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April 1st, 2010
Renesas Electronics Corporation

Issued by: Renesas Electronics Corporation (<http://www.renesas.com>)

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R2A15908SP

5 Input Selector 2ch Electronic Volume with Tone & Surround

REJ03F0270-0100

Rev.1.00

Jan 25, 2008

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 I₂C 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
- I₂C-bus control
- Package SOP with 28 pin

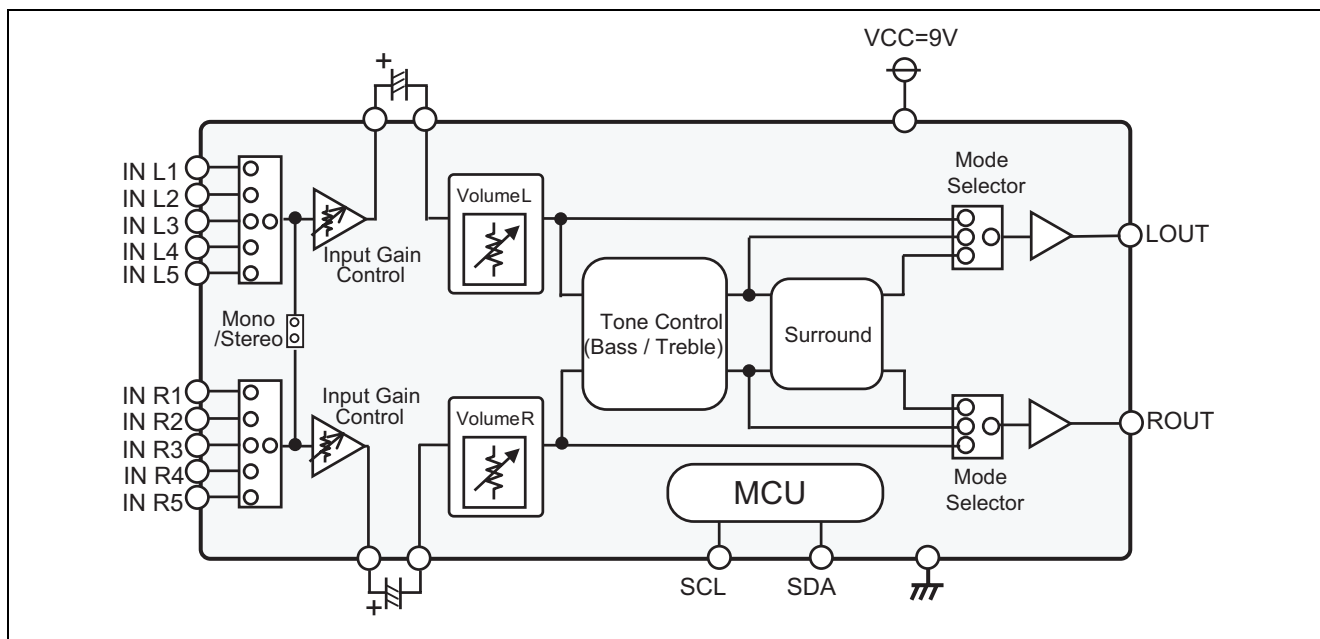
Application

- Mini stereo, TV, etc.

