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R2S15900SP

2ch Electronic Volume with Surround

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^2C 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
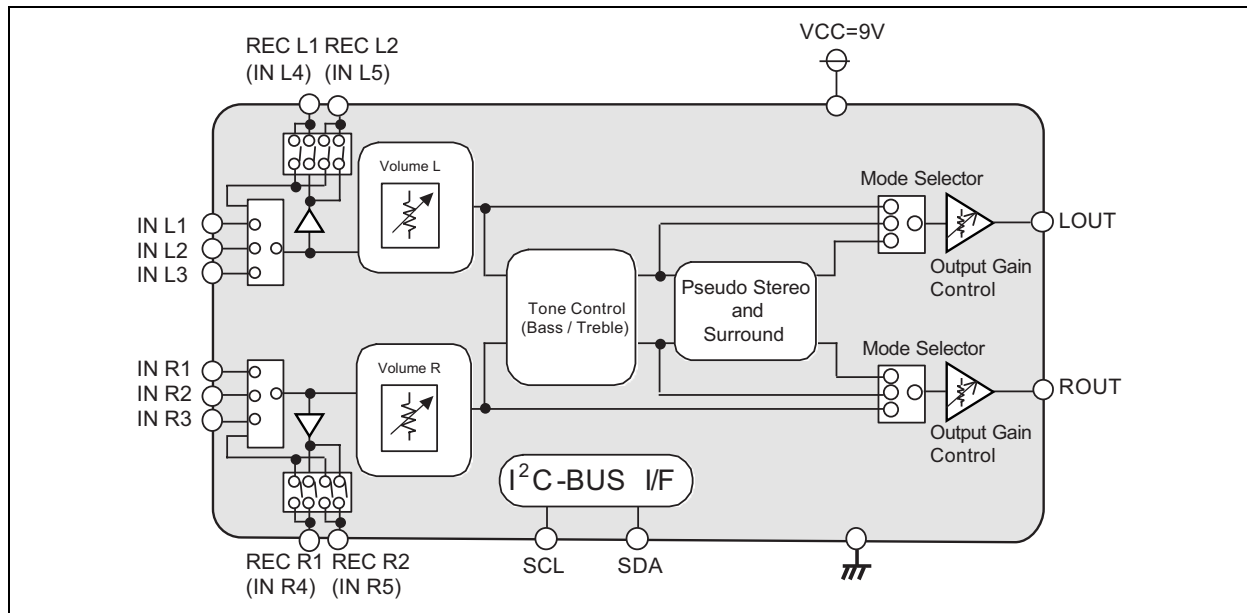- I^2C-BUS control
- Package   28pin SOP

