

To our customers,

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## Old Company Name in Catalogs and Other Documents

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April 1<sup>st</sup>, 2010  
Renesas Electronics Corporation

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# 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 I<sup>2</sup>C 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
- I<sup>2</sup>C-BUS control
- Package 28pin SOP

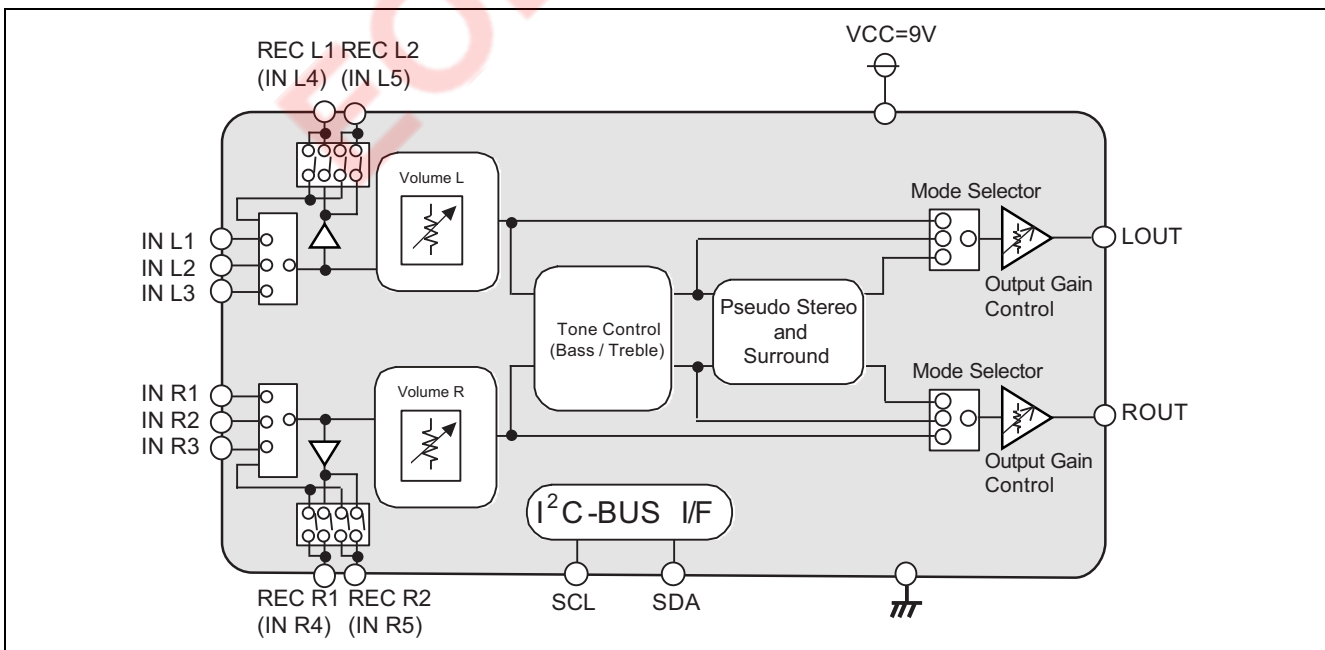
### Recommended Operating Condition

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

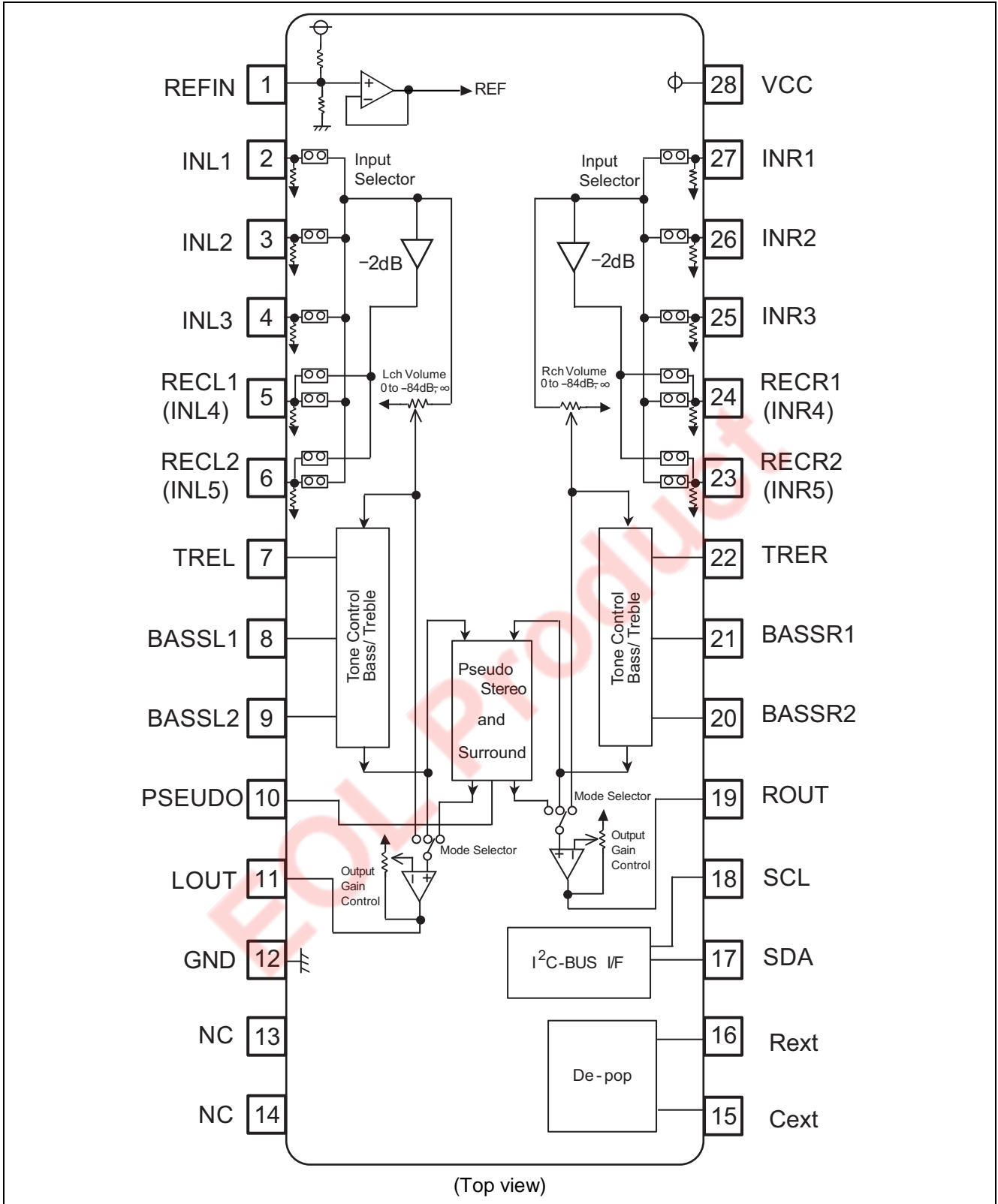
### Application

TV, Mini Stereo, etc.

