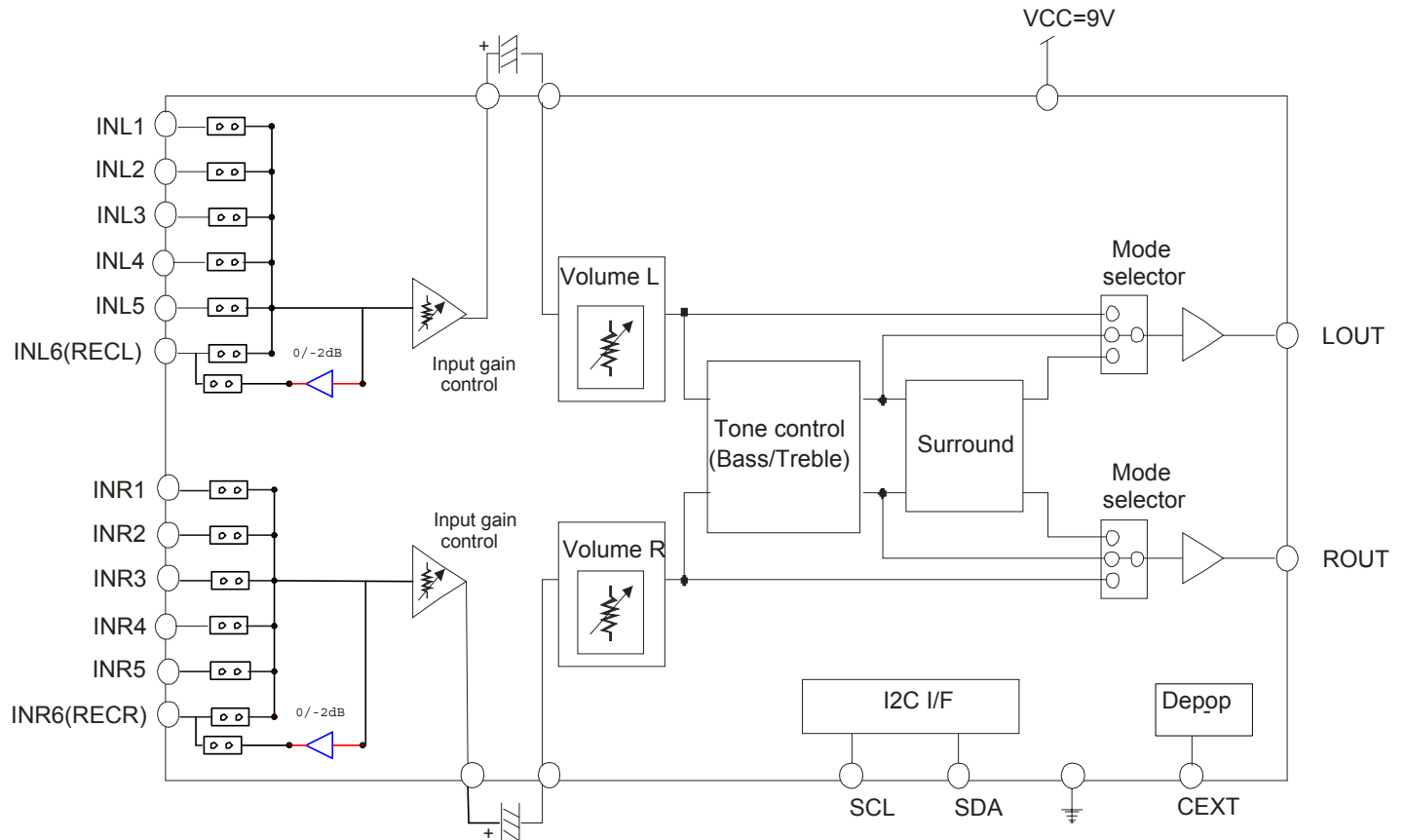
- Supply voltage: Vcc=9V (typ.)
- Volume: 0~-87dB, -∞/1dB step, each channels are independence control.
- Input selector: 6 stereo input selector include 1 REC output of 0/-2dB + Mute
- Input gain control: 0dB~+12dB/1dB step
- Tone control:
 - Bass: -15dB~+15dB/1dB step
 - Treble: -15dB~+15dB/1dB step
- Surround: Surround <Low/High>
- Mode selector: Bypass/Tone/Tone & Surround
- Built-in de-pop function.
- I²C interface: 2 ports serial control

