

R2S15900SP

2ch Electronic Volume with Surround

REJ03F0126-0130

Rev.1.3

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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

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 ² C-BUS control.

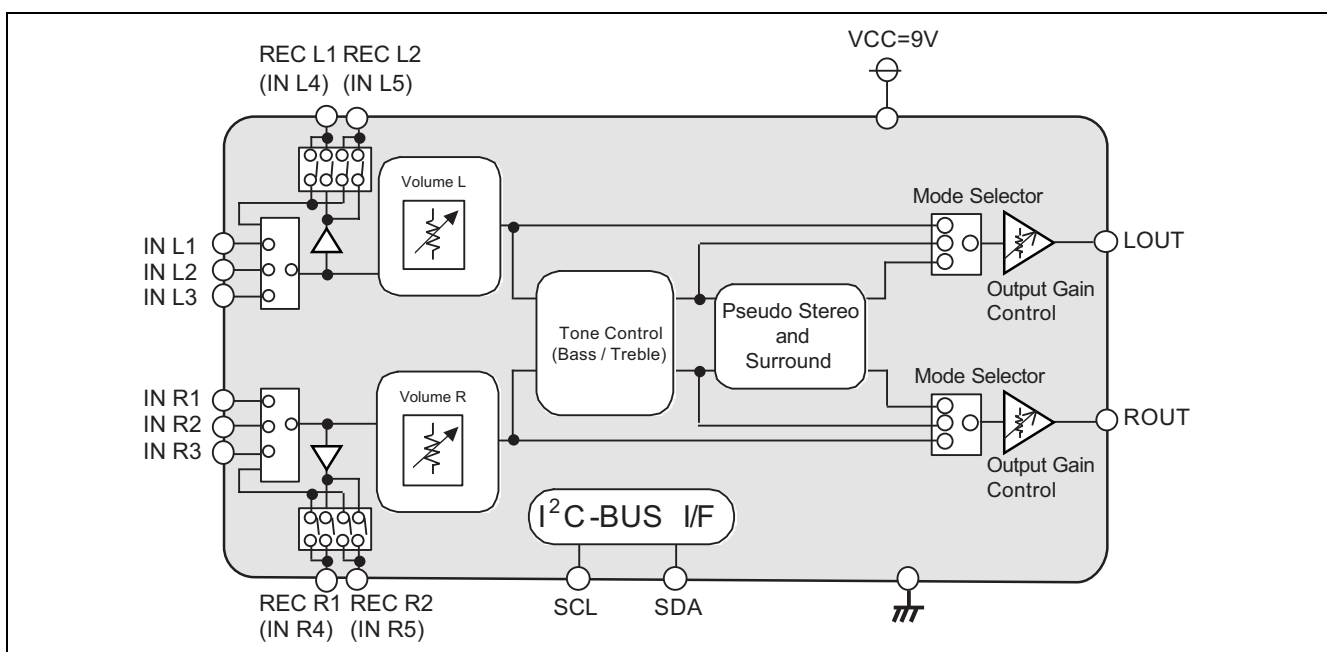
Recommended Operating Condition

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

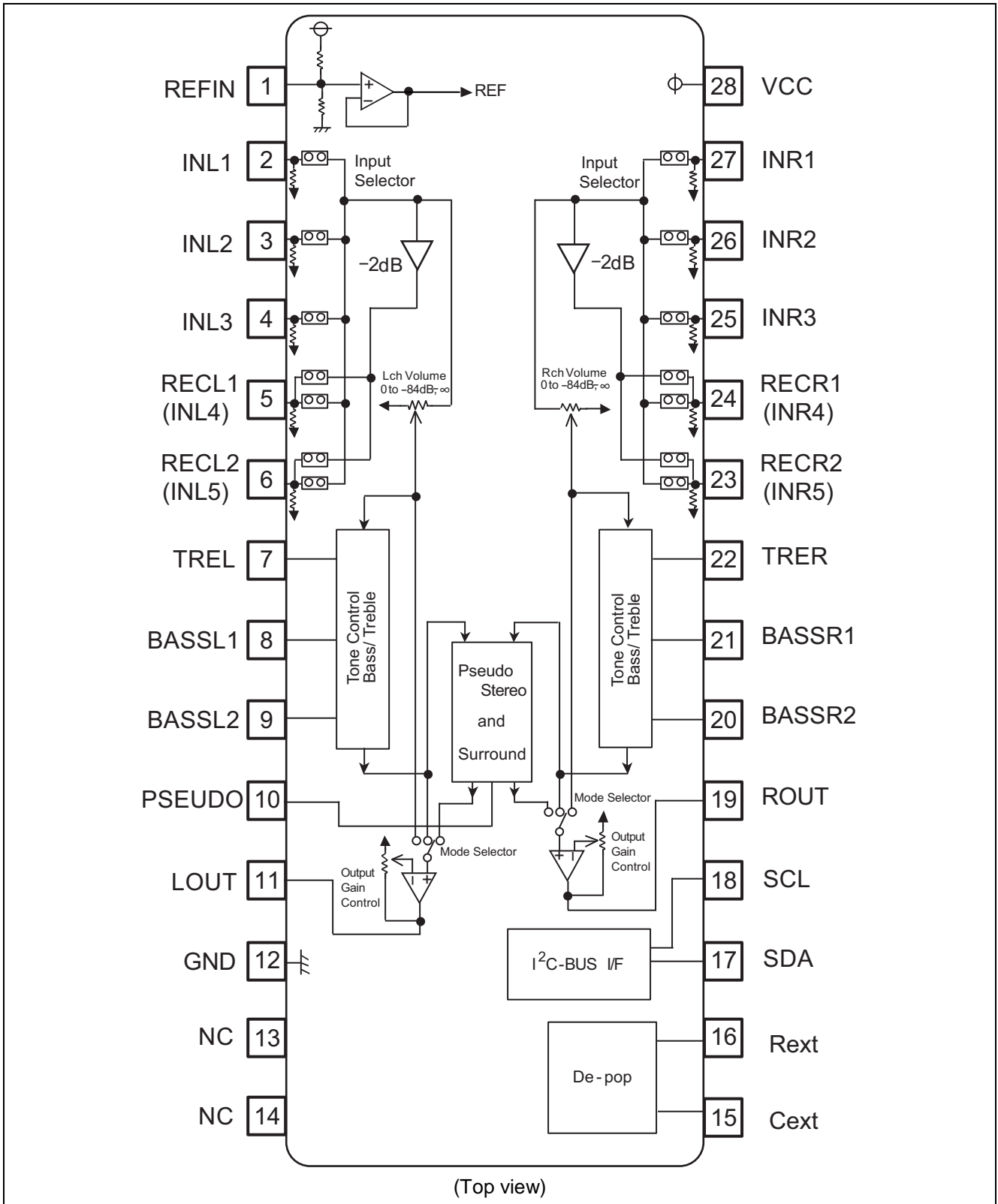
Application

TV, Mini Stereo, etc.

