

# R2A15908SP

## 5 Input Selector 2ch Electronic Volume with Tone & Surround

REJ03F0270-0100

Rev.1.00

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### Description

The R2A15908SP is an optimum audio signal processor IC for TV. It has a 5ch input selector with mono switch, surround, tone control (2band), input gain control and 2ch master volume. It can control all of these functions with I<sub>2</sub>C bus.

### Features

- Volume 0 to -87dB, -∞ / 1dB step  
Each channel is independent control.
- 5 input selector + MUTE with mono switch
- Input gain control 0dB to +20dB / 2dB step
- Tone control Bass : -14dB to +14dB / 2dB step  
Treble : -14dB to +14dB / 2dB step
- Surround Low / High
- Mode selector Bypass / Tone / Tone & Surround
- I<sub>2</sub>C-bus control
- Package SOP with 28 pin

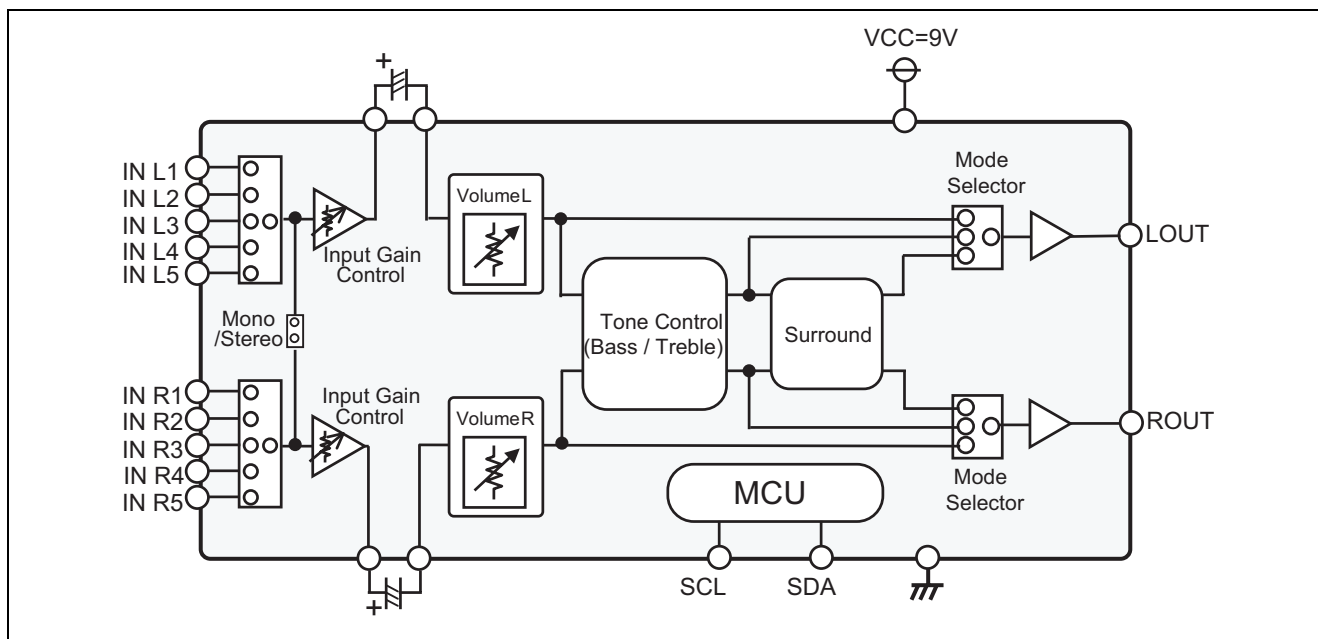
### Application

- Mini stereo, TV, etc.