APPLICATION

- Mini Combo



SYSTEM CONFIGURATION

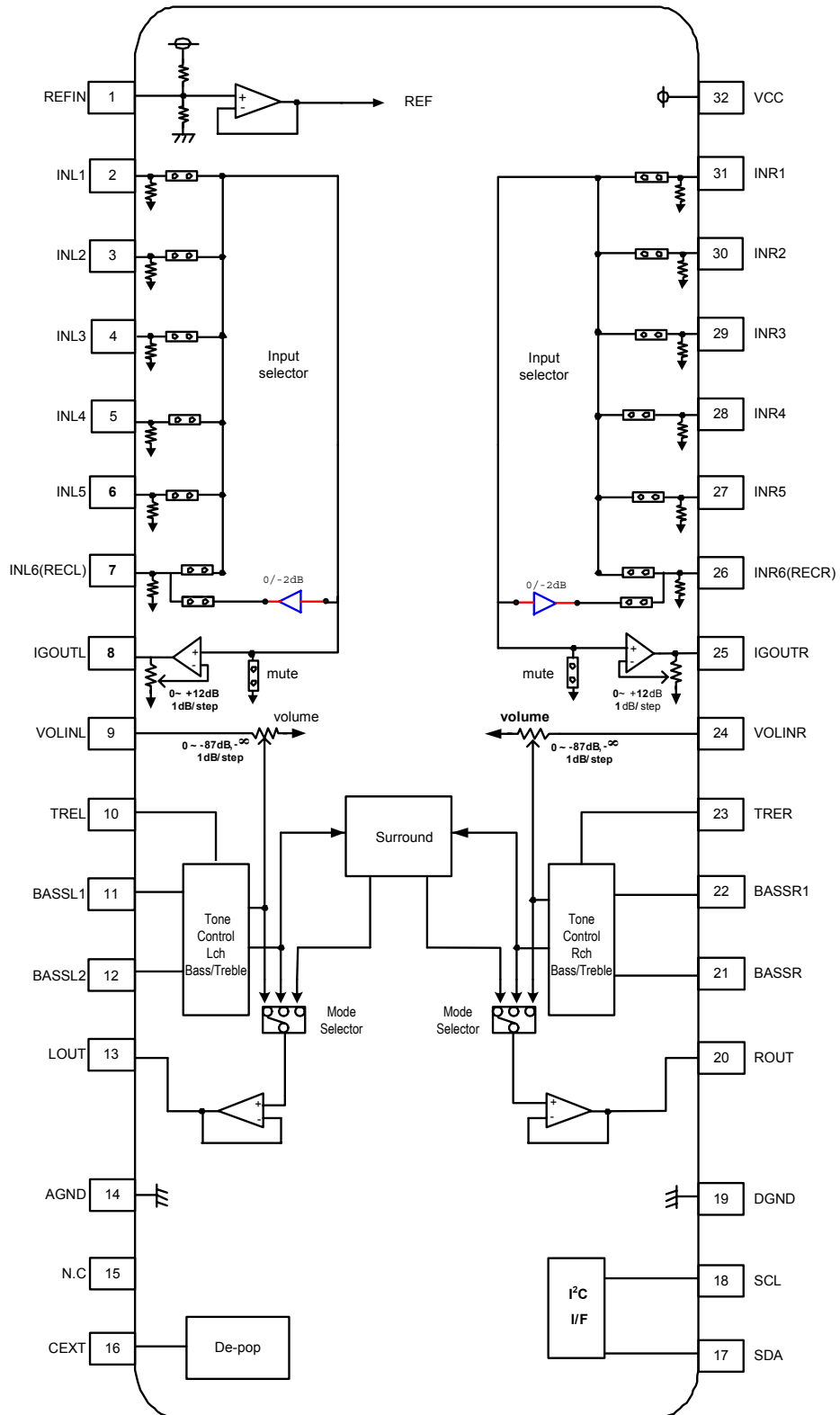




2CH Electronic Volume with Tone & Surround

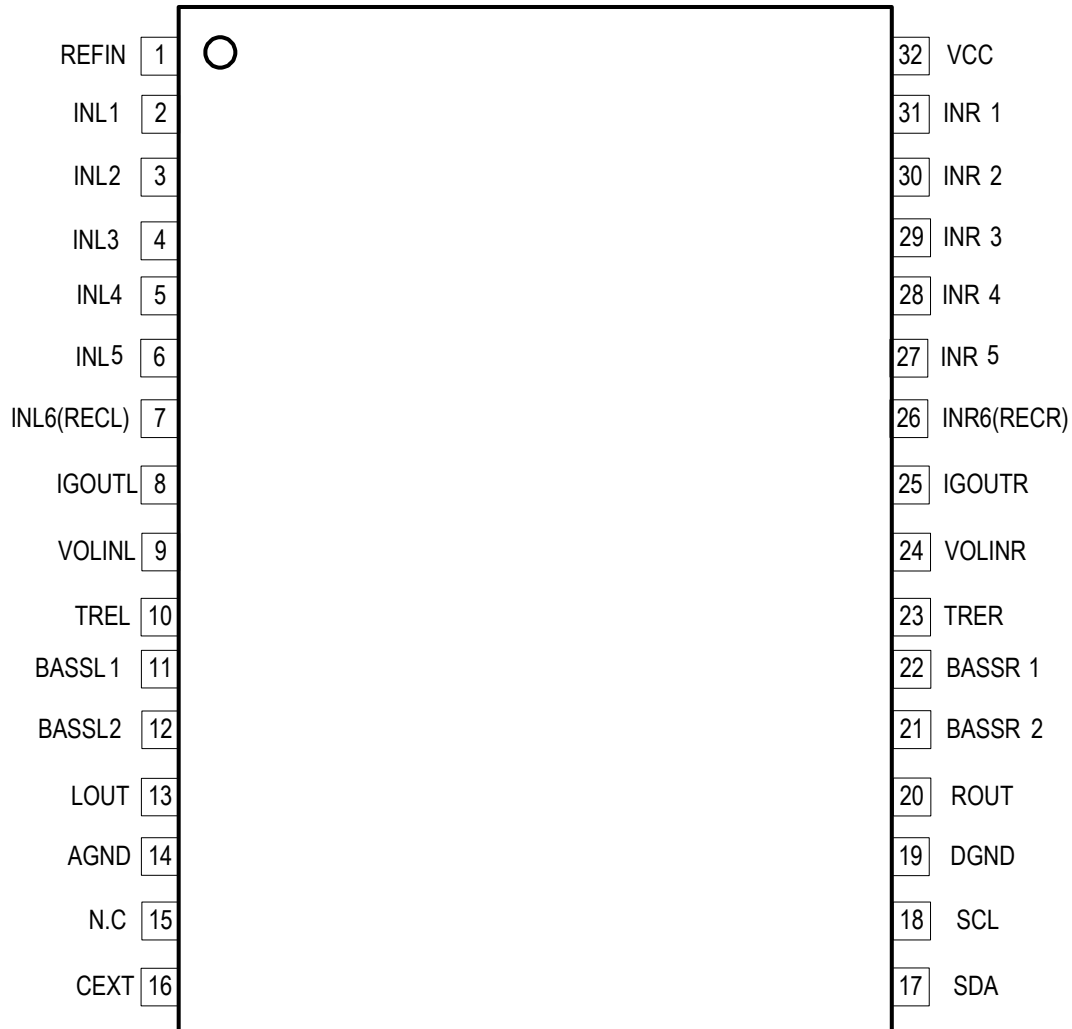
PT2329

BLOCK DIAGRAM





PIN CONFIGURATION

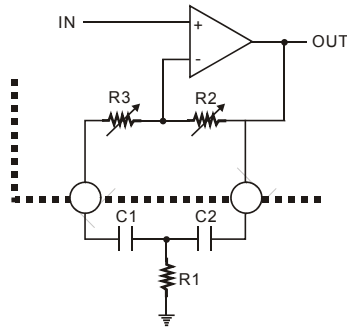


FUNCTION DESCRIPTION

TONE CONTROL CIRCUIT

BASS CIRCUIT

Boost

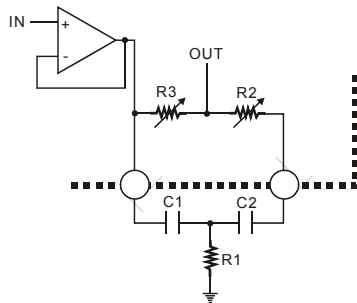


$$f_o = \frac{1}{2\pi\sqrt{R_1(R_2 + R_3)C_1C_2}} \text{ (Hz)}$$

$$Q \cong \frac{1}{C_1 + C_2} \sqrt{\frac{C_1C_2R_2}{R_1}} \text{ (R}_3 = 0\text{)}$$

$$G_v = 20\log \left[\frac{\frac{R_2 + R_3}{R_1} + 2}{\frac{R_3}{R_1} + 2} \right] \text{ (dB) } \text{ (C}_1 = C_2\text{)}$$

Cut



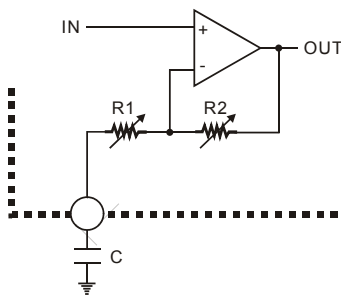
$$f_o = \frac{1}{2\pi\sqrt{R_1(R_2 + R_3)C_1C_2}} \text{ (Hz)}$$

$$Q \cong \frac{1}{C_1 + C_2} \sqrt{\frac{C_1C_2R_2}{R_1}} \text{ (R}_3 = 0\text{)}$$