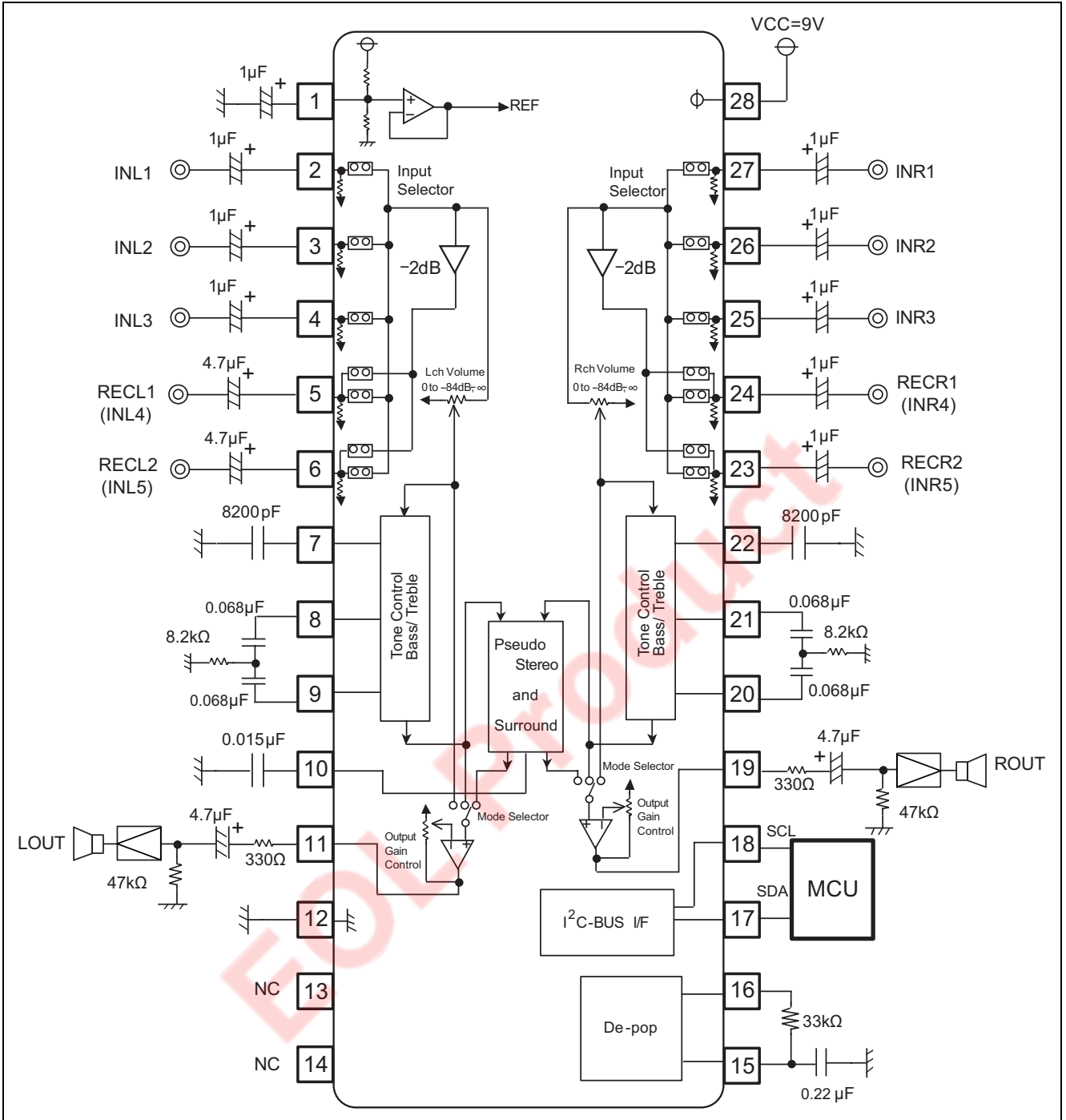
### System Configuration



Block Diagram and Pin Configuration



Application Example



**Absolute Maximum Ratings**

Parameter	Symbol	Ratings	Unit	Condition
Power supply	V <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	

EOL Product

## 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 ( $\mu V_{rms}$ )	$VOL=0dB$ , Output gain=0dB Tone=0dB, Surround ON, IHF-A
Output noise 2	$V_{no2}$	—	-103 (7)	-97 (14)	dBV ( $\mu V_{rms}$ )	$VOL=Mute$ , 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

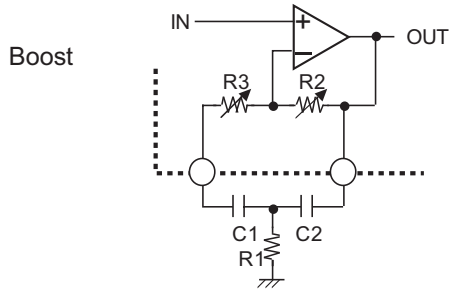
### I<sup>2</sup>C BUS Interface

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



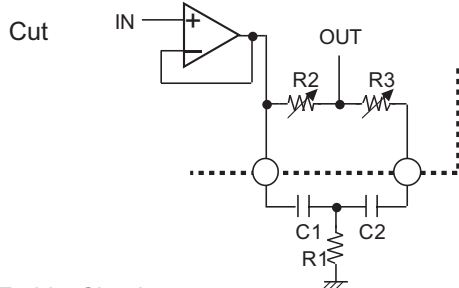
$$f_o = \frac{1}{2\pi\sqrt{R1(R2+R3)C1C2}} \text{ (Hz)}$$

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

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

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

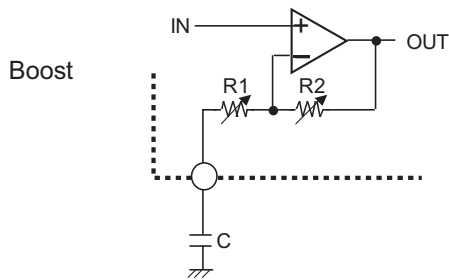


$$f_o = \frac{1}{2\pi\sqrt{R1(R2+R3)C1C2}} \text{ (Hz)}$$

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

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

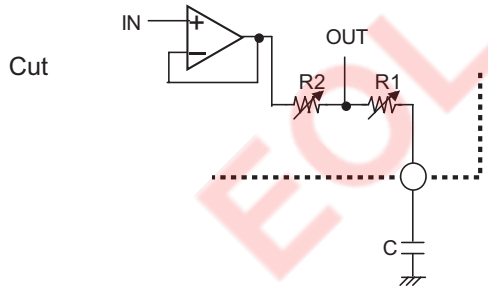
### <2> Treble Circuit



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

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



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



## I<sup>2</sup>C 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 <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	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.