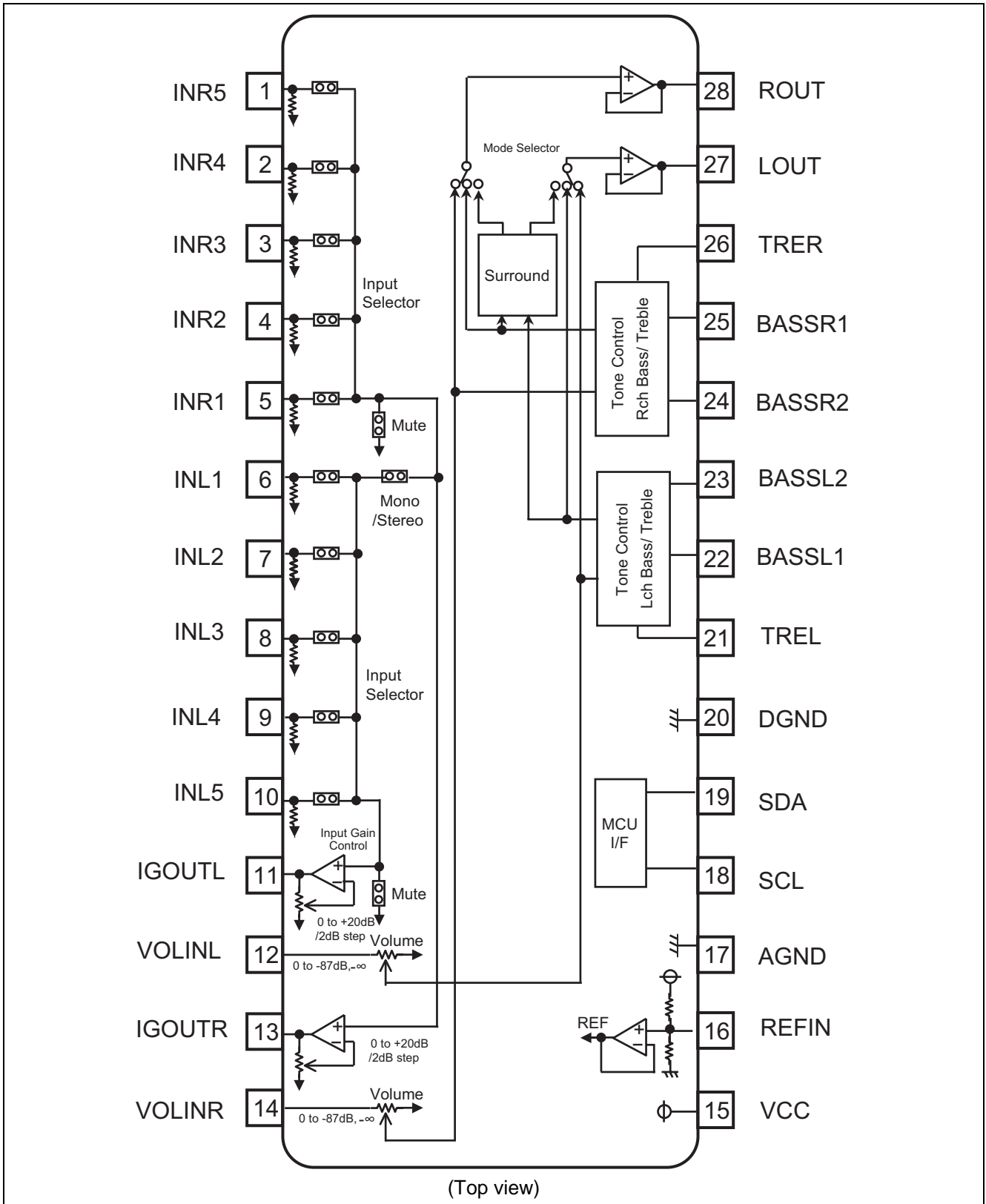
### Recommended Operating Condition

- Supply voltage ..... V<sub>CC</sub> = 9.0V (typ)