$$G_v = 20\log \left[\frac{\frac{R_3}{R_1} + 2}{\frac{R_2 + R_3}{R_1} + 2} \right] \text{ (dB) } \text{ (C}_1 = C_2\text{)}$$

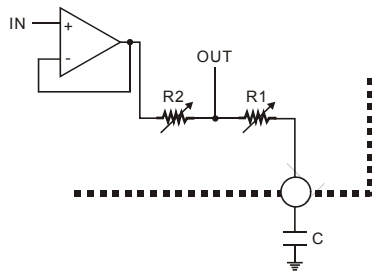
TREBLE CIRCUIT

Boost



$$G_v = 20\log \left[\frac{R_1 + R_2}{R_1} \right] \text{ (dB)}$$

Cut



$$G_v = 20\log \left[\frac{R_1}{R_1 + R_2} \right] \text{ (dB)}$$



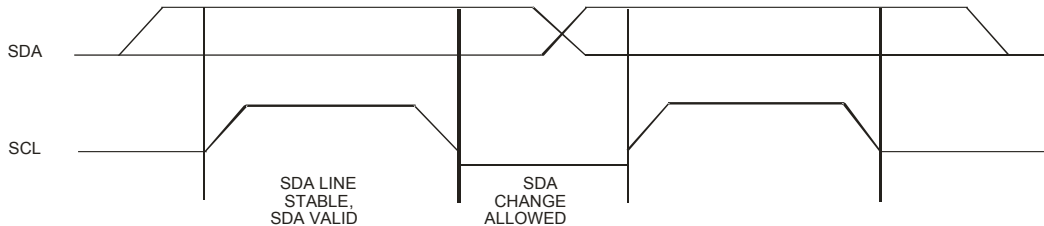
I²C BUS INTERFACE FUNCTION DESCRIPTION

BUS INTERFACE

Data are transmitted to and from the microprocessor to the PT2329 via the SDA and SCL. The SDA and SCL make up the BUS Interface. It should be noted that the pull-up resistors must be connected to the positive supply voltage.

DATA VALIDITY

A data on the SDA Line is considered valid and stable only when the SCL Signal is in HIGH State. The HIGH and LOW States of the SDA Line can only change when the SCL signal is LOW. Please refer to the figure below.



