To our customers,

Old Company Name in Catalogs and Other Documents

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Renesas Electronics website: http://www.renesas.com

April 1st, 2010
Renesas Electronics Corporation

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

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R2S15903SP

Sound Controller with Surround & AGC

REJ03F0159-0140
Rev.1.4
Dec 06, 2005

Description

The R2S15903SP is an optimum audio signal processor IC for TV. It has a 5ch input selector, AGC, surround/pseudo stereo, tone control(2band), output gain control and 2ch master volume. It can control all of these functions with I^2C bus.

Features

- Volume: 0 to –89dB, –∞/ 1dB step. Each channel is independence control.
- 5 input selector + MUTE
- 2 Rec output (0/–2dB)
- Auto gain control (AGC level 4step)
- Tone control Bass: –15dB to +15dB/ 1dB step
  Treble: –15dB to +15dB/ 1dB step
- Surround <Low/ High>/ Pseudo stereo
- Mode selector: Bypass/ Tone / Tone & Pseudo Stereo or Surround
- Output gain control: 0dB/ +4.5dB
- I^2C-BUS control

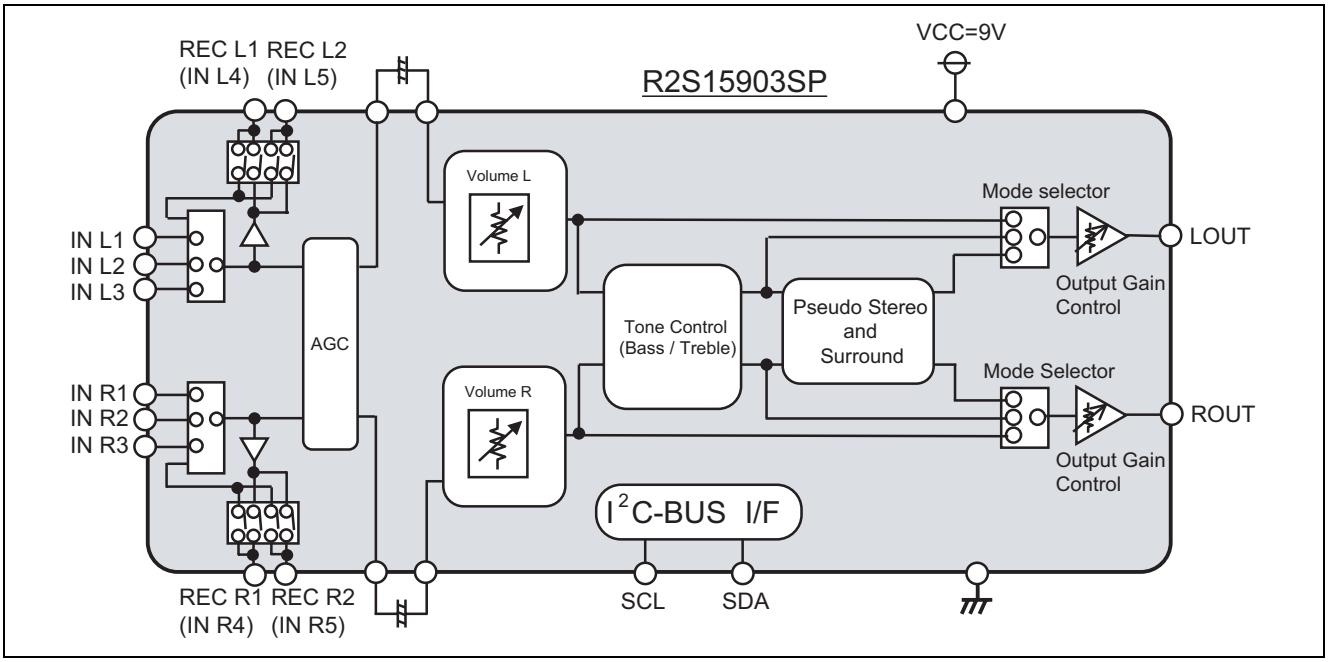
Recommended Operating Condition

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

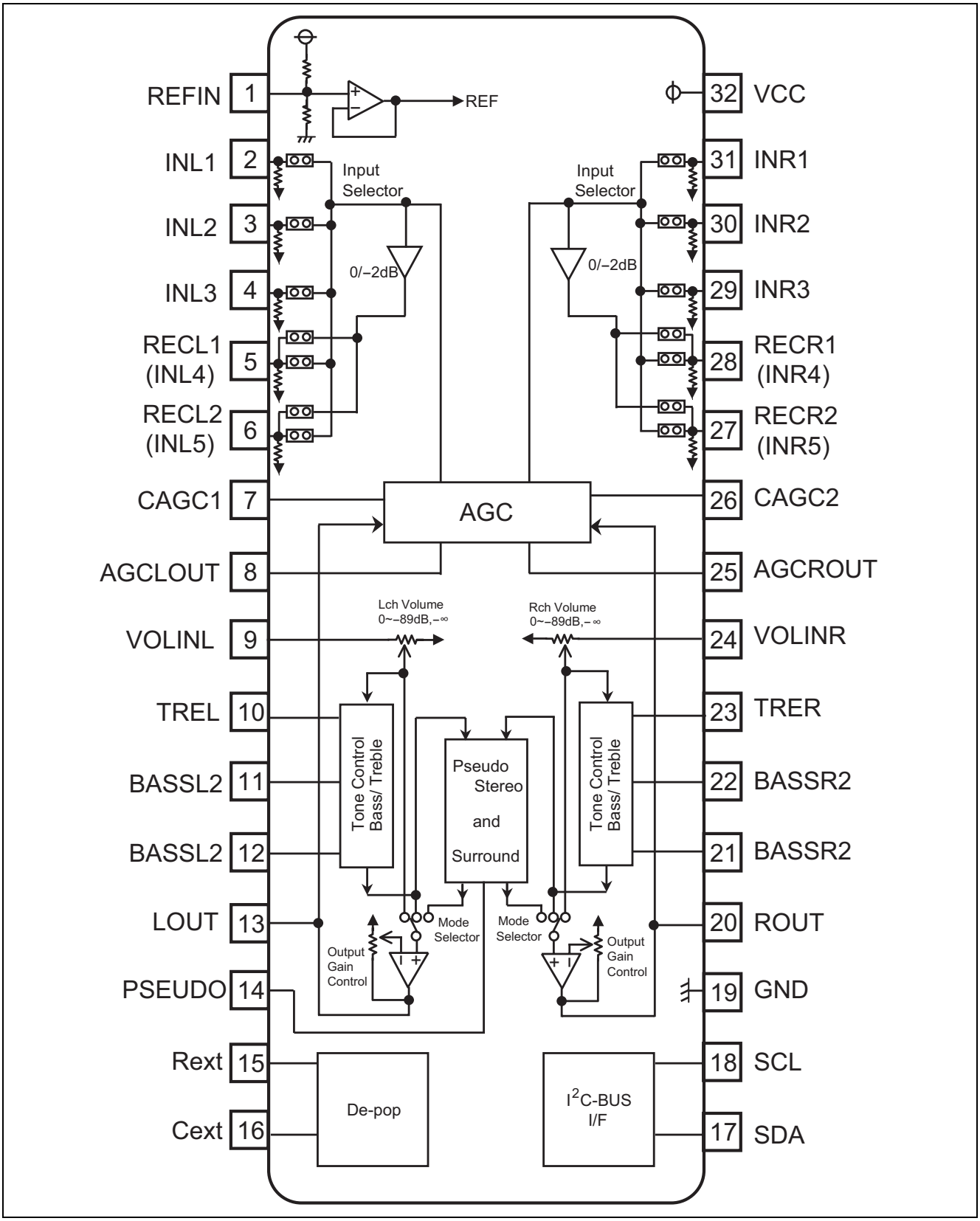
Application

TV, Mini Stereo, etc.