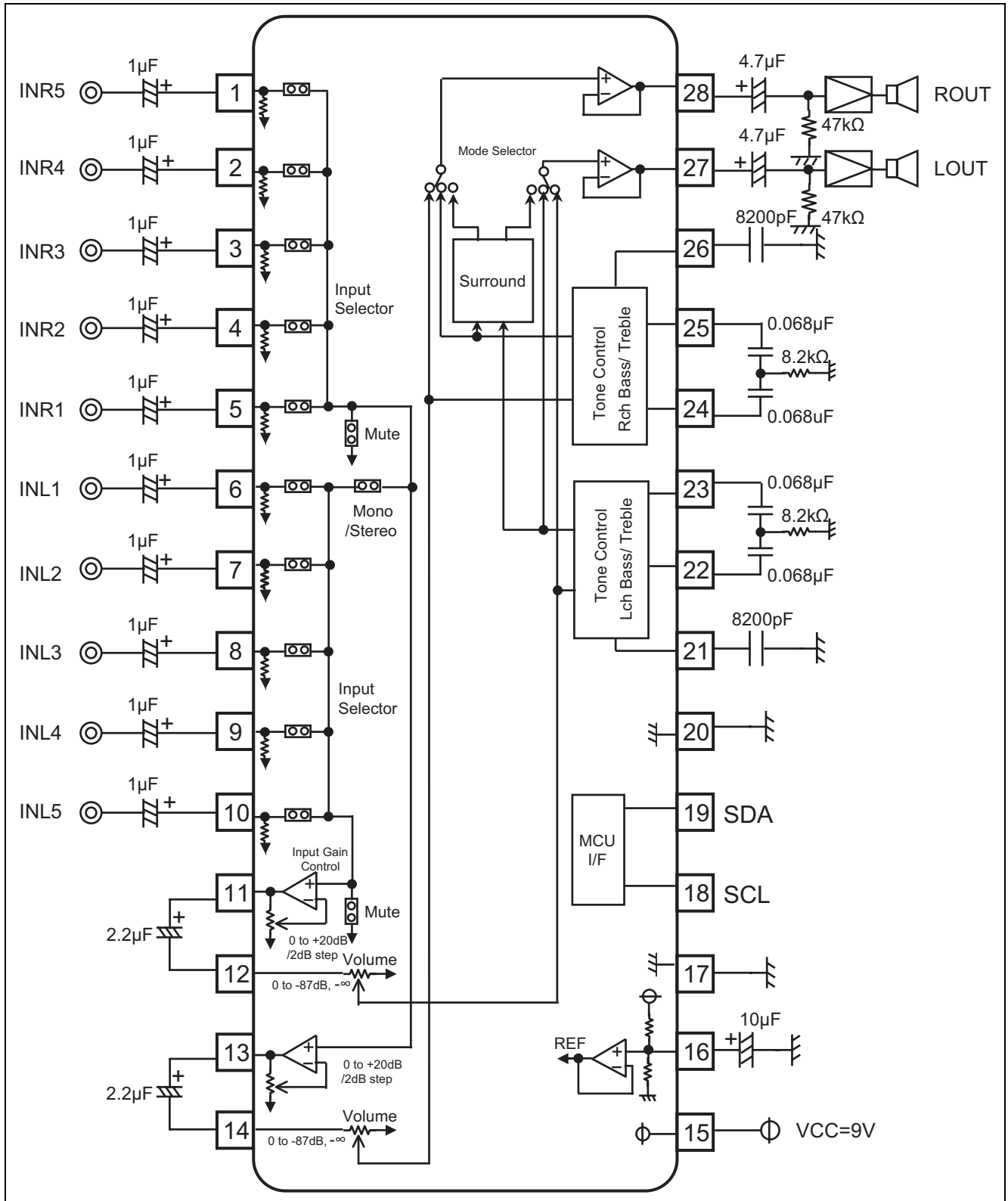
### System Configuration



Block Diagram and Pin Configuration

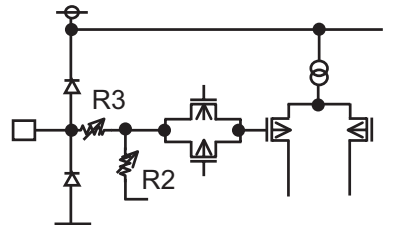
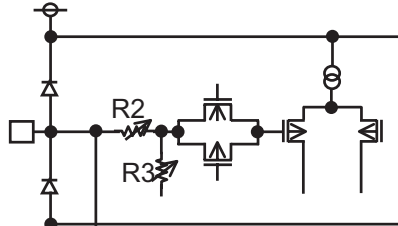
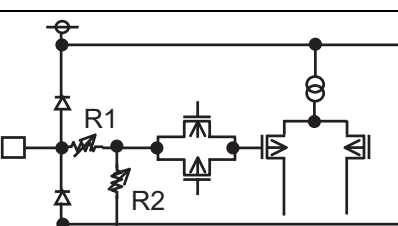


Application Example



Equivalent Circuit of Pin Interface Block

Pin	Pin Name	Equivalent Circuit
1 2 3 4 5 6 7 8 9 10	INR5 INR4 INR3 INR2 INR1 INL1 INL2 INL3 INL4 INL5	
11 13 27 28	IGOUTL IGOUTR LOUT ROUT	
12 14	VOLINL VOLINR	<p style="text-align: right;"><math>R1+R2=50k\Omega</math></p>
18	SCL	
19	SDA	
16	REFIN	
15 17 20	VCC AGND DGND	

Pin	Pin Name	Equivalent Circuit
