

R2S15900SP

2ch Electronic Volume with Surround

REJ03F0126-0140

Rev.1.4

Dec 13, 2006

Description

The R2S15900SP is an optimum audio signal processor IC for TV. It has a 5ch input selector, surround/pseudo stereo, tone control(2band), output gain control and 2ch master volume. It can control all of these functions with I²C bus.

Features

- Volume 0 to -84dB, -∞/ 1dB step
Each channel is independence control.
- 5 input selector + MUTE
- 2 Rec output
- 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
- I²C-BUS control
- Package 28pin SOP

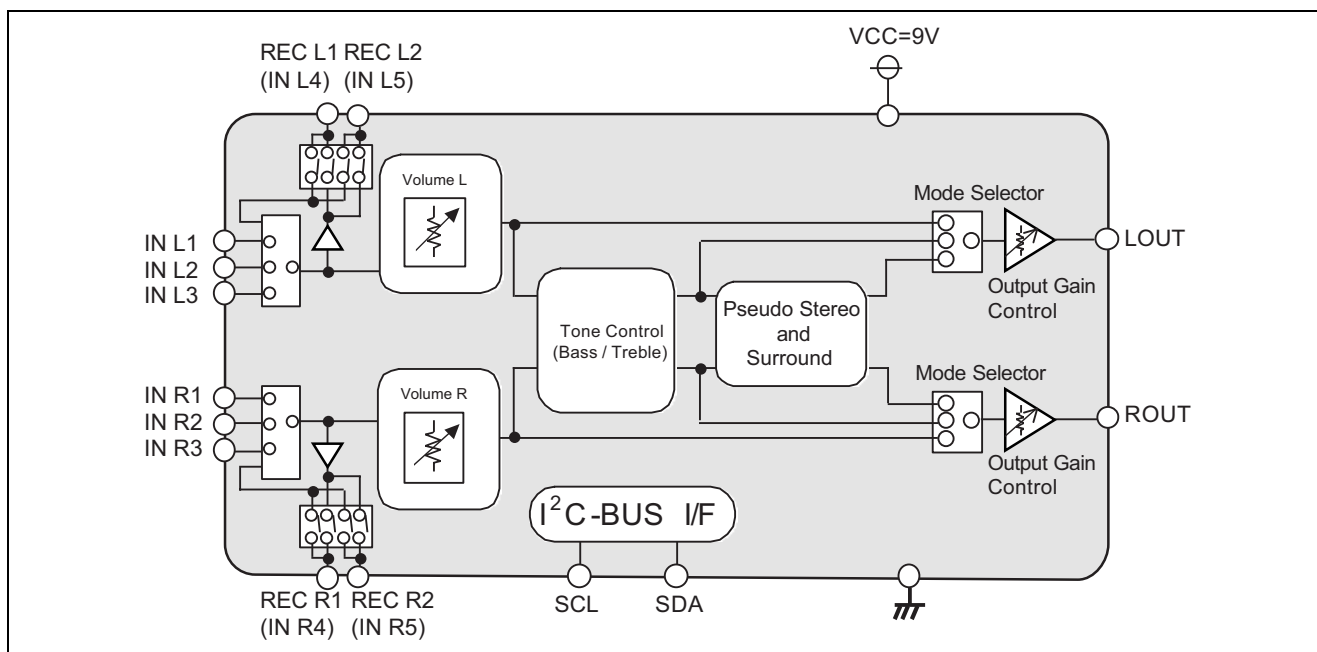
Recommended Operating Condition

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

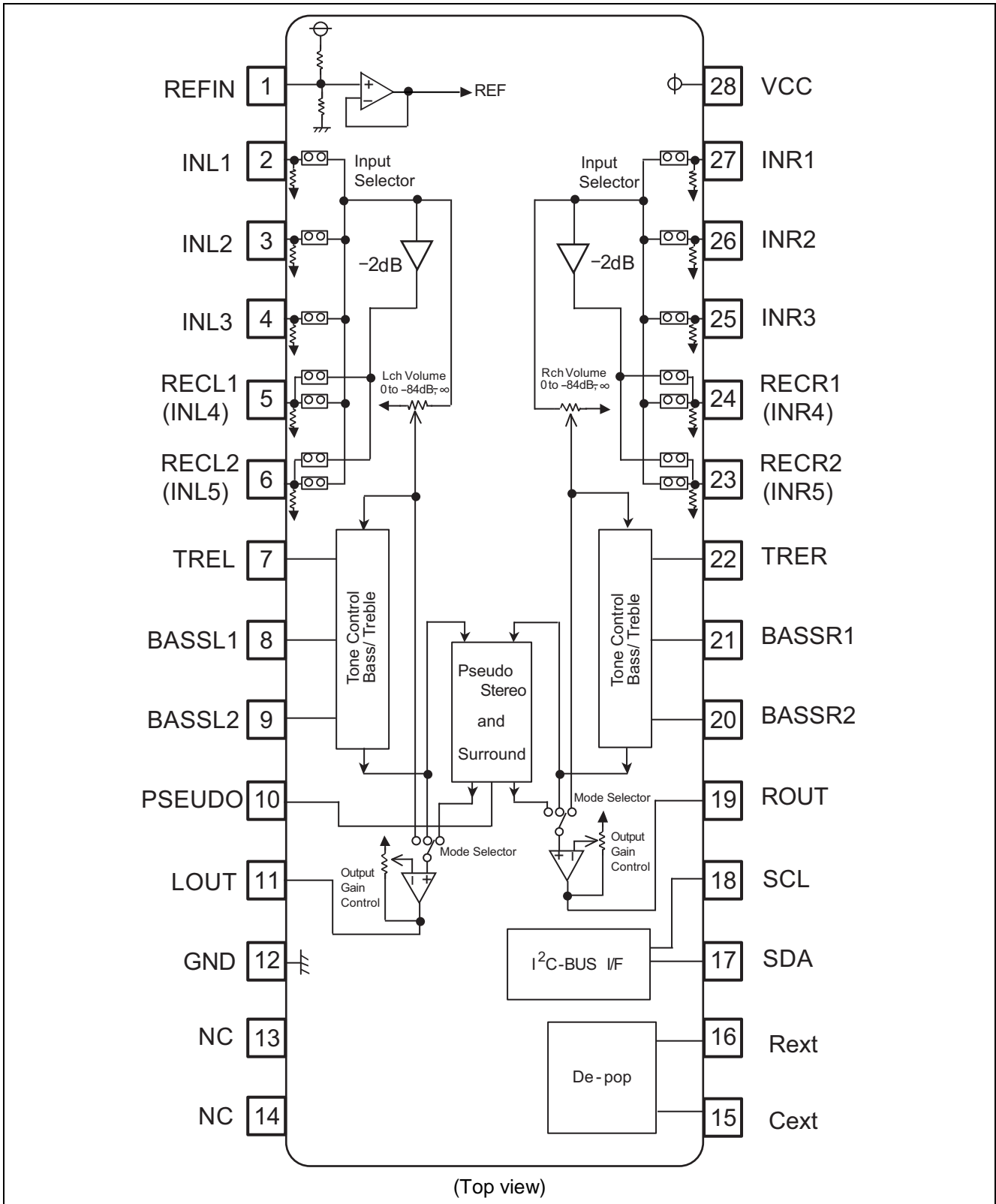
Application

TV, Mini Stereo, etc.