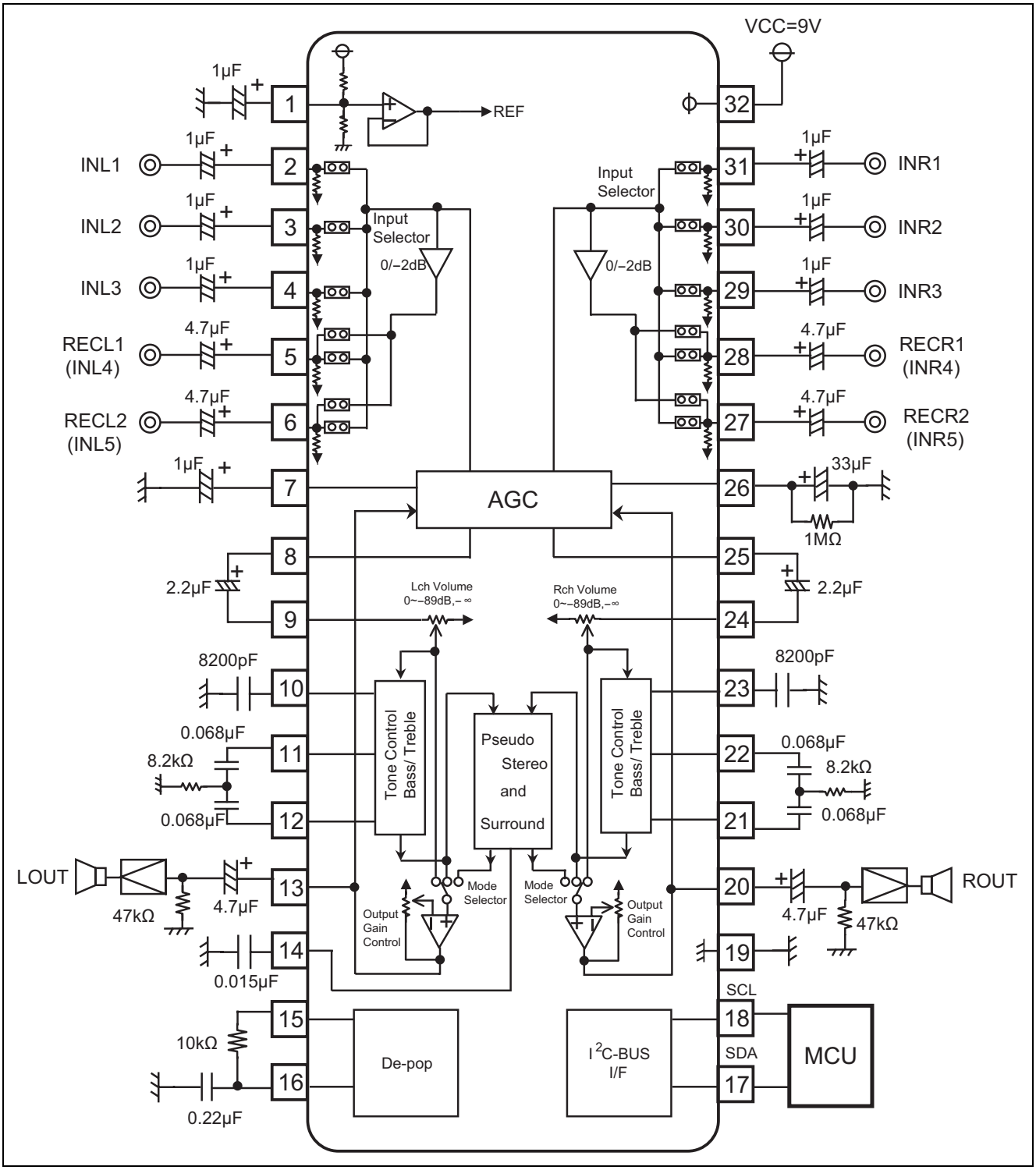
System Configuration



Block Diagram and Pin Configuration

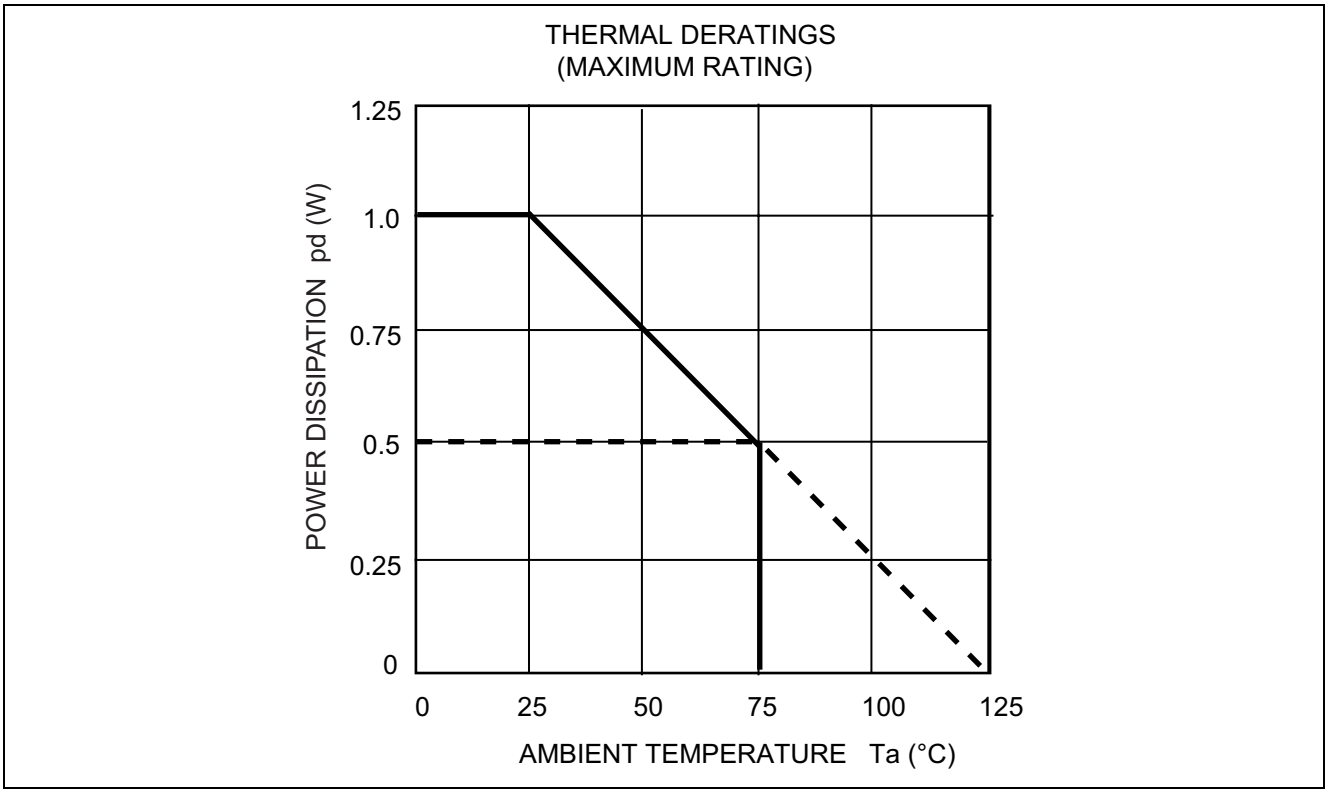


Application Example



Absolute Maximum Ratings

Parameter	Symbol	Ratings	Unit	Condition
Power supply	V_{CC}	10	V	
Power dissipation	Pd	1.0	W	Ta≤25℃
Thermal derating	K	10.0	mW/℃	Ta>25℃ (Circuit board installation)
Operating temperature	Topr	–20 to +75	°C	
Storage temperature	Tstg	–40 to +125	°C	



Electrical Characteristics

(V_{CC}=9V, Ta=25°C, Vi=100mVrms, f=1kHz, Bypass, AGC: off, Rg=0Ω, RL=47kΩ, unless otherwise noted)