22 25	BASSR1 BASSL1	 <p style="text-align: right;">R2+R3=80kΩ</p>
23 24	BASSR2 BASSL2	 <p style="text-align: right;">R2+R3=80kΩ</p>
21 26	TRER TREL	 <p style="text-align: right;">R1+R2=30kΩ</p>

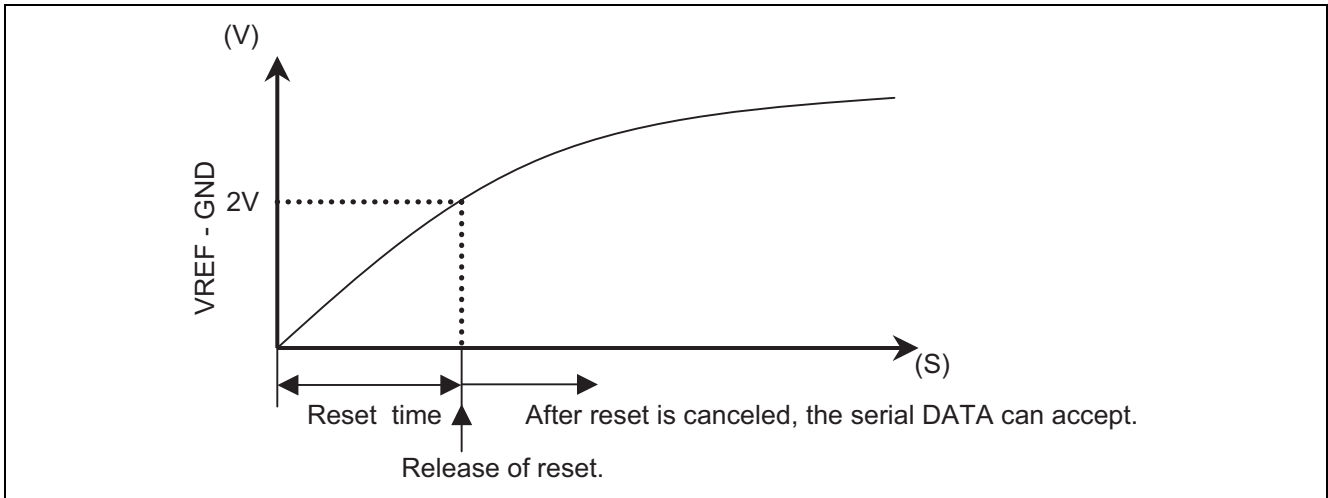
### Absolute Maximum Ratings

Parameter	Symbol	Ratings	Unit	Condition
Power supply	V <sub>cc</sub>	10	V	
Power dissipation	P <sub>d</sub>		W	T <sub>a</sub> ≤ 25°C
Thermal derating	K		mW / °C	T <sub>a</sub> > 25°C (Circuit board installation)
Operating temperature	T <sub>opr</sub>	-20 to +75	°C	
Storage temperature	T <sub>stg</sub>	-40 to +125	°C	

### Power on Reset

This IC built-in the power on reset function.