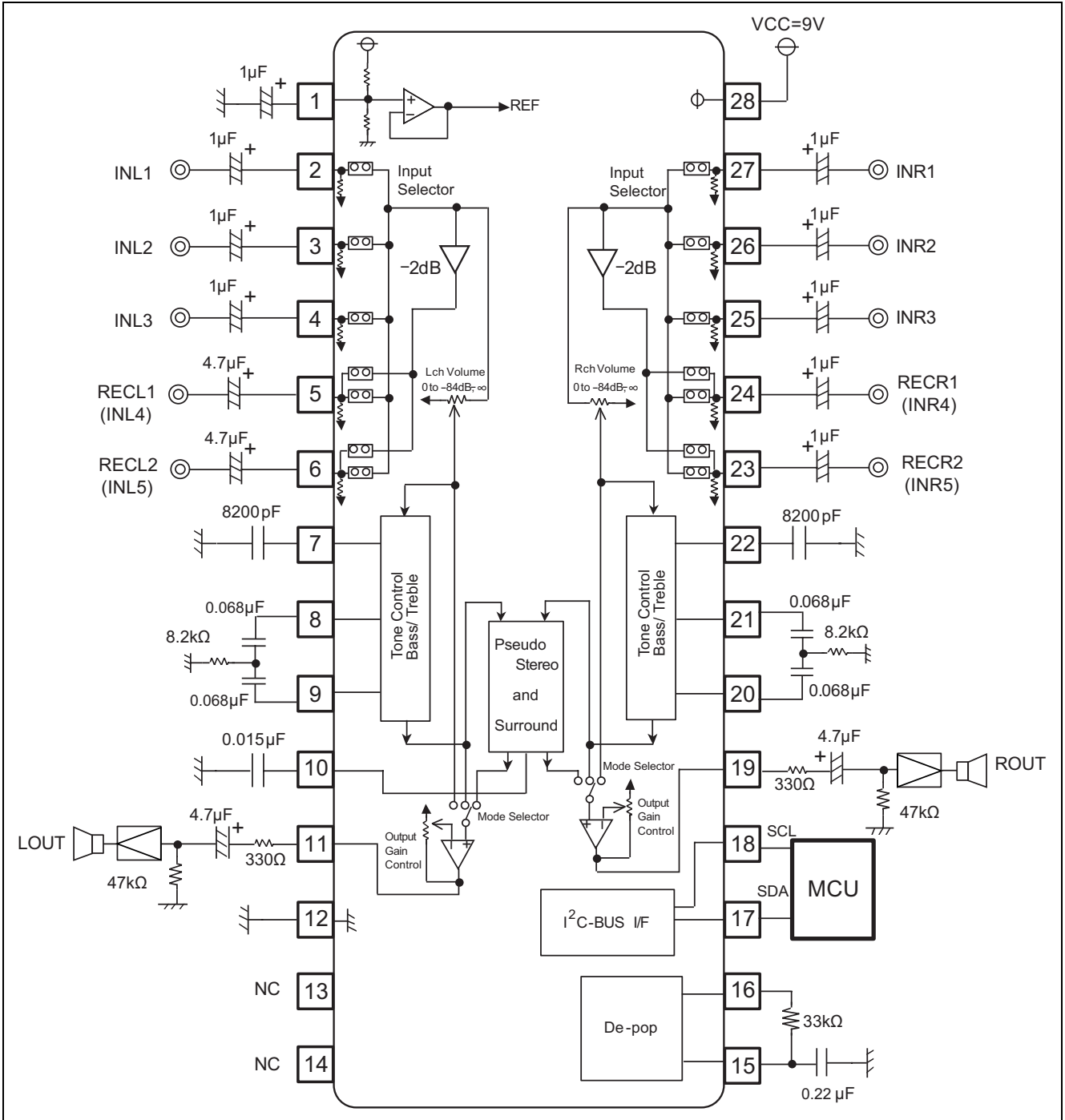
System Configuration



Block Diagram and Pin Configuration



Application Example



Absolute Maximum Ratings

Parameter	Symbol	Ratings	Unit	Condition
Power supply	V _{CC}	10	V	
Power dissipation	P _d		W	T _a ≤ 25°C
Thermal derating	K		mW/°C	T _a > 25°C (Circuit board installation)
Operating temperature	T _{opr}	-20 to +75	°C	
Storage temperature	T _{stg}	-40 to +125	°C	