General Characteristics

Parameter	Symbol	Limits			Unit	Condition
		Min	Typ	Max		
Operational power supply	V_{CC}	8.0	9.0	9.7	V	
Supply current	I_{CC}	—	25	35	mA	No signal
Reference voltage	Vref	4.0	4.5	5.0	V	No signal
Input impedance	RIN	17	25	33	kΩ	
Maximum input voltage	VIM	2.8	3.0	—	Vrms	VOL=–20dB, THD=3%
Maximum output voltage	VOM	—	2.5	—	Vrms	VOL=0dB, THD=1%
Rec output gain	Gvrec	—	0/ –2.0	—	dB	Rec out (0/ –2dB)
Output gain	Gvout	—	4.5	—	dB	Output gain=4.5dB
Volume maximum	VOLmax	–2	0	+2	dB	VOL=0dB
Volume minimum	VOLmin	—	–85	–70	dB	VOL=Mute, Vin=1Vrms, IHF-A
Channel balance	CBAL	–1.5	0	1.5	dB	VOL=0dB
Total harmonic distortion	THD	—	—	0.5	%	400Hz to 30kHz BPF Vo=0.5Vrms
Input selector cross talk	CT	—	—	–70	dB	Vin=1Vrms, IHF-A
Channel separation	CS	—	—	–70	dB	Vin=1Vrms, IHF-A,
Output noise 1	Vno1	—	–90 (31.6)	–85 (56.2)	dBV (μVrms)	VOL=0dB,Output gain=0dB Tone=0dB,Surround ON, AGC: OFF, IHF-A
Output noise 2	Vno2	—	–103 (7)	–97 (14)	dBV (μVrms)	VOL=Mute, Output gain=0dB Bypass, AGC: OFF, IHF-A

Tone Control

Parameter	Symbol	Limits			Unit	Condition
		Min	Typ	Max		
Tone control voltage gain (Boost/Bass)	G (Bass) B	+12.5	+15	+17.5	dB	f = 100Hz Bass= + 15dB
Tone control voltage gain (Cut/Bass)	G (Bass) C	–17.5	–15	–12.5	dB	f = 100Hz Bass = –15dB
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	+12.5	+15	+17.5	dB	f = 10kHz Tre = +15dB
Tone control voltage gain (Cut/Treble)	G (Treble) C	–17.5	–15	–12.5	dB	f = 10kHz Tre = –15dB
Tone control voltage gain (Flat/Treble)	G (Treble) F	–2	0	+2	dB	f = 100Hz Tre = 0dB

AGC

Parameter	Symbol	Limits			Unit	Condition
		Min	Typ	Max		
AGC Boost	AGCBST	1.5	3.5	5.5	dB	AGC level = 300mVrms Vin = 50mVrms, f = 1kHz
AGC FLAT1	AGCFLT1	–2.5	0.0	2.5	dB	AGC level = 300mVrms Vin = 300mVrms, f = 1kHz
AGC FLAT2	AGCFLT2	–2.5	0.0	2.5	dB	AGC level = 400mVrms Vin = 400mVrms, f = 1kHz
AGC FLAT3	AGCFLT3	–2.5	0.0	2.5	dB	AGC level = 500mVrms Vin = 500mVrms, f = 1kHz
AGC FLAT4	AGCFLT4	–2.5	0.0	2.5	dB	AGC level = 600mVrms Vin = 600mVrms, f = 1kHz
AGC CUT	AGCCUT	–14	–10	–6.0	dB	AGC level = 300mVrms Vin = 2Vrms, f = 1kHz

I^2C BUS Interface

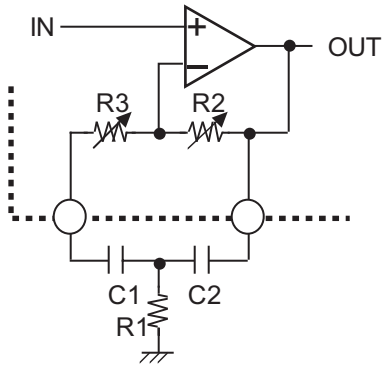
Parameter	Symbol	Limits			Unit	Condition
		Min	Typ	Max		
Low level input voltage	V_{IL}	0	—	1.5	V	V_{CC}=9V
High level input voltage	V_{IH}	3	—	5	V	V_{CC}=9V
Maximum clock frequency	f_{SCL}			100	kHz	

