

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

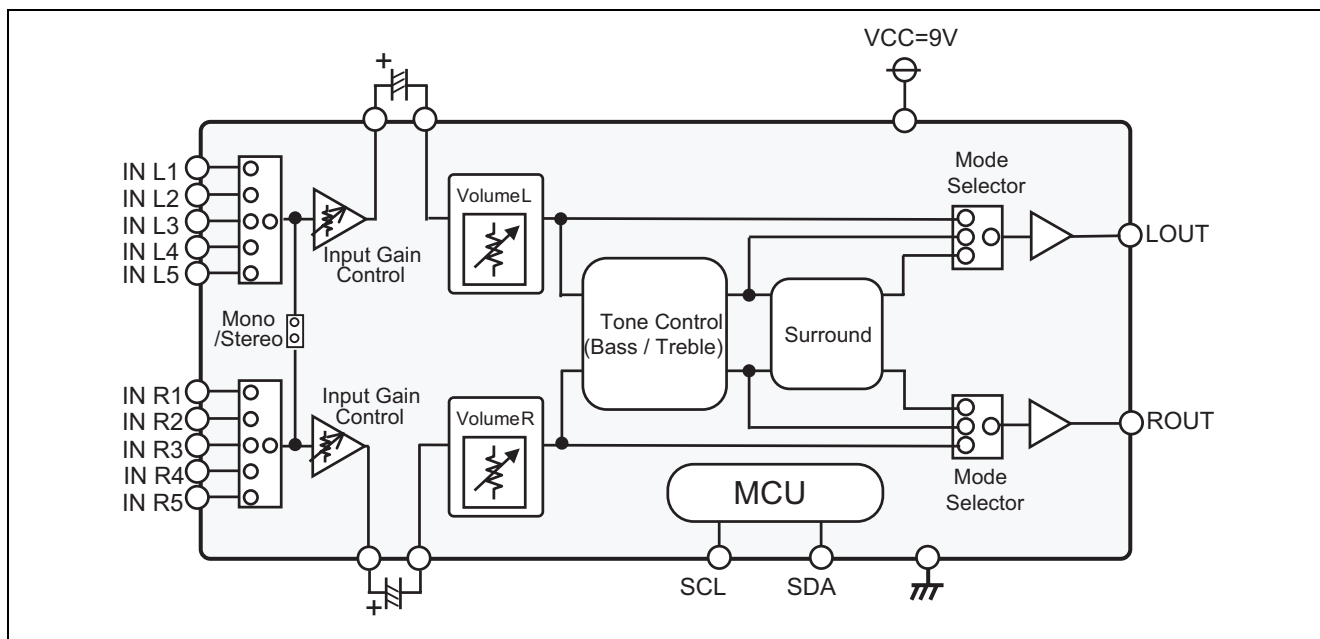
Application

- Mini stereo, TV, etc.