The voltage of VREF-GND less than 2V, the serial DATA can not accept.



### I<sup>2</sup>C Bus Format

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

- S: Starting Term
- A: Acknowledge Bit
- P: Stop Term

If more than one Data Byte is transmitted, then the significant SUB ADDRESS bits are auto incremented.  
00H→01H→02H→03H→04H→00H

#### 1. Slave Address

MSB							LSB
1	0	0	0	0	0	1	R/W <sub>B</sub>

- R/W<sub>B</sub>=0 : Write mode for register setting
- R/W<sub>B</sub>=1 : Not available

#### 2. Sub Address Table


Sub Address	BIT							
	D7	D6	D5	D4	D3	D2	D1	D0
00H	<1>Lch Master volume							0
01H	<1>Rch Master volume							0
02H	<2>Input selector			<3>Input gain				0
03H	<4>Stereo / Mono		<5>Mode selector		0	0	0	0
04H	<6>Tone control Bass				<6>Tone control Treble			

## 3. Data Table

## &lt;1&gt; Master Volume (Sub Address: 00H, 01H)

ATT	Lch	Sub Address	00H	D7	D6	D5	D4	D3	D2	D1	
	Rch		01H	D7	D6	D5	D4	D3	D2	D1	
0dB		L ch R ch Volume		0	0	0	0	0	0	0	
-1dB					0	0	0	0	0	0	1
-2dB					0	0	0	0	0	1	0
-3dB					0	0	0	0	0	1	1
-4dB					0	0	0	0	1	0	0
-5dB					0	0	0	0	1	0	1
-6dB					0	0	0	0	1	1	0
-7dB					0	0	0	0	1	1	1
-8dB					0	0	0	1	0	0	0
-9dB					0	0	0	1	0	0	1
-10dB					0	0	0	1	0	1	0
-11dB					0	0	0	1	0	1	1
-12dB					0	0	0	1	1	0	0
-13dB					0	0	0	1	1	0	1
-14dB					0	0	0	1	1	1	0
-15dB					0	0	0	1	1	1	1
-16dB					0	0	1	0	0	0	0
-17dB					0	0	1	0	0	0	1
-18dB					0	0	1	0	0	1	0
-19dB					0	0	1	0	0	1	1
-20dB					0	0	1	0	1	0	0
-21dB					0	0	1	0	1	0	1
-22dB					0	0	1	0	1	1	0
-23dB					0	0	1	0	1	1	1
-24dB					0	0	1	1	0	0	0
-25dB					0	0	1	1	0	0	1
-26dB					0	0	1	1	0	1	0
-27dB					0	0	1	1	0	1	1
-28dB					0	0	1	1	1	0	0
-29dB					0	0	1	1	1	0	1
-30dB					0	0	1	1	1	1	0
-31dB					0	0	1	1	1	1	1
-32dB					0	1	0	0	0	0	0
-33dB					0	1	0	0	0	0	1
-34dB					0	1	0	0	0	1	0
-35dB					0	1	0	0	0	1	1
-36dB					0	1	0	0	1	0	0
-37dB					0	1	0	0	1	0	1
-38dB					0	1	0	0	1	1	0
-39dB					0	1	0	0	1	1	1
-40dB					0	1	0	1	0	0	0
-41dB					0	1	0	1	0	0	1
-42dB					0	1	0	1	0	1	0
-43dB					0	1	0	1	0	1	1
-44dB					0	1	0	1	1	0	0
-45dB					0	1	0	1	1	0	1
-46dB					0	1	0	1	1	1	0
-47dB					0	1	0	1	1	1	1
-48dB				0	1	1	0	0	0	0	