Electrical Characteristics

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

General Characteristics

Parameter	Symbol	Limits			Unit	Condition
		Min	Typ	Max		
Operational power supply	V_{CC}	5.0	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}	17	25	33	$k\Omega$	
Maximum input voltage	V_{IM}	2.8	3.0	—	V_{rms}	$VOL=-20dB$, THD=3%
Maximum output voltage	V_{OM}	—	2.5	—	V_{rms}	$VOL=0dB$, THD=1%
Rec output gain	G_{vrec}	—	-2.0	—	dB	Rec out
Output gain	G_{vout}	—	4.5	—	dB	Output gain=4.5dB
Volume maximum	VOL_{max}	-2	0	+2	dB	$VOL=0dB$
Volume minimum	VOL_{min}	—	-85	-70	dB	$VOL=Mute$, $V_i=1V_{rms}$, IHF-A
Channel balance	$CBAL$	-1.5	0	1.5	dB	$VOL=0dB$
Total harmonic distortion	THD	—	0.01	0.5	%	$V_o=0.5V_{rms}$ 400Hz to 30kHz BPF
Input selector cross talk	CT	—	-100	-70	dB	$V_i=1V_{rms}$, IHF-A
Channel separation	CS	—	-100	-70	dB	$V_i=1V_{rms}$, IHF-A,
Output noise 1	V_{no1}	—	-90 (31.6)	-85 (56.2)	dBV (μV_{rms})	$VOL=0dB$, Output gain=0dB Tone=0dB, Surround ON, IHF-A
Output noise 2	V_{no2}	—	-103 (7)	-97 (14)	dBV (μV_{rms})	$VOL=Mute$, Output gain=0dB Bypass, 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

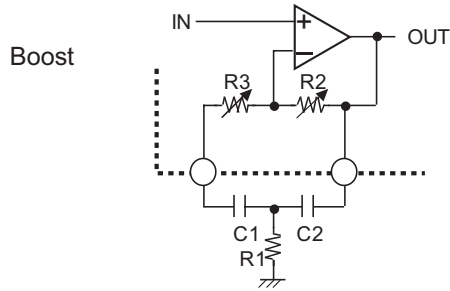
I²C BUS Interface

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



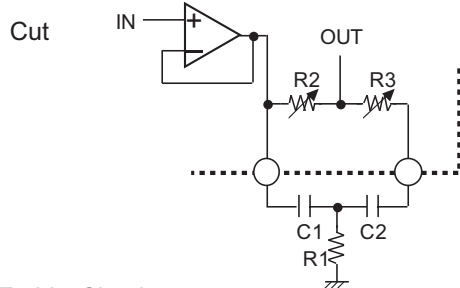
$$f_o = \frac{1}{2\pi\sqrt{R1(R2+R3)C1C2}} \text{ (Hz)}$$

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

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

R1=8.2kΩ
C1=C2=0.068μF

setting[dB]	R2 [Ω]	R3 [Ω]
±0	0	80000
±1	10480	69520
±2	19820	60180
±3	28150	51850
±4	35570	44430
±5	42180	37820
±6	48080	31920
±7	53340	26660
±8	58020	21980
±9	62190	17810
±10	65910	14090
±11	69230	10770
±12	72190	7810
±13	74820	5180
±14	77170	2830
±15	79260	740