START AND STOP CONDITIONS

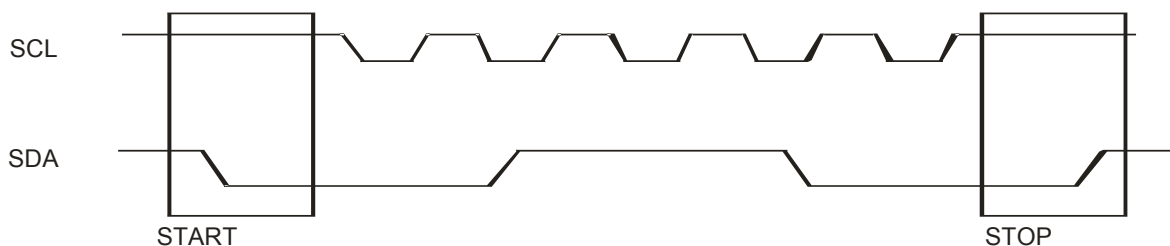
A Start Condition is activated when

1. the SCL is set to HIGH
2. SDA shifts from HIGH to LOW State.

The Stop Condition is activated when

1. SCL is set to HIGH
2. SDA shifts from LOW to HIGH State.

Please refer to the timing diagram below.



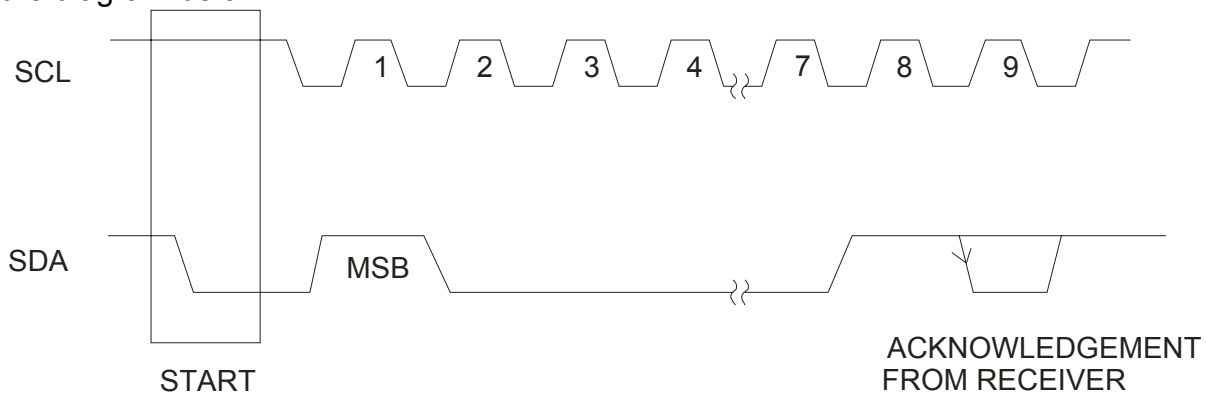


BYTE FORMAT

Every byte transmitted to the SDA Line consists of 8 bits. Each byte must be followed by an Acknowledge Bit. The MSB is transmitted first.

ACKNOWLEDGE

During the Acknowledge Clock Pulse, the master (μ P) puts a resistive HIGH level on the SDA Line. The peripheral (audio processor) that acknowledges has to pull-down (LOW) the SDA line during the Acknowledge Clock Pulse so that the SDA Line is in a Stable Low State during this Clock Pulse. Please refer to the diagram below.



The audio processor that has been addressed has to generate an Acknowledge after receiving each byte; otherwise, the SDA Line will remain at the High Level during the ninth (9th) Clock Pulse. In this case, the master transmitter can generate the STOP Information in order to abort the transfer.

TRANSMISSION WITHOUT ACKNOWLEDGE

If you want to avoid the acknowledge detection of the audio processor, a simpler μ P transmission may be used. Wait one clock and does not check the slave acknowledge of this same clock then send the new data. If you use this approach, there are greater chances of faulty operation as well as decrease in noise immunity.



DATA CONTROL

I²C BUS FORMAT

S	Slave Address	A	Sub Address	A	Data	A	P
1bit	8bit	1bit	8bit	1bit	8bit	1bit	1bit

S: Starting Term

A: Acknowledge Bit

P: Stop Term

00H→01H→02H→03H→04H→05H→00H ----→

1. SLAVE ADDRESS

MSB

LSB

1	0	0	0	0	0	1	0
---	---	---	---	---	---	---	---

2. SUB ADDRESS TABLE

Sub Address	D7	D6	D5	D4	D3	D2	D1	D0
00H	Lch volume							0
01H	Rch volume							0
02H	Tone control bass					0	0	0
03H	Tone control treble					0	0	0
04H	Input gain				0	0	0	0
05H	Input selector			REC	REC gain	Sur	Mode selector	

* Default value is all "0".



3. SETTING CODE

<1> Lch & Rch Volume Control (Sub Address: 00H, 01H)

