

# R2S15900SP

## 2ch Electronic Volume with Surround

REJ03F0126-0130  
Rev.1.3  
May 30, 2005

### 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

Function	Features
Volume	0 to -84dB, -∞/ 1dB step Each channel is independence control.
Input selector	5 input selector + MUTE
Rec output	2 Rec output
Tone control	Bass: -15dB to +15dB/ 1dB step Treble: -15dB to +15dB/ 1dB step
Surround/ Pseudo stereo	Surround <Low/ High> Pseudo Stereo
Mode selector	Bypass/ Tone / Tone & Pseudo Stereo or Surround
Output gain control	0dB/ +4.5dB
MCU interface	I <sup>2</sup> C-BUS control.

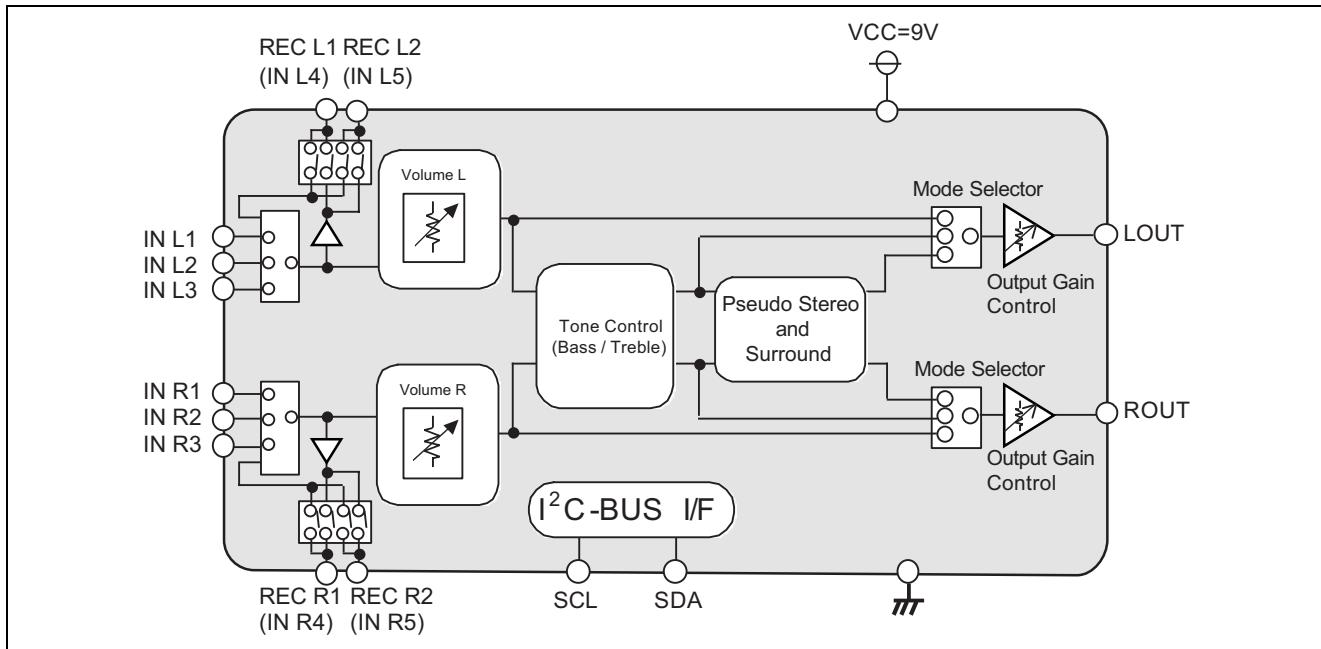
### Recommended Operating Condition

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

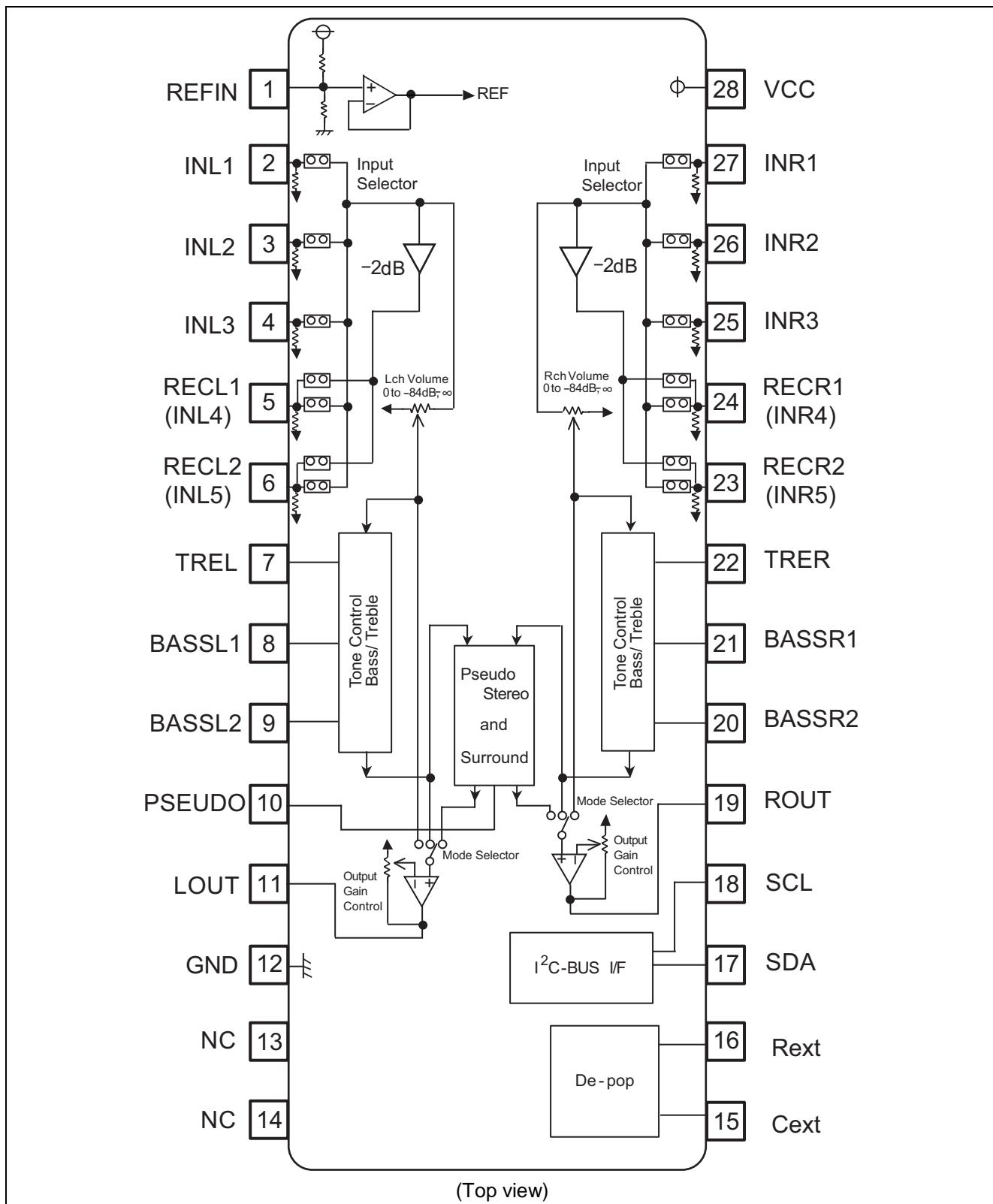
### Application

TV, Mini Stereo, etc.