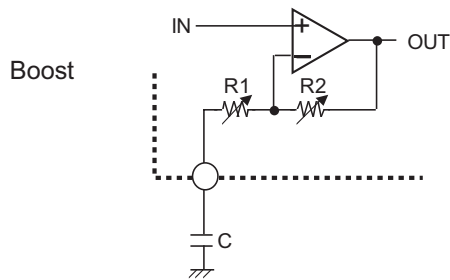


$$f_o = \frac{1}{2\pi\sqrt{R1(R2+R3)C1C2}} \text{ (Hz)}$$

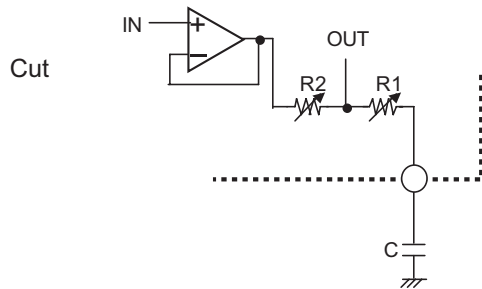
$$Q \cong \frac{1}{C1+C2} \sqrt{\frac{C1C2R2}{R1}} \text{ (R3=0)}$$

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

<2> Treble Circuit



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



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

C=8200pF

setting[dB]	R2 [Ω]	R1 [Ω]
±0	0	30000
±1	3270	26730
±2	6190	23810
±3	8790	21210
±4	11110	18890
±5	13180	16820
±6	15030	14970
±7	16680	13320
±8	18150	11850
±9	19470	10530
±10	20650	9350
±11	21700	8300
±12	22660	7340
±13	23500	6500
±14	24270	5730
±15	24960	5040

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 → 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					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

*No guarantee except for these codes.

<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

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

Surround level	Surround level
	D2
Low level	0
High level	1

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

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

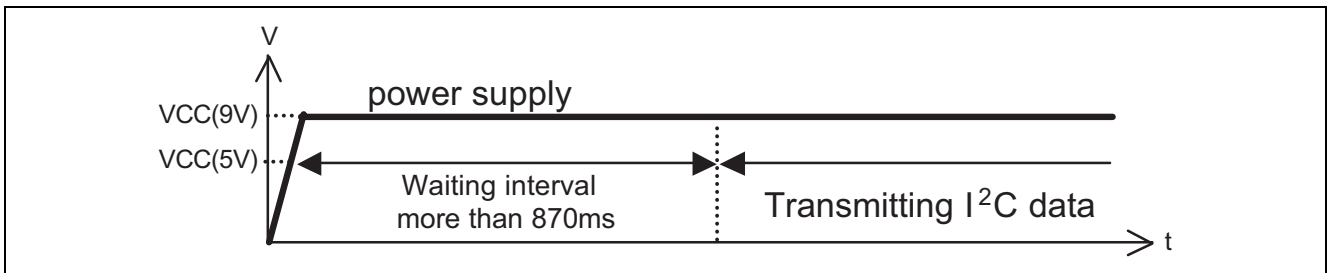
If A=0 means Tone control gain CUT(-), then A=1 means Tone control gain BOOST(+).

*No guarantee except for these codes.