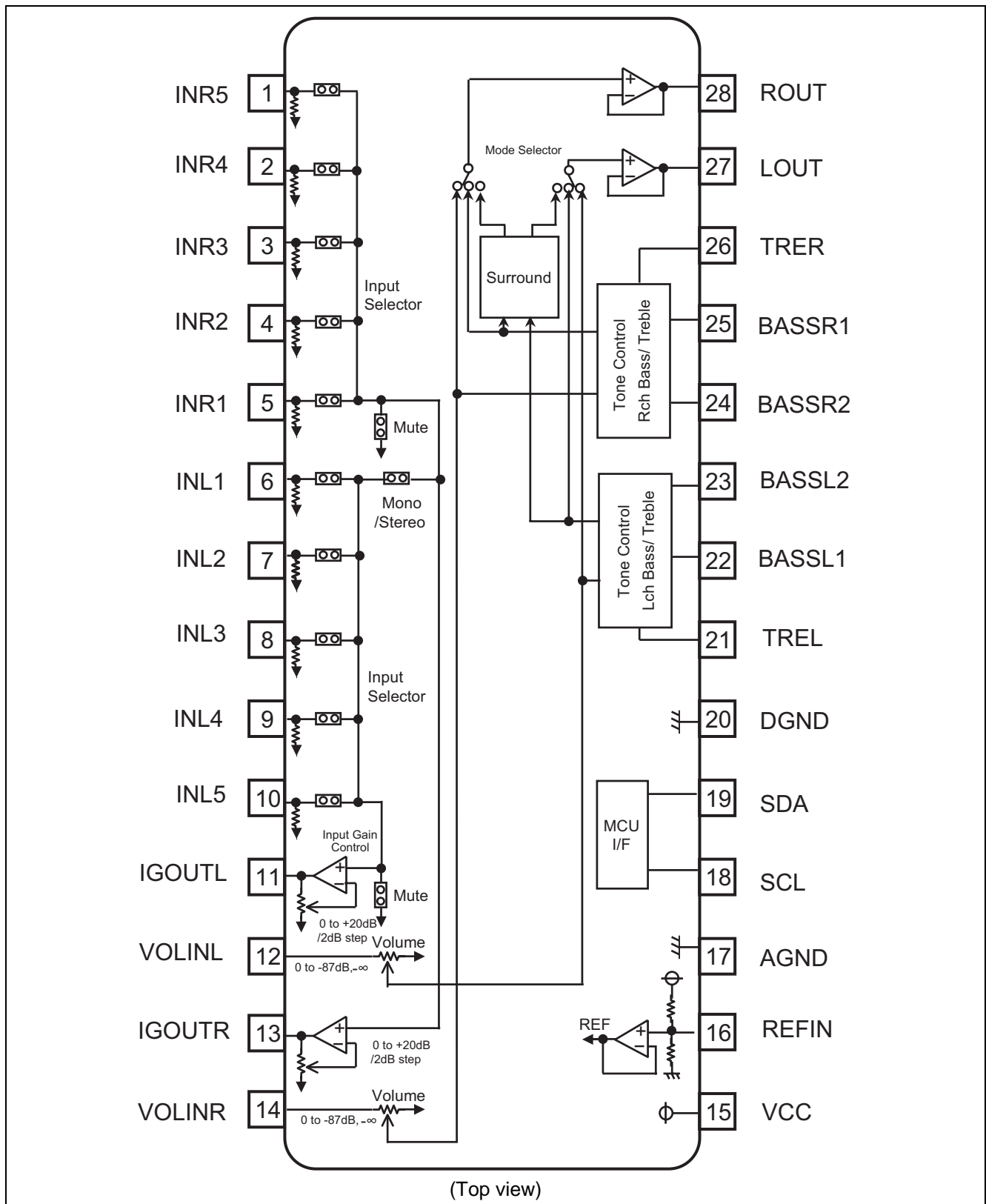
Recommended Operating Condition

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

System Configuration

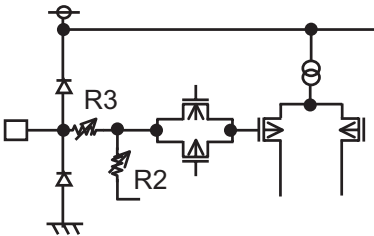
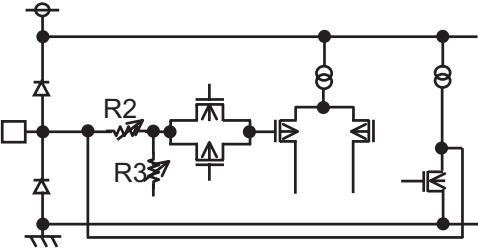
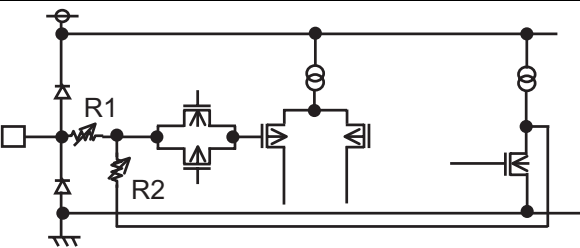


Block Diagram and Pin Configuration



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	
18	SCL	
19	SDA	
16	REFIN	
15 17 20	VCC AGND DGND	