Recommended Operating Condition
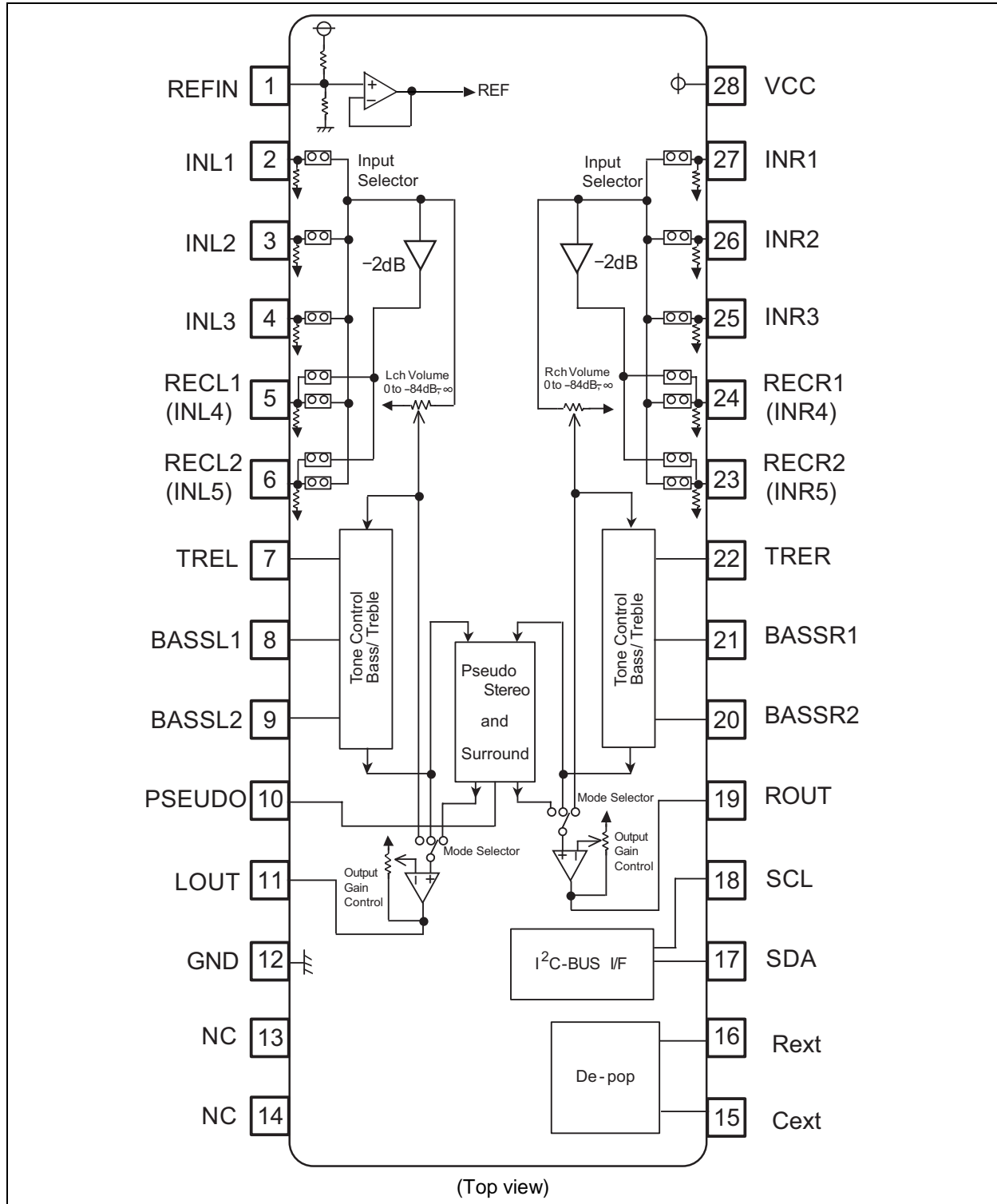
Supply voltage: V_{CC} = 9.0V(typ)
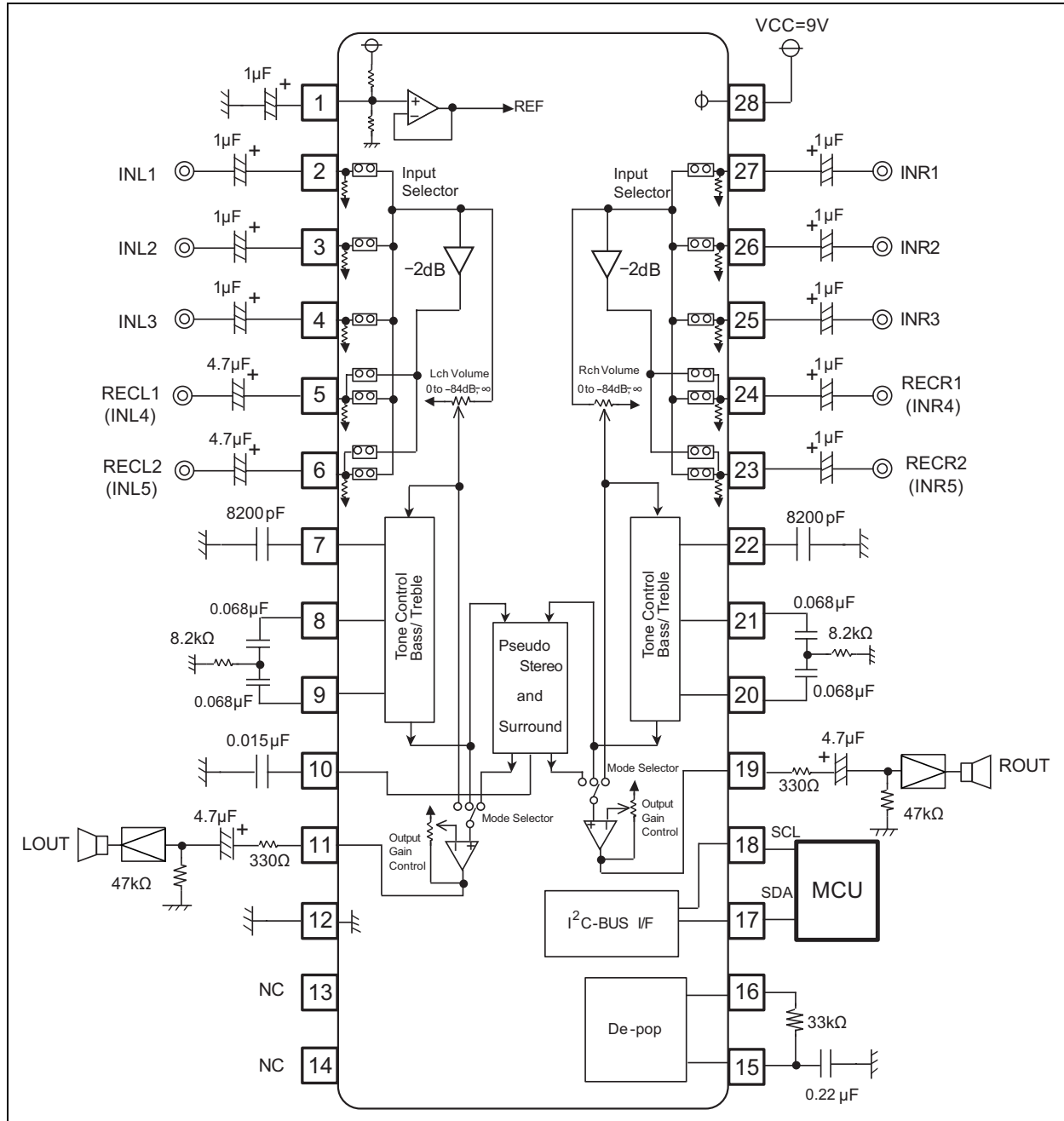
Application

