To our customers,

Old Company Name in Catalogs and Other Documents

On April 1st, 2010, NEC Electronics Corporation merged with Renesas Technology Corporation, and Renesas Electronics Corporation took over all the business of both companies. Therefore, although the old company name remains in this document, it is a valid Renesas Electronics document. We appreciate your understanding.

Renesas Electronics website: http://www.renesas.com

April 1st, 2010
Renesas Electronics Corporation

Issued by: Renesas Electronics Corporation (http://www.renesas.com)

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Notice

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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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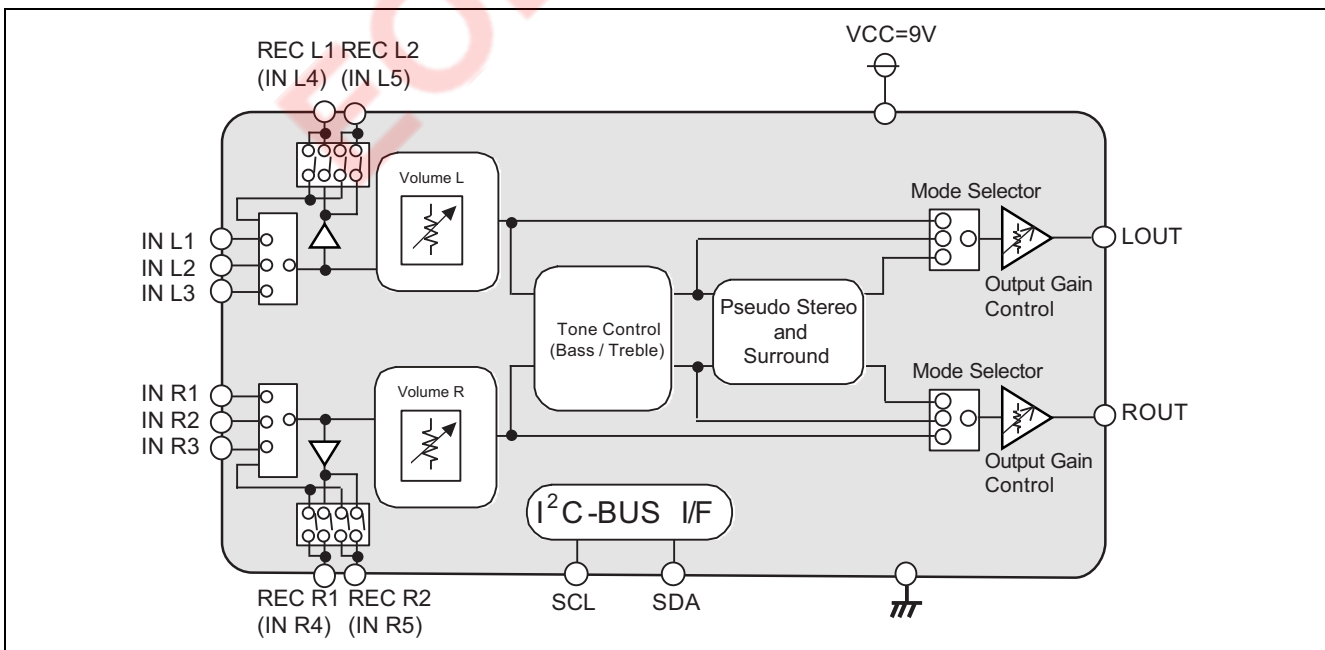
Block Diagram and Pin Configuration