VOL (dB)	Lch	D7	D6	D5	D4	D3	D2	D1
	Rch							
0 dB		0	0	0	0	0	0	0
-1 dB		0	0	0	0	0	0	1
-2 dB		0	0	0	0	0	1	0
-3 dB		0	0	0	0	0	1	1
-4 dB		0	0	0	0	1	0	0
-5 dB		0	0	0	0	1	0	1
-6 dB		0	0	0	0	1	1	0
-7 dB		0	0	0	0	1	1	1
-8 dB		0	0	0	1	0	0	0
-9 dB		0	0	0	1	0	0	1
-10 dB		0	0	0	1	0	1	0
-11 dB		0	0	0	1	0	1	1
-12 dB		0	0	0	1	1	0	0
-13 dB		0	0	0	1	1	0	1
-14 dB		0	0	0	1	1	1	0
-15 dB		0	0	0	1	1	1	1
-16 dB		0	0	1	0	0	0	0
-17 dB		0	0	1	0	0	0	1
-18 dB		0	0	1	0	0	1	0
-19 dB		0	0	1	0	0	1	1
-20 dB		0	0	1	0	1	0	0
-21 dB		0	0	1	0	1	0	1
-22 dB		0	0	1	0	1	1	0
-23 dB		0	0	1	0	1	1	1
-24 dB		0	0	1	1	0	0	0
-25 dB		0	0	1	1	0	0	1
-26 dB		0	0	1	1	0	1	0
-27 dB		0	0	1	1	0	1	1
-28 dB		0	0	1	1	1	0	0
-29 dB		0	0	1	1	1	0	1
-30 dB		0	0	1	1	1	1	0
-31 dB		0	0	1	1	1	1	1
-32 dB		0	1	0	0	0	0	0
-33 dB		0	1	0	0	0	0	1
-34 dB		0	1	0	0	0	1	0
-35 dB		0	1	0	0	0	1	1
-36 dB		0	1	0	0	1	0	0
-37 dB		0	1	0	0	1	0	1
-38 dB		0	1	0	0	1	1	0
-39 dB		0	1	0	0	1	1	1
-40 dB		0	1	0	1	0	0	0
-41 dB		0	1	0	1	0	0	1
-42 dB		0	1	0	1	0	1	0
VOL (dB)	Lch	D7	D6	D5	D4	D3	D2	D1



2CH Electronic Volume with Tone & Surround

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	Rch							
-43 dB	0	1	0	1	0	1	1	1
-44 dB	0	1	0	1	1	0	0	0
-45 dB	0	1	0	1	1	0	1	1
-46 dB	0	1	0	1	1	1	0	0
-47 dB	0	1	0	1	1	1	1	1
-48 dB	0	1	1	0	0	0	0	0
-49 dB	0	1	1	0	0	0	0	1
-50 dB	0	1	1	0	0	1	0	0
-51 dB	0	1	1	0	0	1	1	1
-52 dB	0	1	1	0	1	0	0	0
-53 dB	0	1	1	0	1	0	0	1
-54 dB	0	1	1	0	1	1	1	0
-55 dB	0	1	1	0	1	1	1	1
-56 dB	0	1	1	1	0	0	0	0
-57 dB	0	1	1	1	0	0	0	1
-58 dB	0	1	1	1	0	1	0	0
-59 dB	0	1	1	1	0	1	1	1
-60 dB	0	1	1	1	1	0	0	0
-61 dB	0	1	1	1	1	0	0	1
-62 dB	0	1	1	1	1	1	1	0
-63 dB	0	1	1	1	1	1	1	1
-64 dB	1	0	0	0	0	0	0	0
-65 dB	1	0	0	0	0	0	0	1
-66 dB	1	0	0	0	0	0	1	0
-67 dB	1	0	0	0	0	0	1	1
-68 dB	1	0	0	0	1	0	0	0
-69 dB	1	0	0	0	1	0	0	1
-70 dB	1	0	0	0	1	1	1	0
-71 dB	1	0	0	0	1	1	1	1
-72 dB	1	0	0	1	0	0	0	0
-73 dB	1	0	0	1	0	0	0	1
-74 dB	1	0	0	1	0	1	1	0
-75 dB	1	0	0	1	0	1	1	1
-76 dB	1	0	0	1	1	0	0	0
-77 dB	1	0	0	1	1	0	0	1
-78 dB	1	0	0	1	1	1	1	0
-79 dB	1	0	0	1	1	1	1	1
-80 dB	1	0	1	0	0	0	0	0
-81 dB	1	0	1	0	0	0	0	1
-82 dB	1	0	1	0	0	1	0	0
-83 dB	1	0	1	0	0	1	1	1
-84 dB	1	0	1	0	1	0	0	0
-85 dB	1	0	1	0	1	0	0	1
-86 dB	1	0	1	0	1	1	1	0
-87 dB	1	0	1	0	1	1	1	1
-∞dB	1	1	1	1	1	1	1	1



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<2> Tone Bass Control (Sub Address: 02H)

Treble	D7	D6	D5	D4	D3
0 dB	A	0	0	0	0
1 dB		0	0	0	1
2 dB		0	0	1	0
3 dB		0	0	1	1
4 dB		0	1	0	0
5 dB		0	1	0	1
6 dB		0	1	1	0
7 dB		0	1	1	1
8 dB		1	0	0	0
9 dB		1	0	0	1
10dB		1	0	1	0
11dB		1	0	1	1
12dB		1	1	0	0
13dB		1	1	0	1
14dB		1	1	1	0
15dB		1	1	1	1

If A =0 means CUT(-)
A=1 means BOOST(+)

<3> Tone Treble Control (Sub Address: 03H)

Treble	D7	D6	D5	D4	D3
0 dB	A	0	0	0	0
1 dB		0	0	0	1
2 dB		0	0	1	0
3 dB		0	0	1	1
4 dB		0	1	0	0
5 dB		0	1	0	1
6 dB		0	1	1	0
7 dB		0	1	1	1
8 dB		1	0	0	0
9 dB		1	0	0	1
10dB		1	0	1	0
11dB		1	0	1	1
12dB		1	1	0	0
13dB		1	1	0	1
14dB		1	1	1	0
15dB		1	1	1	1

If A =0 means CUT(-)
A=1 means BOOST(+)



2CH Electronic Volume with Tone & Surround

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<4> Input Gain (Sub Address: 04H)