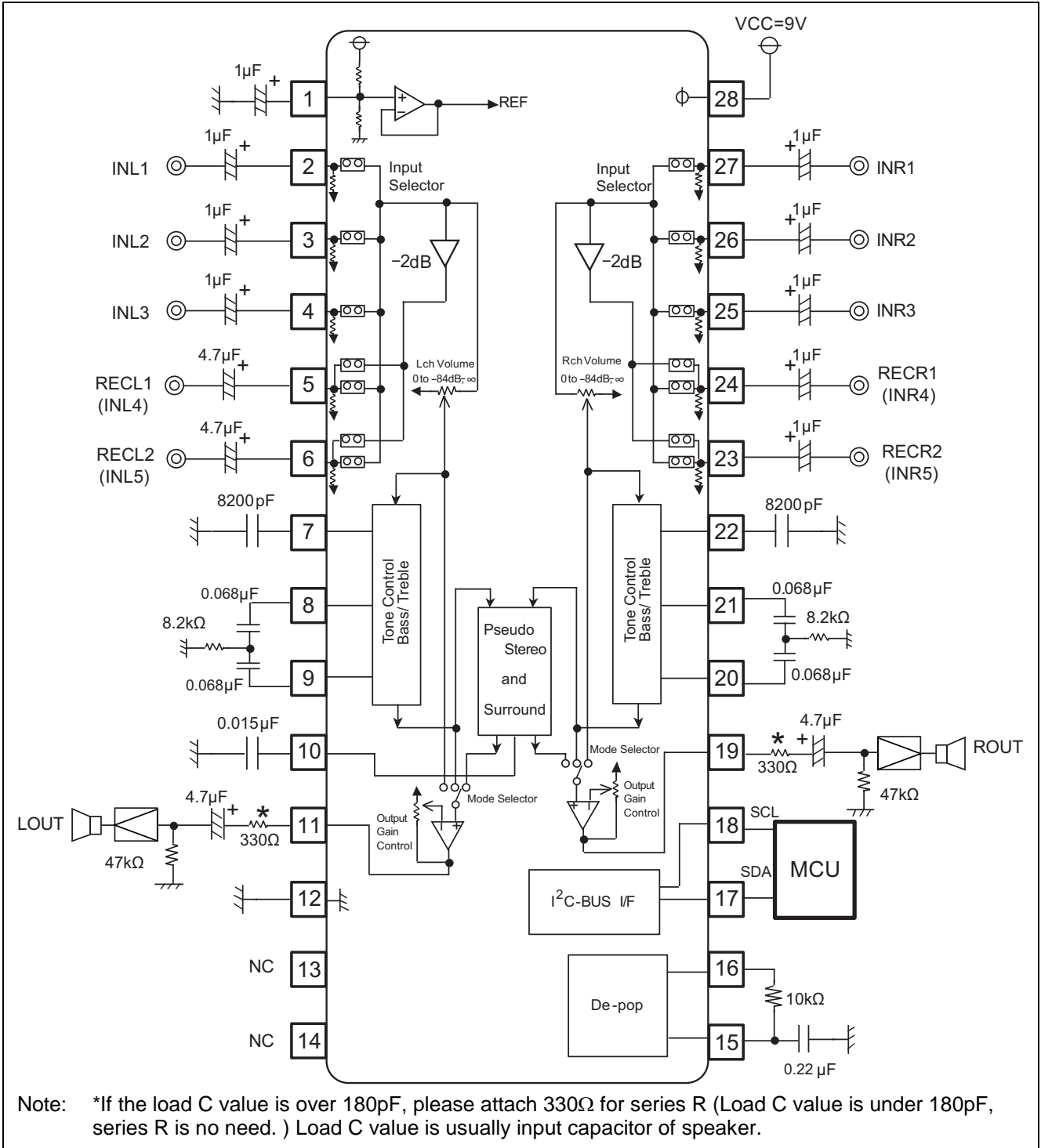
System Configuration



Block Diagram and Pin Configuration



Application Example



Absolute Maximum Ratings

Parameter	Symbol	Ratings	Unit	Condition
Power supply	V _{CC}	10	V	
Power dissipation	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	—	—	0.5	%	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 (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

Boost

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

$$Q \cong \frac{1}{C_1+C_2} \sqrt{\frac{C_1C_2R_2}{R_1}} \text{ (R}_3=0\text{)}$$

$$G_v = 20 \log \left[\frac{\frac{R_2+R_3}{R_1} + 2}{\frac{R_3}{R_1} + 2} \right] \text{ (dB) (C}_1=C_2\text{)}$$

Cut

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

$$Q \cong \frac{1}{C_1+C_2} \sqrt{\frac{C_1C_2R_2}{R_1}} \text{ (R}_3=0\text{)}$$

$$G_v = 20 \log \left[\frac{\frac{R_3}{R_1} + 2}{\frac{R_2+R_3}{R_1} + 2} \right] \text{ (dB) (C}_1=C_2\text{)}$$

<2> Treble Circuit

Boost

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

Cut

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

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 → 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

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

<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(+).

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