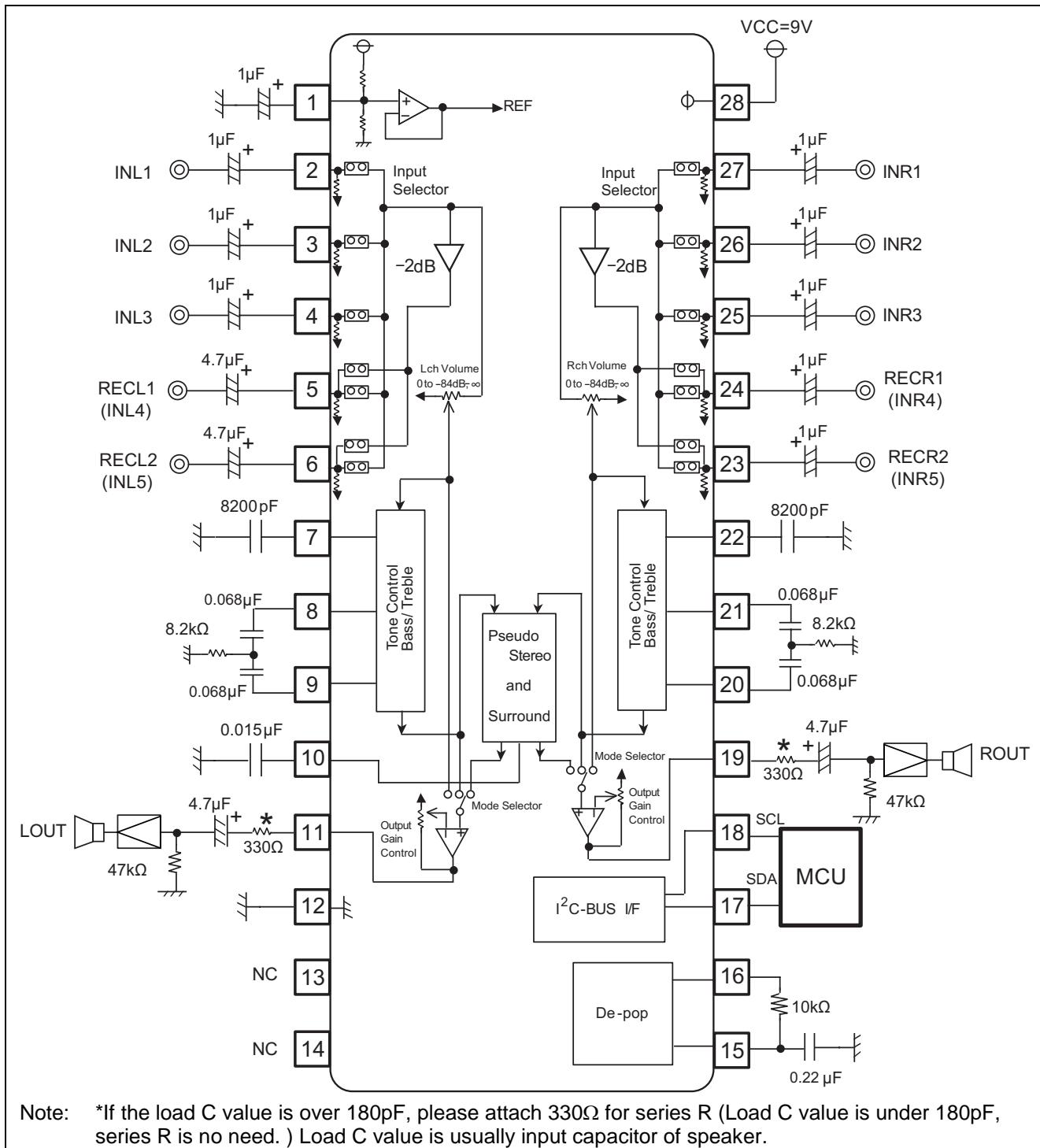
### System Configuration



## Block Diagram and Pin Configuration



## Application Example



**Absolute Maximum Ratings**

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

## Electrical Characteristics

( $V_{CC}=9V$ ,  $T_a=25^\circ C$ ,  $V_i=100mV_{rms}$ ,  $f=1kHz$ , Tone control=0dB,  $R_g=0\Omega$ ,  $RL=47k\Omega$ , 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	$THD$	—	—	0.5	%	400Hz to 30kHz BPF $V_o=0.5V_{rms}$
Input selector cross talk	$CT$	—	—	-70	dB	$V_i=1V_{rms}$ , IHF-A
Channel separation	$CS$	—	—	-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