(Top view)
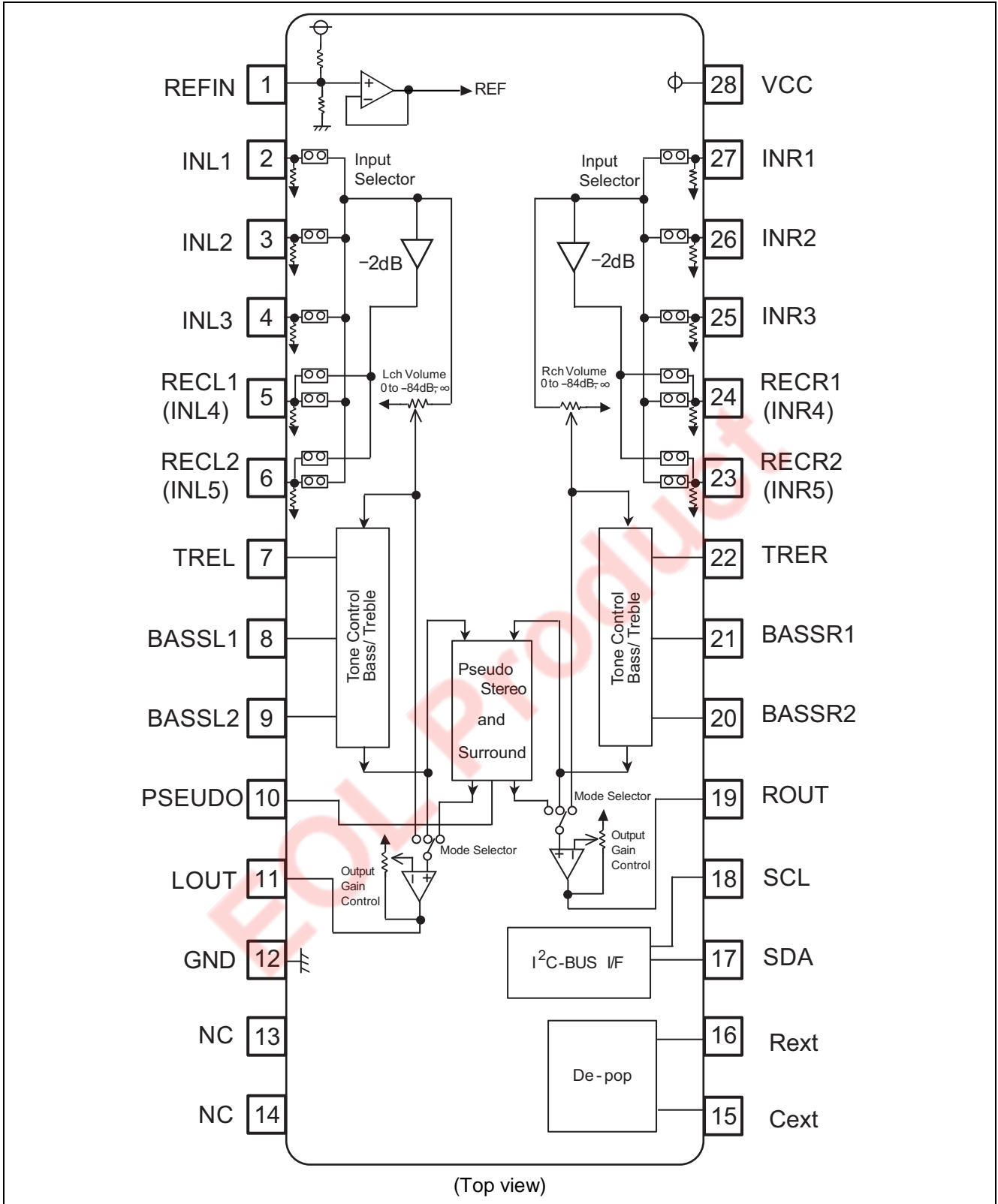
Application Example

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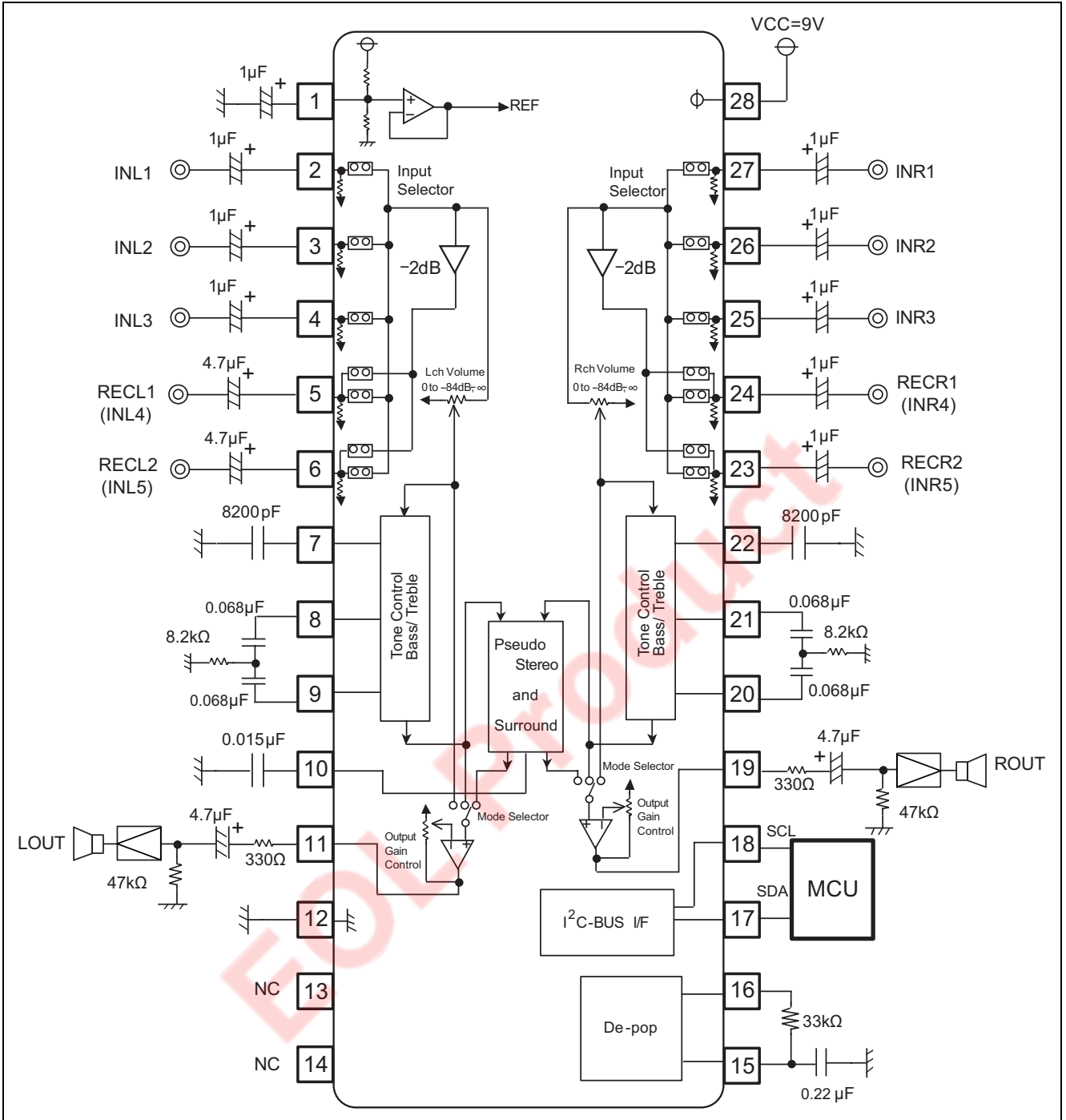
Absolute Maximum Ratings

Parameter	Symbol	Ratings	Unit	Condition
Power supply	V_{CC}	10	V	
Power dissipation	Pd		W	Ta≤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	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	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	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	

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Function Description

1. Tone Control Circuit

<1> Bass Circuit

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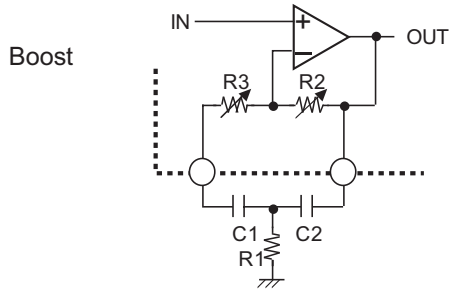
$$f_o = \frac{1}{2\pi\sqrt{R1(R2+R3)C1C2}} \quad (Hz)$$

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

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

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