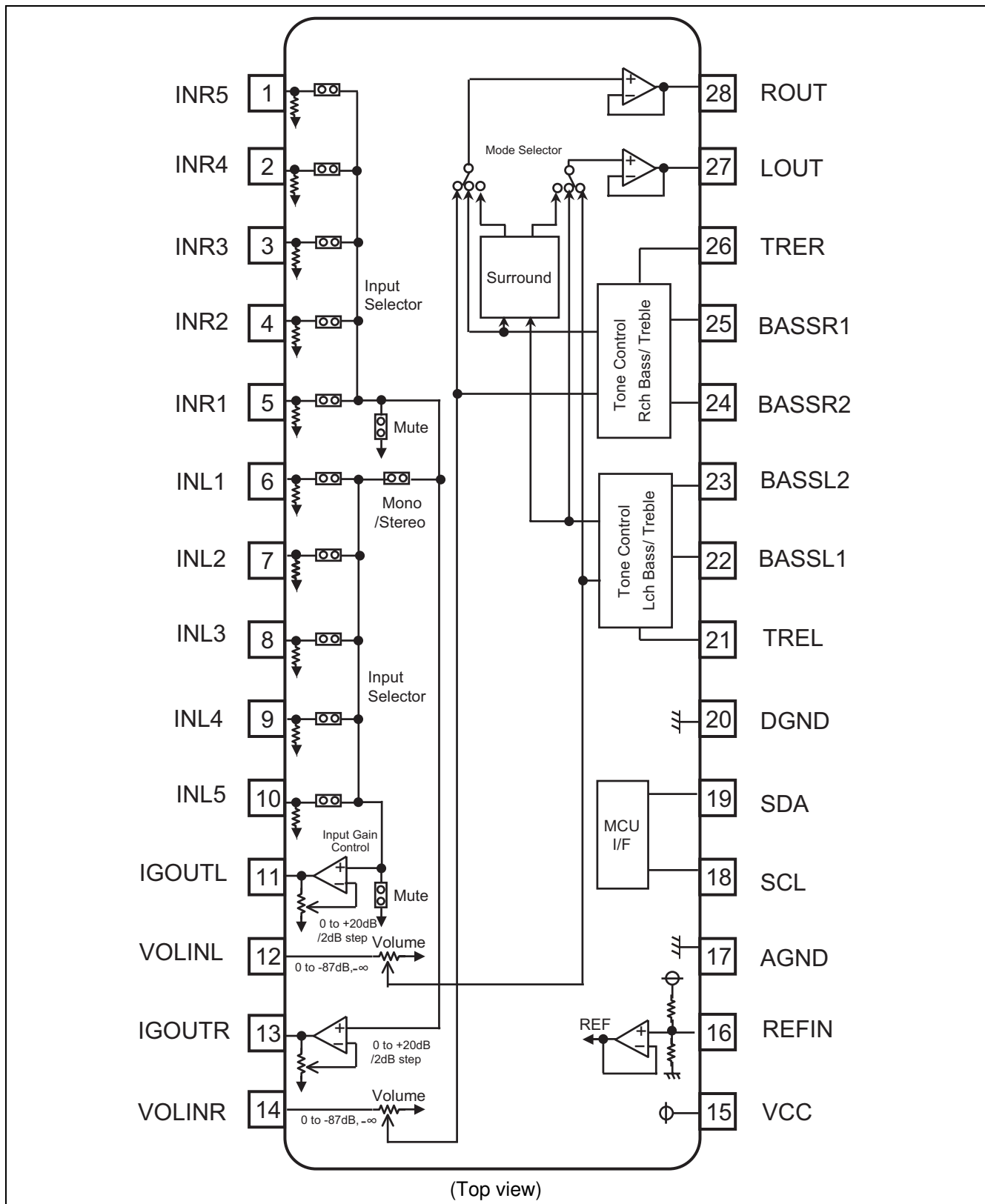
Recommended Operating Condition

- Supply voltage V_{CC} = 9.0V (typ)