Function Description

1. Tone Control Circuit

<1> Bass Circuit

Boost

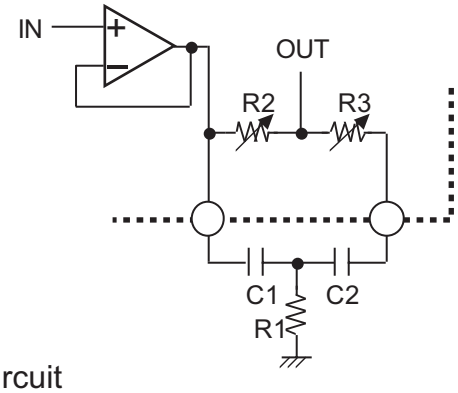


$$fo = \frac{1}{2\pi\sqrt{R1(R2+R3)C1C2}} \quad (Hz)$$

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

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

Cut



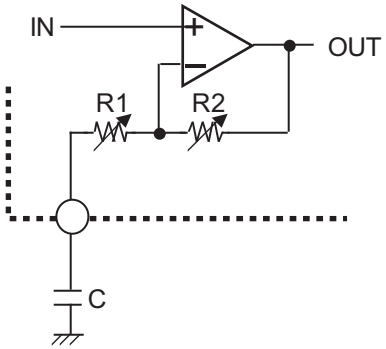
$$fo = \frac{1}{2\pi\sqrt{R1(R2+R3)C1C2}} \quad (Hz)$$

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

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

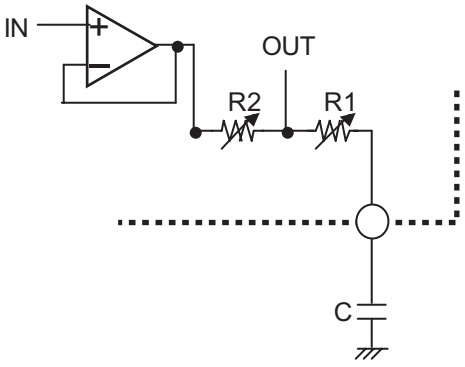
<2> Treble Circuit

Boost



$$Gv = 20\log\left[\frac{R1+R2}{R1}\right] \quad (dB)$$

Cut



$$Gv = 20\log\left[\frac{R1}{R1+R2}\right] \quad (dB)$$

I²C Bus Format

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

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 → 05H → 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	Lch VOL<H>				Lch VOL<L>			
01H	Rch VOL<H>				Rch VOL<L>			
02H	Input selector			Rec output		Output gain	Lch mute	Rch mute
03H	Bass					Surround level	Mode selector	
04H	Treble					Rec gain	0	0
05H	AGC/ Bypass	AGC level		AGC mode	0	0	0	0

3. Data Table

<1> Master Volume Control (Sub Address: 00H, 01H)

VOL ATT (dB)	VOL<H>			
	D7	D6	D5	D4
0	0	0	0	0
–10	0	0	0	1
–20	0	0	1	0
–30	0	0	1	1
–40	0	1	0	0
–50	0	1	0	1
–60	0	1	1	0
–70	0	1	1	1
–80	1	0	0	0

VOL ATT (dB)	VOL<L>			
	D3	D2	D1	D0
0	0	0	0	0
–1	0	0	0	1
–2	0	0	1	0
–3	0	0	1	1
–4	0	1	0	0
–5	0	1	0	1
–6	0	1	1	0
–7	0	1	1	1
–8	1	0	0	0
–9	1	0	0	1

Example: If the volume of the Lch is set to –28dB, the Data byte is transmitted as follows:

Sub address	BIT							
	D7	D6	D5	D4	D3	D2	D1	D0
00H	0	0	1	0	1	0	0	0

<2> Input Selector (Sub Address: 02H)

Input	Input selector			REC1	REC2
	D7	D6	D5	D4	D3
All OFF	0	0	0	A	A
IN1	0	0	1	A	A
IN2	0	1	0	A	A
IN3	0	1	1	A	A
IN4	1	0	0	1	A
IN5	1	0	1	A	1

If A=0 means REC1 or REC2 output ON, then A=1 means REC1 or REC2 output OFF.