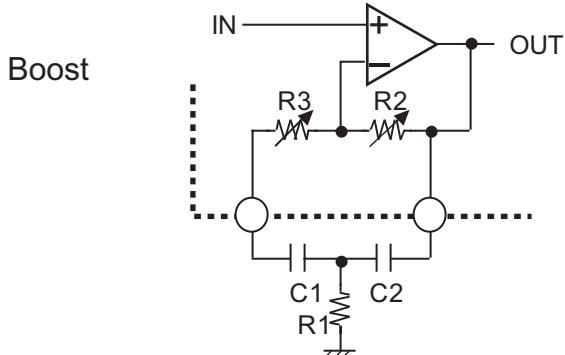
### $I^2C$ BUS Interface

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

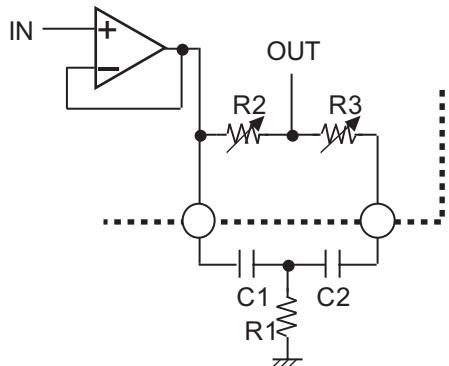


$$f_0 = \frac{1}{2\pi\sqrt{R_1(R_2+R_3)C_1C_2}} \text{ (Hz)}$$

$$Q \approx \frac{1}{C_1+C_2} \sqrt{\frac{C_1C_2R_2}{R_1}} \quad (R_3=0)$$

$$Gv = 20 \log \left( \frac{\frac{R_2+R_3}{R_1} + 2}{\frac{R_3}{R_1} + 2} \right) \text{ (dB)} \quad (C_1=C_2)$$

#### Cut



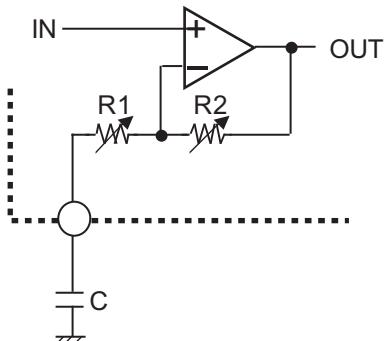
$$f_0 = \frac{1}{2\pi\sqrt{R_1(R_2+R_3)C_1C_2}} \text{ (Hz)}$$

$$Q \approx \frac{1}{C_1+C_2} \sqrt{\frac{C_1C_2R_2}{R_1}} \quad (R_3=0)$$

$$Gv = 20 \log \left( \frac{\frac{R_3}{R_1} + 2}{\frac{R_2+R_3}{R_1} + 2} \right) \text{ (dB)} \quad (C_1=C_2)$$

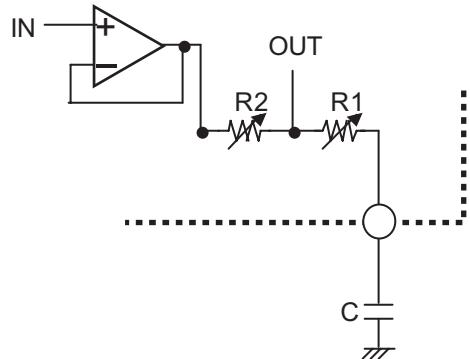
#### <2> Treble Circuit

##### Boost



$$Gv = 20 \log \left( \frac{R_1+R_2}{R_1} \right) \text{ (dB)}$$

##### Cut



$$Gv = 20 \log \left( \frac{R_1}{R_1+R_2} \right) \text{ (dB)}$$

**I<sup>2</sup>C Bus Format**

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

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 settingR/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			
03H	Bass						Surround level	Mode selector			
04H	Treble						0	0			

Default values are all "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

## &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(+).

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