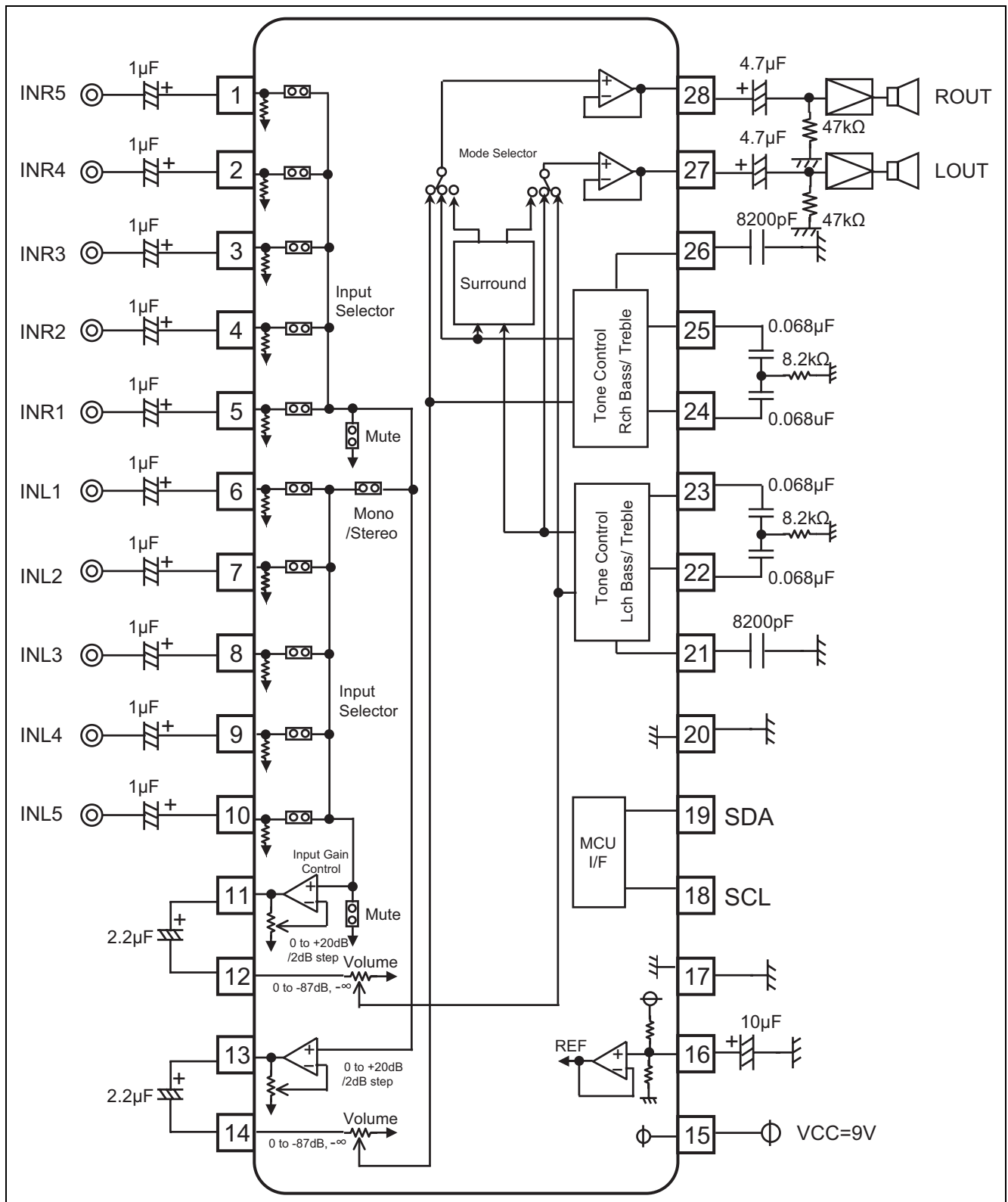
System Configuration



Block Diagram and Pin Configuration

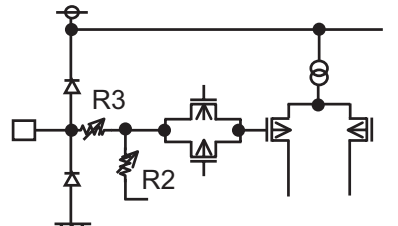
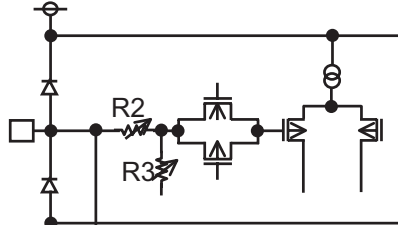
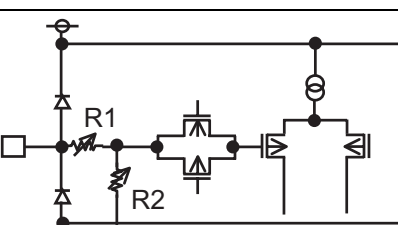


Application Example



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	$R1 + R2 = 50k\Omega$
18	SCL	
19	SDA	
16	REFIN	
15 17 20	VCC AGND DGND	

Pin	Pin Name	Equivalent Circuit
22 25	BASSR1 BASSL1	 $R2+R3=80k\Omega$
23 24	BASSR2 BASSL2	 $R2+R3=80k\Omega$
21 26	TRER TREL	 $R1+R2=30k\Omega$

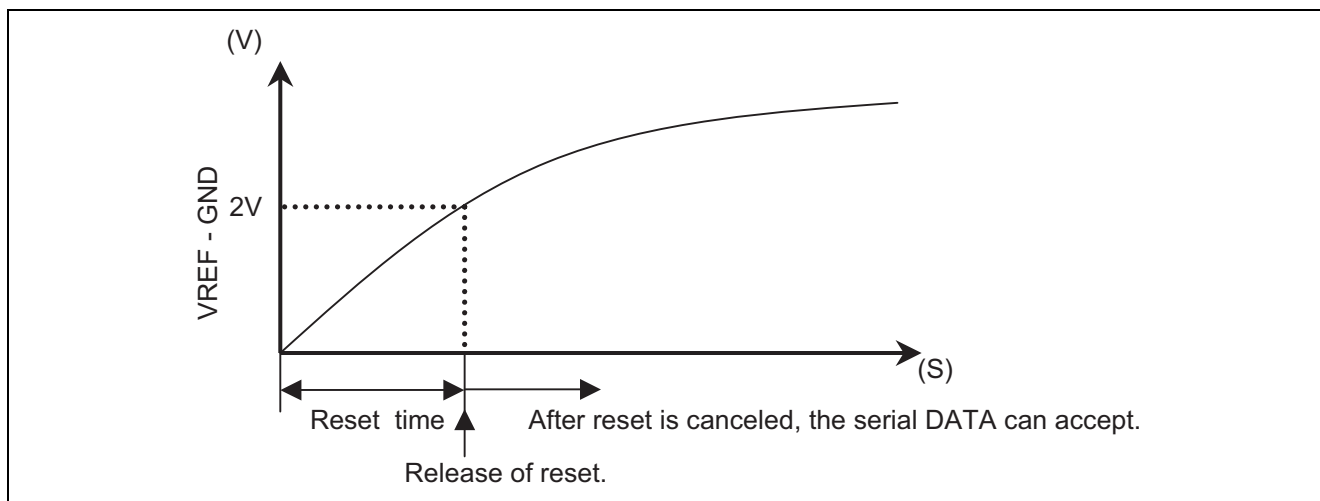
Absolute Maximum Ratings

Parameter	Symbol	Ratings	Unit	Condition
Power supply	V_{CC}	10	V	
Power dissipation	P_d		W	$T_a \leq 25^\circ\text{C}$
Thermal derating	K		mW / $^\circ\text{C}$	$T_a > 25^\circ\text{C}$ (Circuit board installation)
Operating temperature	T_{opr}	-20 to +75	$^\circ\text{C}$	
Storage temperature	T_{stg}	-40 to +125	$^\circ\text{C}$	

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.



I²C Bus Format

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 _B

R/W_B=0 : Write mode for register setting

R/W_B=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

<1> 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.