ATT	Lch	Sub Address	00H	D7	D6	D5	D4	D3	D2	D1
	Rch		01H	D7	D6	D5	D4	D3	D2	D1
-49dB		L ch R ch	Volume	0	1	1	0	0	0	1
-50dB				0	1	1	0	0	1	0
-51dB				0	1	1	0	0	1	1
-52dB				0	1	1	0	1	0	0
-53dB				0	1	1	0	1	0	1
-54dB				0	1	1	0	1	1	0
-55dB				0	1	1	0	1	1	1
-56dB				0	1	1	1	0	0	0
-57dB				0	1	1	1	0	0	1
-58dB				0	1	1	1	0	1	0
-59dB				0	1	1	1	0	1	1
-60dB				0	1	1	1	1	0	0
-61dB				0	1	1	1	1	0	1
-62dB				0	1	1	1	1	1	0
-63dB				0	1	1	1	1	1	1
-64dB				1	0	0	0	0	0	0
-65dB				1	0	0	0	0	0	1
-66dB				1	0	0	0	0	1	0
-67dB				1	0	0	0	0	1	1
-68dB				1	0	0	0	1	0	0
-69dB				1	0	0	0	1	0	1
-70dB				1	0	0	0	1	1	0
-71dB				1	0	0	0	1	1	1
-72dB				1	0	0	1	0	0	0
-73dB				1	0	0	1	0	0	1
-74dB				1	0	0	1	0	1	0
-75dB				1	0	0	1	0	1	1
-76dB				1	0	0	1	1	0	0
-77dB				1	0	0	1	1	0	1
-78dB				1	0	0	1	1	1	0
-79dB				1	0	0	1	1	1	1
-80dB				1	0	1	0	0	0	0
-81dB		1	0	1	0	0	0	1		
-82dB		1	0	1	0	0	1	0		
-83dB		1	0	1	0	0	1	1		
-84dB		1	0	1	0	1	0	0		
-85dB		1	0	1	0	1	0	1		
-86dB		1	0	1	0	1	1	0		
-87dB		1	0	1	0	1	1	1		
-∞		1	1	1	1	1	1	1		

 \* It's initial setting when power is turned on.



## &lt;2&gt; Input Selector (Sub Address: 02H)

Setting	Input Selector		
	D7	D6	D5
IN1	0	0	0
IN2	0	0	1
IN3	0	1	0
IN4	0	1	1
IN5	1	0	0
MUTE	1	1	1

## &lt;3&gt; Input Gain (Sub Address: 02H)


Setting	Input Gain			
	D4	D3	D2	D1
0dB	0	0	0	0
+2dB	0	0	0	1
+4dB	0	0	1	0
+6dB	0	0	1	1
+8dB	0	1	0	0
+10dB	0	1	0	1
+12dB	0	1	1	0
+14dB	0	1	1	1
+16dB	1	0	0	0
+18dB	1	0	0	1
+20dB	1	0	1	0

## &lt;4&gt; Stereo / Mono Selector (Sub Address: 03H)

Setting	Mode Selector	
	D7	D6
Stereo	0	0
Lch Mono	0	1
Rch Mono	1	0

## &lt;5&gt; Mode Selector (Sub Address: 03H)


Setting	Mode Selector	
	D5	D4
Bypass	0	0
Tone	0	1
Tone & Surround Hi	1	0
Tone & Surround Low	1	1

 \* It's initial setting when power is turned on.

## &lt;6&gt; Tone control (Sub Address: 04H)

Gain	Bass	D7	D6	D5	D4
	Treble	D3	D2	D1	D0
0dB		A	0	0	0
2dB			0	0	1
4dB			0	1	0
6dB			0	1	1
8dB			1	0	0
10dB			1	0	1
12dB			1	1	0
14dB			1	1	1

If A = 0 means Tone control gain CUT(-), then A = 1 means Tone control gain BOOST(+).

 \* It's initial setting when power is turned on.