Input Gain	D7	D6	D5	D4
0dB	0	0	0	0
+1dB	0	0	0	1
+2dB	0	0	1	0
+3dB	0	0	1	1
+4dB	0	1	0	0
+5dB	0	1	0	1
+6dB	0	1	1	0
+7dB	0	1	1	1
+8dB	1	0	0	0
+9dB	1	0	0	1
+10dB	1	0	1	0
+11dB	1	0	1	1
+12dB	1	1	0	0

<5> Input Selector & Rec & Surround & Mode Selector (Sub Address: 05H)

Input Selector	D7	D6	D5	REC(In6)D4	REC Gain D3		Surround D2		Mode Selector		
									D1		D0
IN1	0	0	1	A	-2dB	0	Low	0	Bypass	0	0
IN2	0	1	0	A	0dB	1	High	1	Tone	0	1
IN3	0	1	1	A					Tone & Sur	1	0
IN4	1	0	0	A							
IN5	1	0	1	A							
IN6	1	1	0	0							
MUTE	0	0	0	0							

If A=0 means IN6 output OFF, than A=1 means IN6 output ON



ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Condition	Rating	Unit
Power supply	V_{CC}	-	10	V
Power dissipation	P_d	$T_a \leq 25^\circ\text{C}$	-	W
Thermal derating	K	$T_a > 25^\circ\text{C}$ (Circuit board installation)	-	mW/ $^\circ\text{C}$
Operating temperature	T_{opr}	-	-40 ~ +85	$^\circ\text{C}$
Storage temperature	T_{stg}	-	-65 ~ +150	$^\circ\text{C}$

RECOMMENDED OPERATING CONDITION

Parameter	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Supply voltage	V_{CC}		5	9	9.7	V
Logic "H" level input voltage	V_{IH}	$V_{CC}=9\text{V}$	2.2	-	5.5	V
Logic "L" level input voltage	V_{IL}	$V_{CC}=9\text{V}$	0	-	0.6	V
Maximum clock frequency	f_{SCL}	-	-		100	KHz



2CH Electronic Volume with Tone & Surround

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ELECTRICAL CHARACTERISTICS

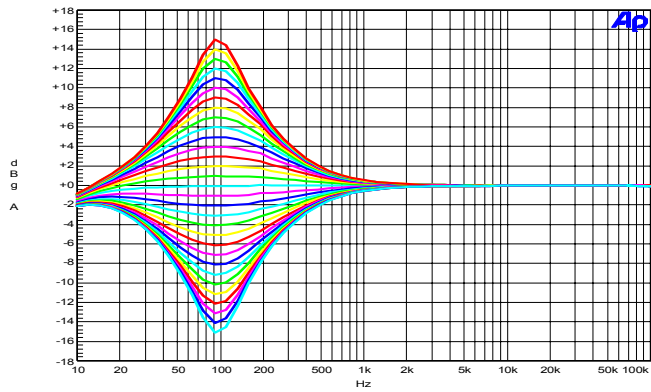
(Unless otherwise specified, $V_{CC}=9V$, $T_a=25^{\circ}C$, $V_i=100mV_{rms}$, $f=1KHz$, Tone control=0dB, $R_g=600\Omega$, $R_L=47K\Omega$)

Parameter	Symbol	Test Condition	Min.	Typ.	Max.	Unit
General Characteristics						
Operational power supply	V_{CC}	-	5.0	9.0	9.7	V
Supply current	I_{CC}	No signal	-	20	25	mA
Reference voltage	V_{ref}	No signal	4.0	4.5	5.0	V
Input impedance	R_{IN}		17	25	33	$K\Omega$
Maximum output voltage	V_{OM}	$V_{OL}=0dB$, $T_{HD}=1\%$	-	2.5	-	V_{rms}
Volume maximum	VOL_{max}	$V_{OL}=0dB$	-2	0	+2	dB
Volume minimum	VOL_{min}	$V_{OL}=Mute$, $V_{in}=1V_{rms}$, IHF-A	-	-100	-90	dB
Channel balance	CBAL	$V_{OL}=0dB$	-1.5	-	1.5	dB
Total harmonic distortion	THD	400Hz~30KHz BPF, $V_o=0.5V_{rms}$	-	0.005	0.1	%
Input selector cross talk	CT	400Hz~30KHz BPF, $V_o=1V_{rms}$	-	-100	-70	dB
Channel separation	CS	400Hz~30KHz BPF, $V_o=1V_{rms}$	-	-100	-70	dB
Output noise 1	V_{no1}	$VOL=0dB$, Input gain=0dB, Tone=0dB, Surround=Low, IHF-A	-	10	30	μV_{rms}
Output noise 2	V_{no2}	$VOL=Mute$, Input gain=0dB, Bypass, IHF-A	-	4.0	10	μV_{rms}
Tone Control						
Tone control voltage gain (Boost/Bass)	G(Bass)B	$f=100Hz$, Bass=+15dB	+12.5	+15	+17.5	dB
Tone control voltage gain (Cut/Bass)	G(Bass)C	$f=100Hz$, Bass=-15dB	-17.5	-15	-12.5	dB
Tone control voltage gain (Flat/Bass)	G(Bass)F	$f=100Hz$, Bass=0dB	-2	0	+2	dB
Tone control voltage gain (Boost/Treble)	G(Treble)B	$f=10KHz$, Treble=+15dB	+12.5	+15	+17.5	dB
Tone control voltage gain (Cut/Treble)	G(Treble)C	$f=10KHz$, Treble=-15dB	-17.5	-15	-12.5	dB
Tone control voltage gain (Flat/Treble)	G(Treble)F	$f=10KHz$, Treble=0dB	-2	0	+2	dB