<2> 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

<3> 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

<4> Stereo / Mono Selector (Sub Address: 03H)

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

<5> 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.

<6> 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, $R_g = 600\Omega$, $R_L = 47k\Omega$)

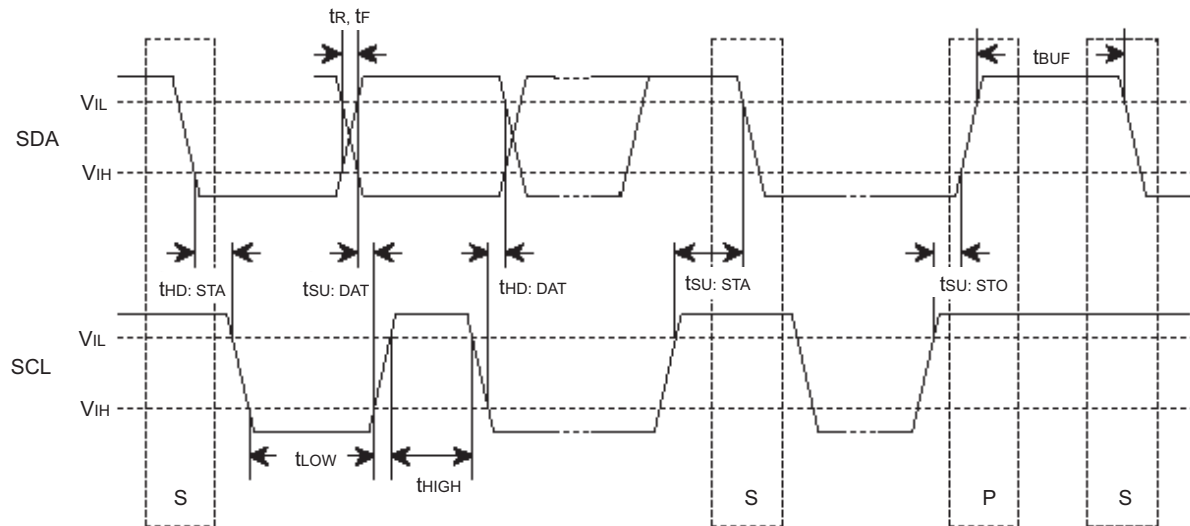
General Characteristics

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	V_{OM}	—	2.5	—	V_{rms}	$VOL = 0dB$, $THD = 1\%$
Volume maximum	VOL_{max}	-2	0	+2	dB	$VOL = 0dB$
Volume minimum	VOL_{min}	—	-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	μV_{rms}	$VOL = 0dB$, Input gain = 0dB Tone = 0dB, Surround = Low, IHF-A
Output noise 2	V_{no2}	—	5	15	μV_{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	—	μs
Hold time start condition. After this period the first clock pulse is generated	$t_{HD:STA}$	4.0	—	μs
The Low period of the clock	t_{Low}	4.7	—	μs
The High period of the clock	t_{High}	4.0	—	μs
Set-up time for start condition (Only relevant for a repeated start condition)	$t_{SU:STA}$	4.7	—	μs
Hold time DATA	$t_{HD:DAT}$	0	—	μs
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	—	μs

Function Description

1. Tone Control

<1> Bass Circuit

Boost

Cut

$$f_0 = \frac{1}{2\pi \sqrt{R1(R2+R3)C1C2}} \text{ (Hz)}$$
$$Q \cong \frac{1}{C1+C2} \sqrt{\frac{C1C2R2}{R1}} \text{ (R3=0)}$$
$$G_v = 20\log \left[\frac{\frac{R2+R3}{R1} + 2}{\frac{R3}{R1} + 2} \right] \text{ (dB)}$$
$$\text{(C1=C2)}$$

$R1=8.2k\Omega$
 $C1=C2=0.068\mu F$

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

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

* $\omega=2\pi f$

$C=8200pF$

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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