Note

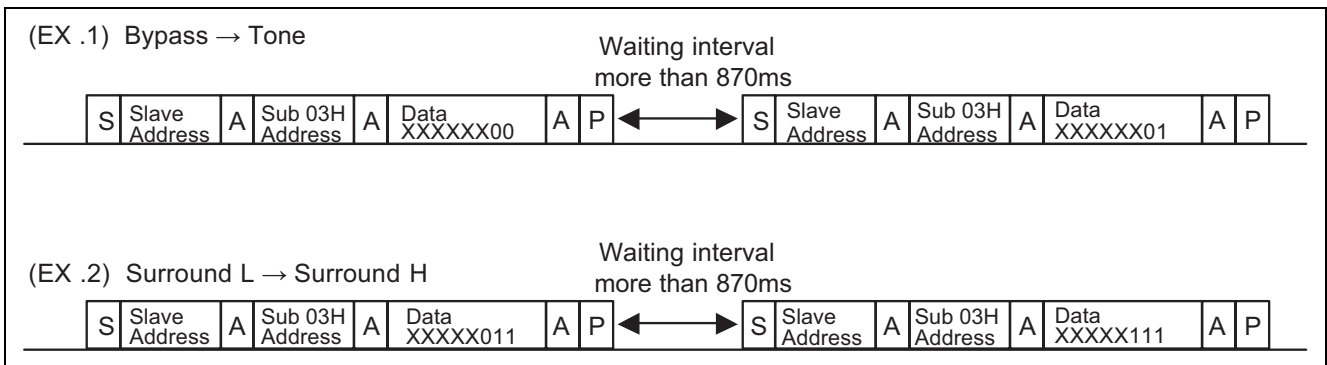
1. When power supply is turned on

- Please do not transmit I²C data during 870ms when you turn on the power supply.
(Cext(15pin)=0.22μF , Rext(15-16pin)=33kΩ)

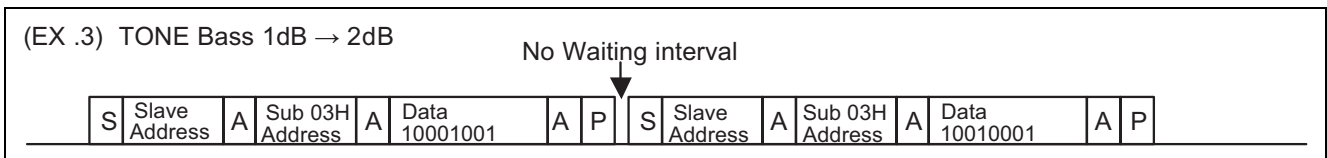


2. When mode is changed

- Please do not transmit I²C data during 870ms when you change the mode selector.
(Cext(15pin)=0.22μF , Rext(15-16pin)=33kΩ)



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



Notes:

1. This document is provided for reference purposes only so that Renesas customers may select the appropriate Renesas products for their use. Renesas neither makes warranties or representations with respect to the accuracy or completeness of the information contained in this document nor grants any license to any intellectual property rights or any other rights of Renesas or any third party with respect to the information in this document.
2. Renesas shall have no liability for damages or infringement of any intellectual property or other rights arising out of the use of any information in this document, including, but not limited to, product data, diagrams, charts, programs, algorithms, and application circuit examples.
3. You should not use the products or the technology described in this document for the purpose of military applications such as the development of weapons of mass destruction or for the purpose of any other military use. When exporting the products or technology described herein, you should follow the applicable export control laws and regulations, and procedures required by such laws and regulations.
4. All information included in this document such as product data, diagrams, charts, programs, algorithms, and application circuit examples, is current as of the date this document is issued. Such information, however, is subject to change without any prior notice. Before purchasing or using any Renesas products listed in this document, please confirm the latest product information with a Renesas sales office. Also, please pay regular and careful attention to additional and different information to be disclosed by Renesas such as that disclosed through our website. (<http://www.renesas.com>)
5. Renesas has used reasonable care in compiling the information included in this document, but Renesas assumes no liability whatsoever for any damages incurred as a result of errors or omissions in the information included in this document.
6. When using or otherwise relying on the information in this document, you should evaluate the information in light of the total system before deciding about the applicability of such information to the intended application. Renesas makes no representations, warranties or guaranties regarding the suitability of its products for any particular application and specifically disclaims any liability arising out of the application and use of the information in this document or Renesas products.
7. With the exception of products specified by Renesas as suitable for automobile applications, Renesas products are not designed, manufactured or tested for applications or otherwise in systems the failure or malfunction of which may cause a direct threat to human life or create a risk of human injury or which require especially high quality and reliability such as safety systems, or equipment or systems for transportation and traffic, healthcare, combustion control, aerospace and aeronautics, nuclear power, or undersea communication transmission. If you are considering the use of our products for such purposes, please contact a Renesas sales office beforehand. Renesas shall have no liability for damages arising out of the uses set forth above.
8. Notwithstanding the preceding paragraph, you should not use Renesas products for the purposes listed below:
 - (1) artificial life support devices or systems
 - (2) surgical implantations
 - (3) healthcare intervention (e.g., excision, administration of medication, etc.)
 - (4) any other purposes that pose a direct threat to human lifeRenesas shall have no liability for damages arising out of the uses set forth in the above and purchasers who elect to use Renesas products in any of the foregoing applications shall indemnify and hold harmless Renesas Technology Corp., its affiliated companies and their officers, directors, and employees against any and all damages arising out of such applications.
9. You should use the products described herein within the range specified by Renesas, especially with respect to the maximum rating, operating supply voltage range, movement power voltage range, heat radiation characteristics, installation and other product characteristics. Renesas shall have no liability for malfunctions or damages arising out of the use of Renesas products beyond such specified ranges.
10. Although Renesas endeavors to improve the quality and reliability of its products, IC products have specific characteristics such as the occurrence of failure at a certain rate and malfunctions under certain use conditions. Please be sure to implement safety measures to guard against the possibility of physical injury, and injury or damage caused by fire in the event of the failure of a Renesas product, such as safety design for hardware and software including but not limited to redundancy, fire control and malfunction prevention, appropriate treatment for aging degradation or any other applicable measures. Among others, since the evaluation of microcomputer software alone is very difficult, please evaluate the safety of the final products or system manufactured by you.
11. In case Renesas products listed in this document are detached from the products to which the Renesas products are attached or affixed, the risk of accident such as swallowing by infants and small children is very high. You should implement safety measures so that Renesas products may not be easily detached from your products. Renesas shall have no liability for damages arising out of such detachment.
12. This document may not be reproduced or duplicated, in any form, in whole or in part, without prior written approval from Renesas.
13. Please contact a Renesas sales office if you have any questions regarding the information contained in this document, Renesas semiconductor products, or if you have any other inquiries.