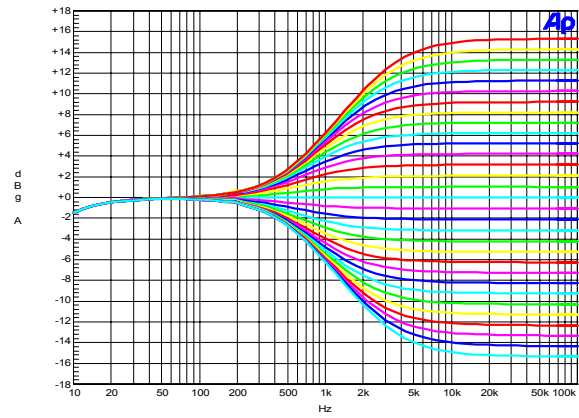


2CH Electronic Volume with Tone & Surround

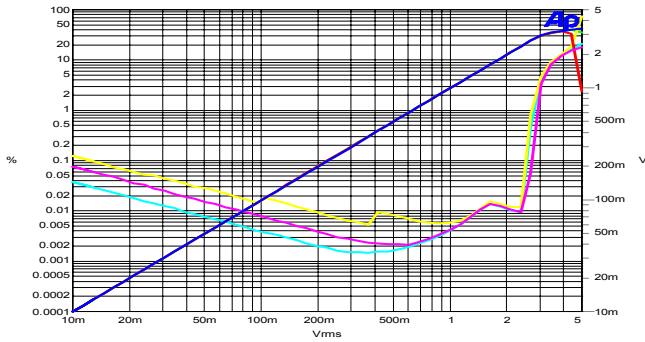
PT2329



Bass Control Characteristics



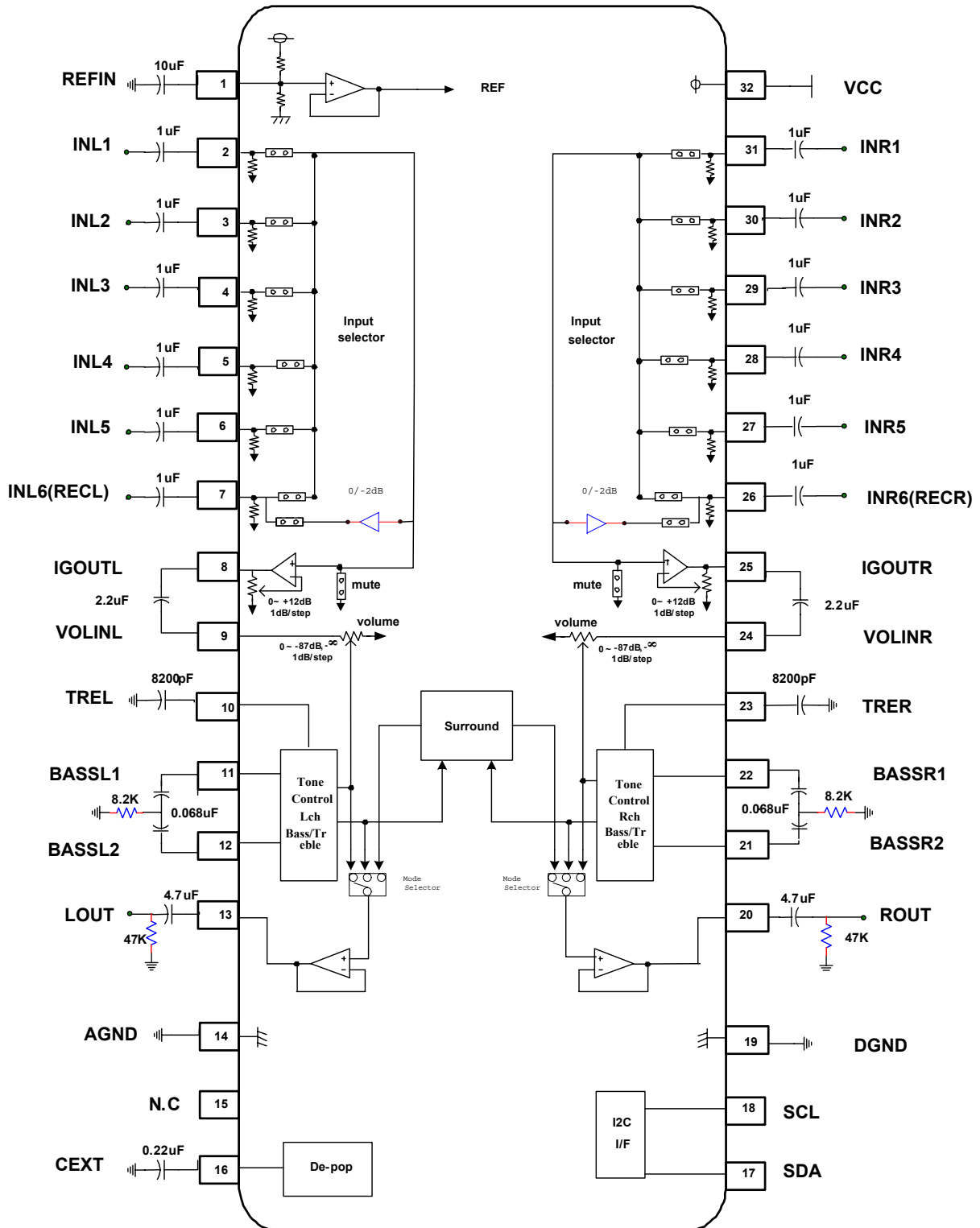
Treble Control Characteristics



THD - Output Voltage VS Input Voltage



APPLICATION EXAMPLE





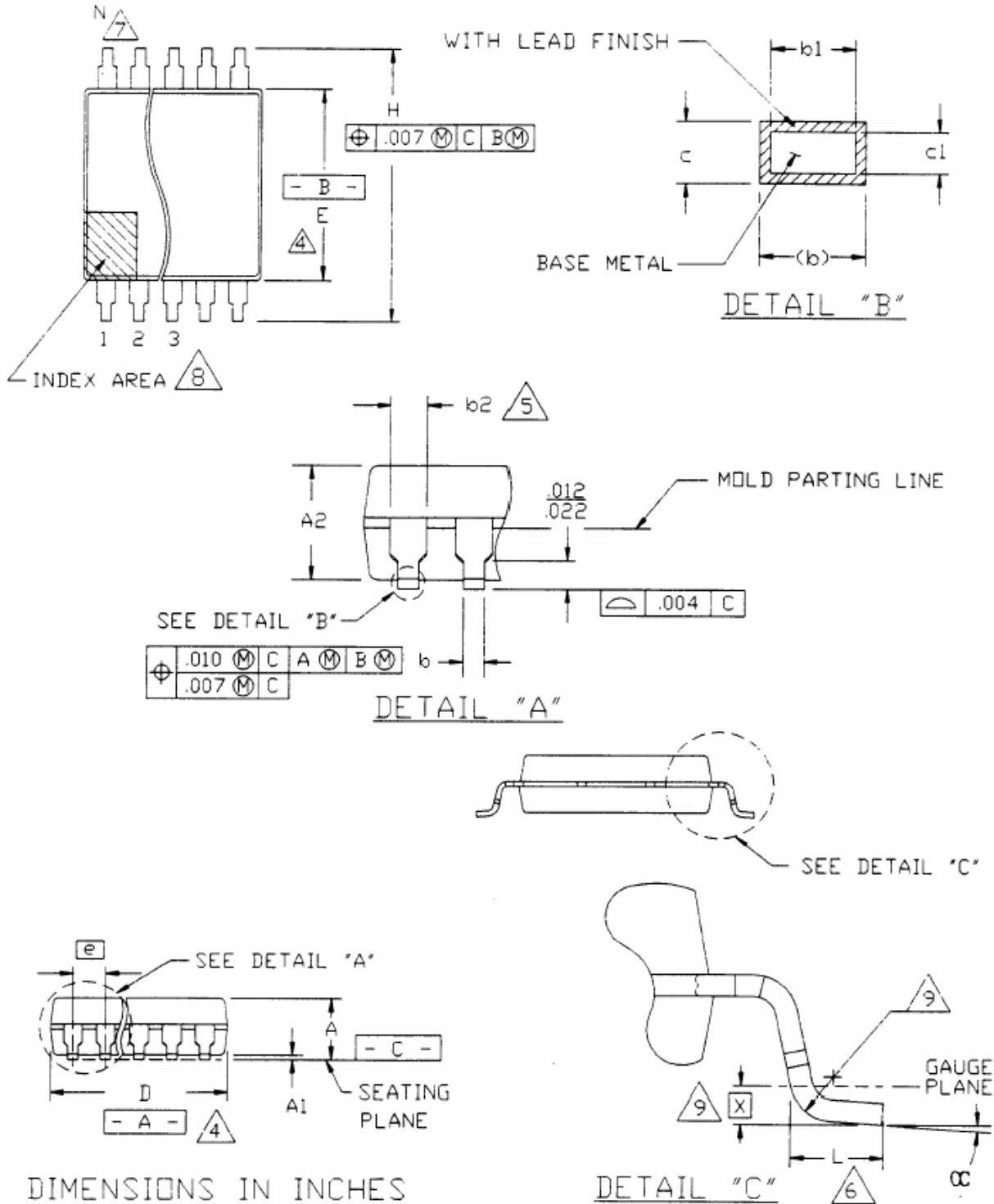
ORDER INFORMATION

Valid Part Number	Package Type	Top Code
PT2329	32 Pins, SOP, 300MIL	PT2329



PACKAGE INFORMATION

32 PINS, SOP, 300MIL





2CH Electronic Volume with Tone & Surround **PT2329**

Symbols	Min.	Nom.	Max.
A	-	-	0.104
A1	0.004	-	-
A2	0.082	0.088	0.094
b	0.014	0.016	0.020
b1	0.014	0.016	0.018
b2	0.026	0.028	0.032
c	0.007	0.008	0.0125
c1	0.007	0.008	0.010
D	0.812	0.818	0.824
E	0.292	0.296	0.299
e	0.050 BSC.		
H	0.405	0.412	0.419
L	0.021	0.031	0.041
α	0°	4°	8°

Notes:

1. Dimensioning and tolerancing per ANSI Y14.5-1982.
2. Dimension D does not include mold flash, protrusions or gate burrs. Mold Flash, protrusion or gate burrs shall not exceed 0.15mm (0.006 in) per side.
3. Dimension E does not include interlead flash or protrusions. Interlead flash or protrusions shall not exceed 0.25 mm (0.010 in) per side.
4. The chamfer on the body is optional. It is not present, a visual index feature must be located within the crosshatched area.
5. L is the length of the terminal for soldering to a substrate.
6. The lead width B as measured 0.36 mm (0.014 in) or greater above the seating plane, shall not exceed a maximum value of 0.61 mm (0.24 in)
7. Controlling dimension: Inch
8. N=Number of terminal position (N=32)
9. Refer to JEDEC MO-119 variation AC.

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