TV, Mini Stereo, etc.

System Configuration

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Block Diagram and Pin Configuration

(Top view)

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Application Example

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Absolute Maximum Ratings

Parameter	Symbol	Ratings	Unit	Condition
Power supply	V_{CC}	10	V	
Power dissipation	Pd		W	Ta$\leq$25°C
Thermal derating	K		mW/°C	Ta>25°C (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, Tone control=0dB, Rg=0Ω, RL=47kΩ, unless otherwise noted)

General Characteristics

Parameter	Symbol	Min	Typ	Max	Unit	Condition
		Limits				
		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	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	—	−2.0	—	dB	Rec out
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, Vi=1Vrms, IHF-A
Channel balance	CBAL	−1.5	0	1.5	dB	VOL=0dB
Total harmonic distortion	THD	—	0.01	0.5	%	Vo=0.5Vrms 400Hz to 30kHz BPF
Input selector cross talk	CT	—	−100	−70	dB	Vi=1Vrms, IHF-A
Channel separation	CS	—	−100	−70	dB	Vi=1Vrms, IHF-A,
Output noise 1	Vno1	—	−90 (31.6)	−85 (56.2)	dBV (µVrms)	VOL=0dB,Output gain=0dB Tone=0dB,Surround ON, IHF-A
Output noise 2	Vno2	—	−103 (7)	−97 (14)	dBV (µVrms)	VOL=Mute, Output gain=0dB Bypass, IHF-A

Tone Control

Parameter	Symbol	Min	Typ	Max	Unit	Condition
		Limits				
		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	Min	Typ	Max	Unit	Condition
		Limits				
		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	

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Function Description
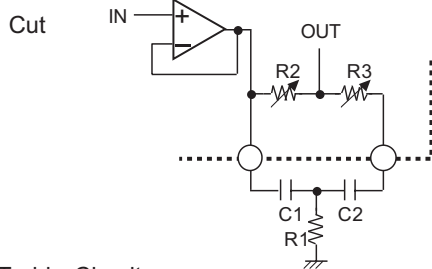
1. Tone Control Circuit

<1> Bass Circuit

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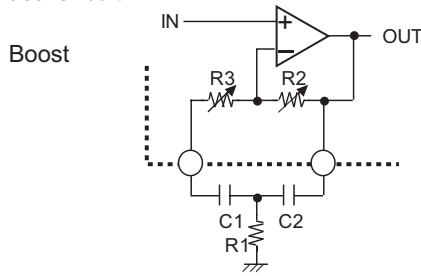
$$fo = \frac{1}{2\pi\sqrt{R1(R2+R3)C1C2}} \quad (Hz)$$