RENESAS SALES OFFICES

<http://www.renesas.com>

Refer to "<http://www.renesas.com/en/network>" for the latest and detailed information.

Renesas Technology America, Inc.

450 Holger Way, San Jose, CA 95134-1368, U.S.A
Tel: <1> (408) 382-7500, Fax: <1> (408) 382-7501

Renesas Technology Europe Limited

Dukes Meadow, Millboard Road, Bourne End, Buckinghamshire, SL8 5FH, U.K.
Tel: <44> (1628) 585-100, Fax: <44> (1628) 585-900

Renesas Technology (Shanghai) Co., Ltd.

Unit 204, 205, AZIACenter, No.1233 Lujiazui Ring Rd, Pudong District, Shanghai, China 200120
Tel: <86> (21) 5877-1818, Fax: <86> (21) 6887-7898

Renesas Technology Hong Kong Ltd.

7th Floor, North Tower, World Finance Centre, Harbour City, 1 Canton Road, Tsimshatsui, Kowloon, Hong Kong
Tel: <852> 2265-6688, Fax: <852> 2730-6071

Renesas Technology Taiwan Co., Ltd.

10th Floor, No.99, Fushing North Road, Taipei, Taiwan
Tel: <886> (2) 2715-2888, Fax: <886> (2) 2713-2999

Renesas Technology Singapore Pte. Ltd.

1 Harbour Front Avenue, #06-10, Keppel Bay Tower, Singapore 098632
Tel: <65> 6213-0200, Fax: <65> 6278-8001

Renesas Technology Korea Co., Ltd.

Kukje Center Bldg. 18th Fl., 191, 2-ka, Hangang-ro, Yongsan-ku, Seoul 140-702, Korea
Tel: <82> (2) 796-3115, Fax: <82> (2) 796-2145

Renesas Technology Malaysia Sdn. Bhd

Unit 906, Block B, Menara Amcorp, Amcorp Trade Centre, No.18, Jalan Persiaran Barat, 46050 Petaling Jaya, Selangor Darul Ehsan, Malaysia
Tel: <603> 7955-9390, Fax: <603> 7955-9510