<3> Output Gain (Sub Address: 02H)

Gain	Output gain
	D2
0dB	0
+4.5dB	1

<4> Mute Function (Sub Address: 02H)

Mute	Lch	Rch
	D1	D0
Mute ON	0	0
Mute OFF	1	1

<5> Surround Mode (Sub Address: 03H)

Surround level	Surround level
	D2
Low level	0
High level	1

<6> Mode Selector (Sub Address: 03H)

Mode	Mode selector	
	D1	D0
Bypass	0	0
Tone	0	1
Tone & Pseudo stereo	1	0
Tone & Surround	1	1

<7> Tone Control (Sub Address: 03H Bass, 04H Treble)

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

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

<8> AGC/ Bypass (Sub Address: 05H)

Mode	Mode selector
	D7
Bypass	0
AGC	1

<9> AGC Level (Sub Address: 05H)

AGC level	AGC level	
	D6	D5
300mVrms	0	0
400mVrms	0	1
500mVrms	1	0
600mVrms	1	1

<10> AGC Mode (Sub Address: 05H)

AGC mode	AGC mode
	D4
Limitation*	0
Always**	1

*: When input level is more than 10mVrms, AGC circuit works.

**: Regardless of input level, AGC circuit always works.

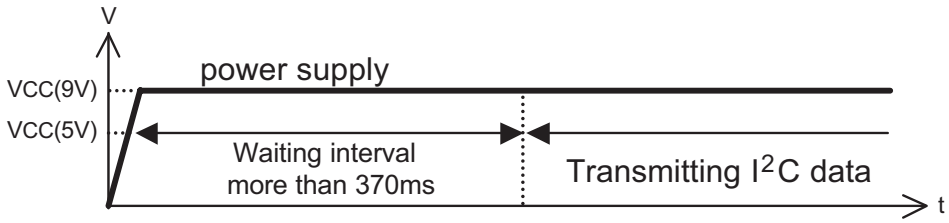
<11> REC Gain (Sub Address: 04H)

Gain	Rec gain
	D2
0dB	0
–2dB	1

Note

1. When power supply is turned on

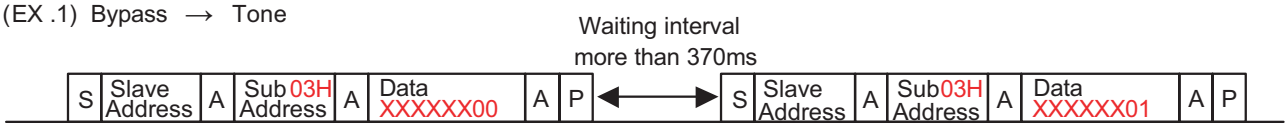
- Please do not transmit I²C data during 370ms when you turn on the power supply.
  (Cext(16pin)=0.22µF , Rext(15-16pin)=10kΩ)



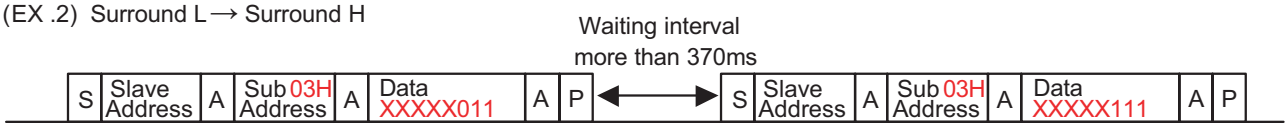
2. When mode is changed

- Please do not transmit I²C data during 370ms when you change the mode selector.
  (Cext(16pin)=0.22µF , Rext(15-16pin)=10kΩ)

(EX .1) Bypass → Tone

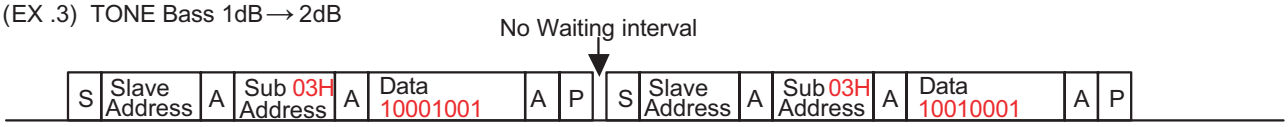


(EX .2) Surround L → Surround H



- When the TONE Bass gain is changed, waiting interval is unnecessary.

(EX .3) TONE Bass 1dB → 2dB



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