## Electrical Characteristics

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

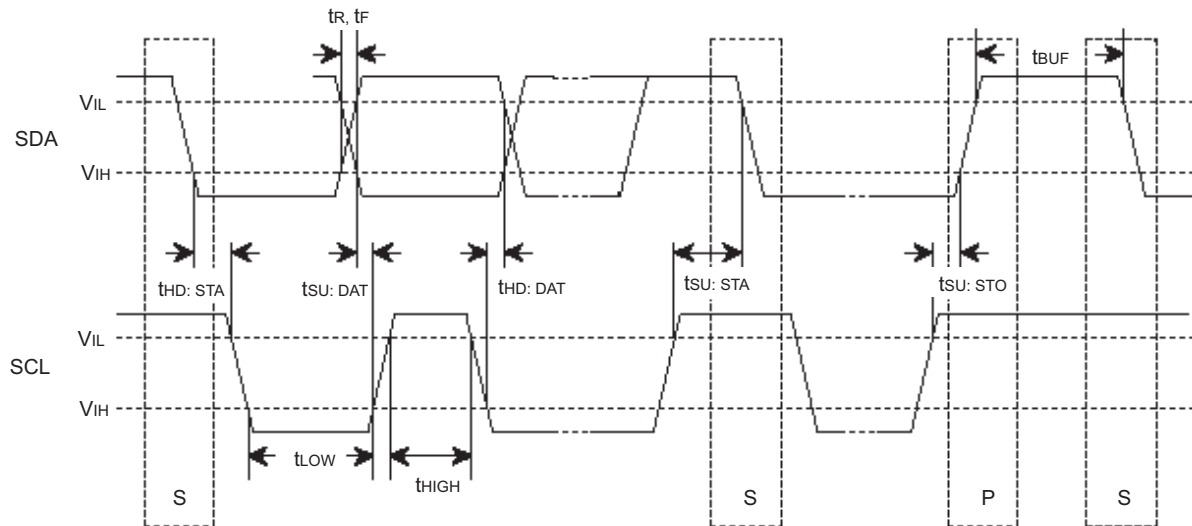
### General Characteristics

Parameter	Symbol	Limits			Unit	Condition
		Min	Typ	Max		
Operational power supply	$V_{CC}$	4.75	9.0	9.7	V	
Supply current	$I_{CC}$	—	15	25	mA	No signal
Reference voltage	$V_{ref}$	4.0	4.5	5.0	V	No signal
Input impedance	$R_{IN}$	35	50	65	$k\Omega$	
Maximum output voltage	VOM	—	2.5	—	$V_{rms}$	VOL = 0dB, THD = 1%
Volume maximum	VOLmax	-2	0	+2	dB	VOL = 0dB
Volume minimum	VOLmin	—	-100	-90	dB	VOL = Mute, $V_{in} = 1V_{rms}$ , IHF-A
Channel balance	CBAL	-1.5	0	1.5	dB	VOL = 0dB
Total harmonic distortion	THD	—	0.01	0.5	%	400Hz to 30kHz BPF, $V_o = 0.5V_{rms}$
Input selector cross talk	CT	—	-100	-70	dB	400Hz to 30kHz BPF $V_{in} = 1V_{rms}$
Channel separation	CS	—	-100	-70	dB	400Hz to 30kHz BPF $V_{in} = 1V_{rms}$
Output noise 1	$V_{no1}$	—	30	50	$\mu V_{rms}$	VOL = 0dB, Input gain = 0dB Tone = 0dB, Surround = Low, IHF-A
Output noise 2	$V_{no2}$	—	5	15	$\mu V_{rms}$	VOL = Mute, Input gain = 0dB Bypass, IHF-A