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

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

Cut

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

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

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

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

<2> Treble Circuit

Boost

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

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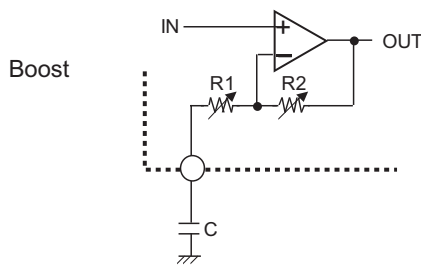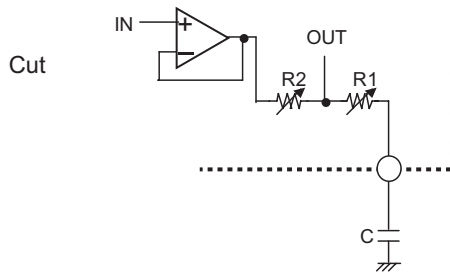
$$Gv = 20\log\left(\frac{R1}{R1+R2}\right) \quad (dB)$$

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

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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>				VOL ATT (dB)	VOL<L>			
	D7	D6	D5	D4		D3	D2	D1	D0
0	0	0	0	0	0	0	0	0	0
−10	0	0	0	1	−1	0	0	0	1
−20	0	0	1	0	−2	0	0	1	0
−30	0	0	1	1	−3	0	0	1	1
−40	0	1	0	0	−4	0	1	0	0
−50	0	1	0	1	−5	0	1	0	1
−60	0	1	1	0	−6	0	1	1	0
−70	0	1	1	1	−7	0	1	1	1
−80	1	0	0	0	−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.

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<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.

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Note

1. When power supply is turned on

■ Please do not transmit I^{2}C data during 870ms when you turn on the power supply.

(Cext(15pin)=0.22μF , Rext(15-16pin)=33kΩ)
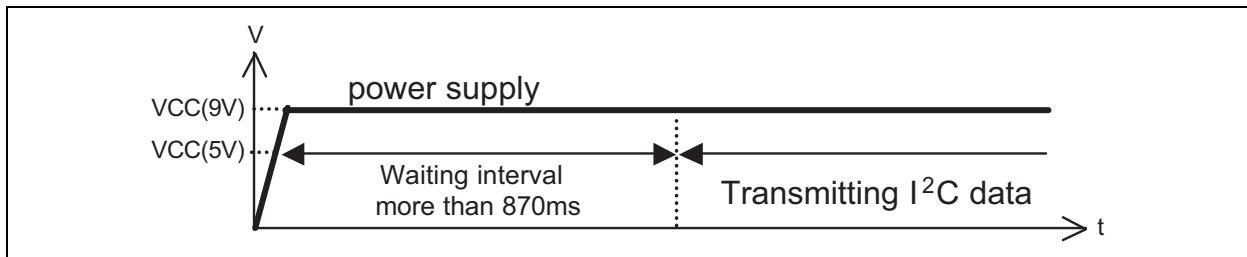
2.When mode is changed

■ Please do not transmit I^{2}C data during 870ms when you change themode selector.

(Cext(15pin)=0.22μF , Rext(15-16pin)=33kΩ)
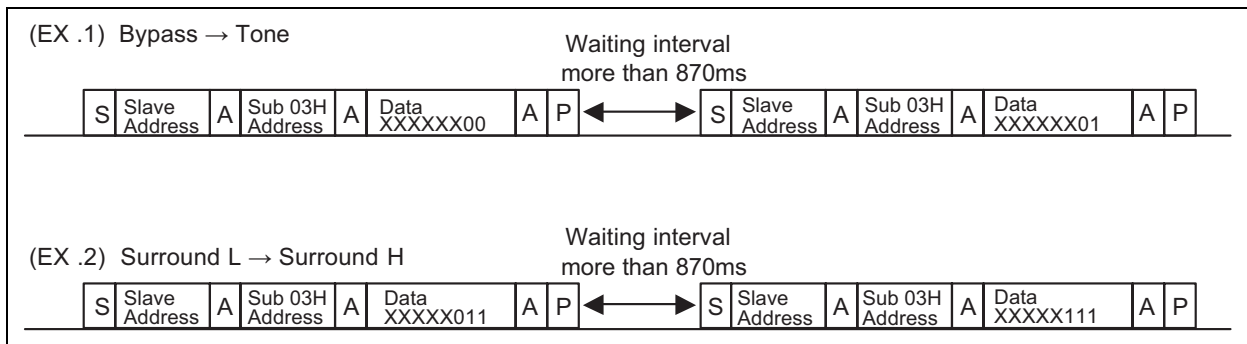
■ When the TONE Bass gain is changed, waiting interval is unnecessary.

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