## &lt;2&gt; 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.

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

Gain	Output gain
	D2
0dB	0
+4.5dB	1

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

Surround level	Surround level
	D2
Low level	0
High level	1

## &lt;4&gt; Mute Function (Sub Address: 02H)

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

## &lt;6&gt; 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

## &lt;7&gt; 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

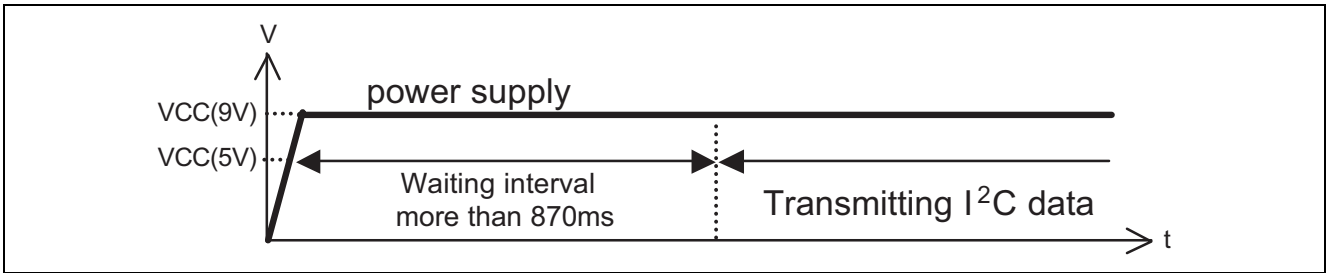
If A=0 means Tone control gain CUT(-), then A=1 means Tone control gain BOOST(+).

\*No guarantee except for these codes.

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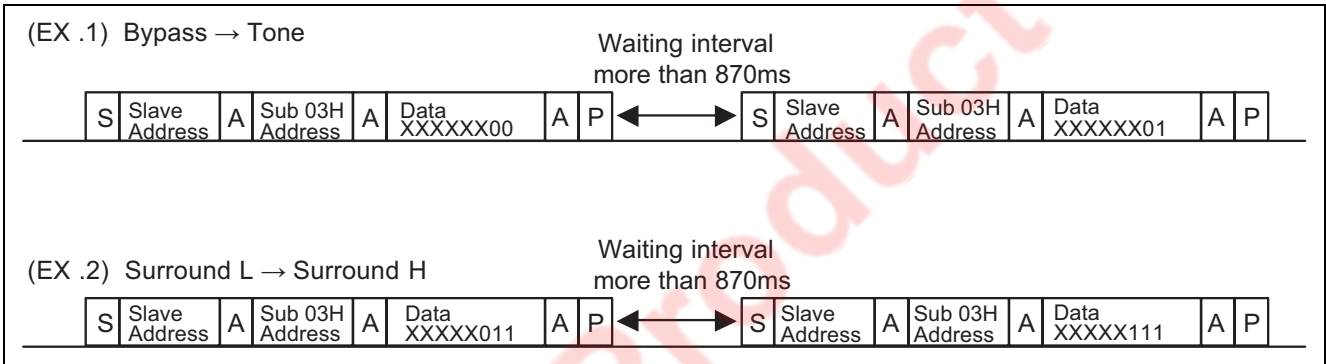
**1. When power supply is turned on**

- Please do not transmit I<sup>2</sup>C data during 870ms when you turn on the power supply.  
(Cext(15pin)=0.22μF , Rext(15-16pin)=33kΩ)

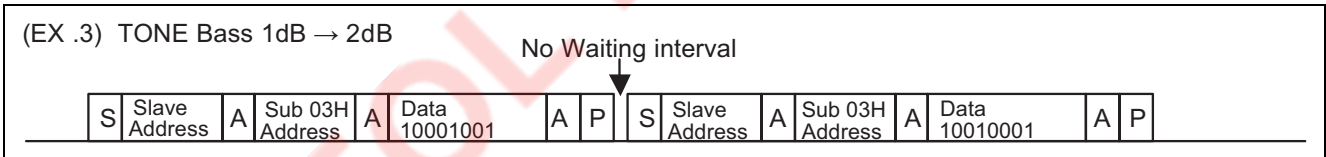


**2. When mode is changed**

- Please do not transmit I<sup>2</sup>C 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.



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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

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Tel: <886> (2) 2715-2888, Fax: <886> (2) 2713-2999

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