### Tone Control

Parameter	Symbol	Limits			Unit	Condition
		Min	Typ	Max		
Tone control voltage gain (Boost/ Bass)	G(Bass)B	+11.5	+14	+16.5	dB	$f = 100Hz$ , Bass = +14dB
Tone control voltage gain (Cut/ Bass)	G(Bass)C	-16.5	-14	-11.5	dB	$f = 100Hz$ , Bass = -14dB
Tone control voltage gain (Flat/ Bass)	G(Bass)F	-2	0	+2	dB	$f = 100Hz$ , Bass = 0dB
Tone control voltage gain (Boost/ Treble)	G(Treble)B	+11.5	+14	+16.5	dB	$f = 10kHz$ , Tre = +14dB
Tone control voltage gain (Cut/ Treble)	G(Treble)C	-16.5	-14	-11.5	dB	$f = 10kHz$ , Tre = -14dB
Tone control voltage gain (Flat/ Treble)	G(Treble)F	-2	0	+2	dB	$f = 100Hz$ , Tre = 0dB

## Bus Line Timing Specification



Parameters	Symbol	Min	Max	Units
Min input low voltage	$V_{IL}$	0	1.5	V
Max input high voltage	$V_{IH}$	3.0	5.0	V
SCL clock frequency	$f_{SCL}$	—	100	kHz
Time the bus must be free before a new transmission can start	$t_{BUF}$	4.7	—	$\mu$ S
Hold time start condition. After this period the first clock pulse is generated	$t_{HD:STA}$	4.0	—	$\mu$ S
The Low period of the clock	$t_{Low}$	4.7	—	$\mu$ S
The High period of the clock	$t_{High}$	4.0	—	$\mu$ S
Set-up time for start condition (Only relevant for a repeated start condition)	$t_{SU:STA}$	4.7	—	$\mu$ S
Hold time DATA	$t_{HD:DAT}$	0	—	$\mu$ S
Set-up time DATA	$t_{SU:DAT}$	250	—	ns
Rise time of both SDA & SCL lines	$t_R$	—	1000	ns
Fall time of both SDA & SCL lines	$t_F$	—	300	ns
Set-up time for stop condition	$t_{SU:STO}$	4.0	—	$\mu$ S

## Function Description

### 1. Tone Control

#### <1> Bass Circuit

**Boost**

**Cut**

$$f_o = \frac{1}{2\pi \sqrt{R1(R2+R3)C1C2}} \text{ (Hz)}$$

$$Q \cong \frac{1}{C1+C2} \sqrt{\frac{C1C2R2}{R1}} \text{ (R3=0)}$$

$$G_v = 20\log \left[ \frac{\frac{R2+R3}{R1} + 2}{\frac{R3}{R1} + 2} \right] \text{ (dB)} \text{ (C1=C2)}$$
  

$$f_o = \frac{1}{2\pi \sqrt{R1(R2+R3)C1C2}} \text{ (Hz)}$$

$$Q \cong \frac{1}{C1+C2} \sqrt{\frac{C1C2R2}{R1}} \text{ (R3=0)}$$

$$G_v = 20\log \left[ \frac{\frac{R3}{R1} + 2}{\frac{R2+R3}{R1} + 2} \right] \text{ (dB)} \text{ (C1=C2)}$$

R1=8.2kΩ  
C1=C2=0.068μF

Setting [dB]	R2[Ω]	R3[Ω]
± 0	0	80000
± 2	19820	60180
± 4	35570	44430
± 6	48040	31920
± 8	58020	21980
± 10	65910	14090
± 12	72190	7810
± 14	77170	2830

#### <2> Treble Circuit

**Boost**

**Cut**

$$A_v = 20\log \sqrt{\frac{\{\omega C(R1+R2)\}^2 + 1}{(\omega CR1^2) + 1}} \text{ (dB)}$$

\*ω=2πf

$$A_v = 20\log \sqrt{\frac{(\omega CR1)^2 + 1}{\{\omega C(R1+R2)\}^2 + 1}} \text{ (dB)}$$

\*ω=2πf

C=8200pF

Setting [dB]	R1 [Ω]	R2 [Ω]
± 0	30000	0
± 2	23810	6190
± 4	18890	11110
± 6	14970	15030
± 8	11850	18150
± 10	9350	20650
± 12	7340	22660
± 14	5730	24270

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