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

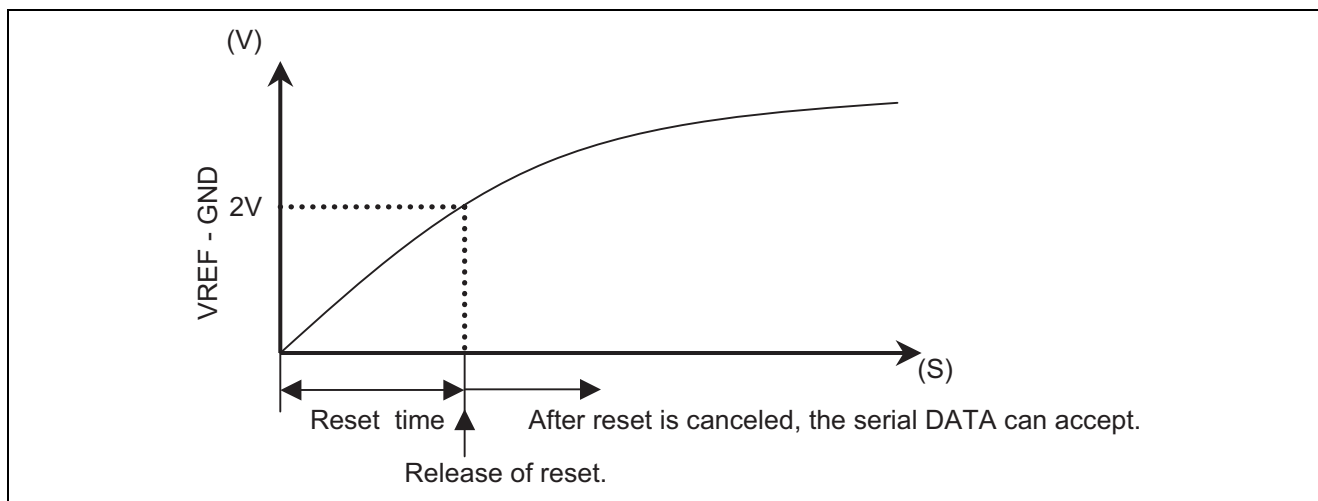
Absolute Maximum Ratings

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 01H	D7	D6	D5	D4	D3	D2	D1
	Rch			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, $R_g = 600\Omega$, $R_L = 47k\Omega$)

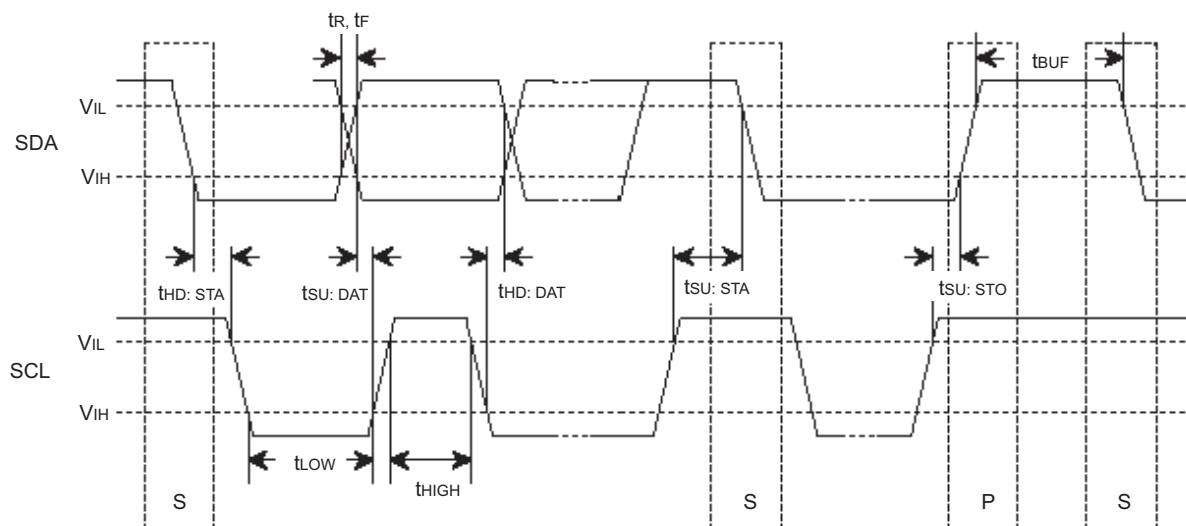
General Characteristics

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

$$f_0 = \frac{1}{2\pi \sqrt{R1(R2+R3)C1C2}} \text{ (Hz)}$$

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

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

$$f_0 = \frac{1}{2\pi \sqrt{R1(R2+R3)C1C2}} \text{ (Hz)}$$

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

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

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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