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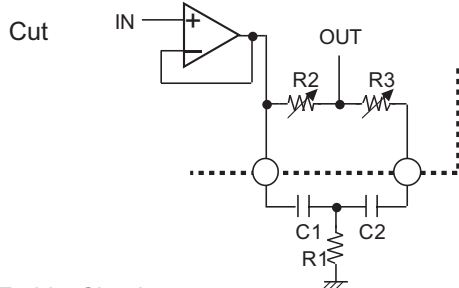
$$f_o = \frac{1}{2\pi\sqrt{R1(R2+R3)C1C2}} \quad (Hz)$$

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

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

<2> Treble Circuit

Boost

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

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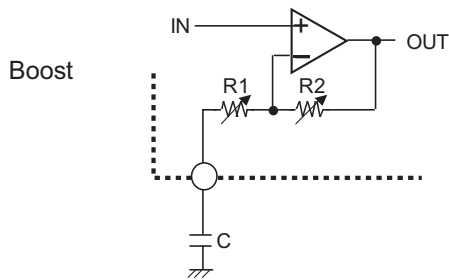
$$Gv = 20\log\left(\frac{R1}{R1+R2}\right) \quad (dB)$$

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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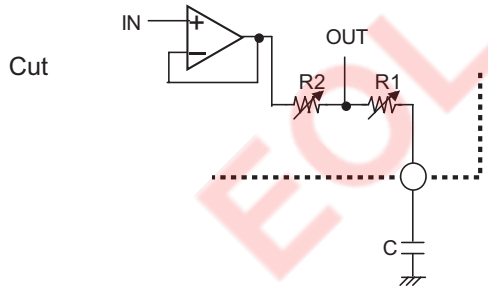
I²C Bus Format

	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.

<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		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	A	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(+).
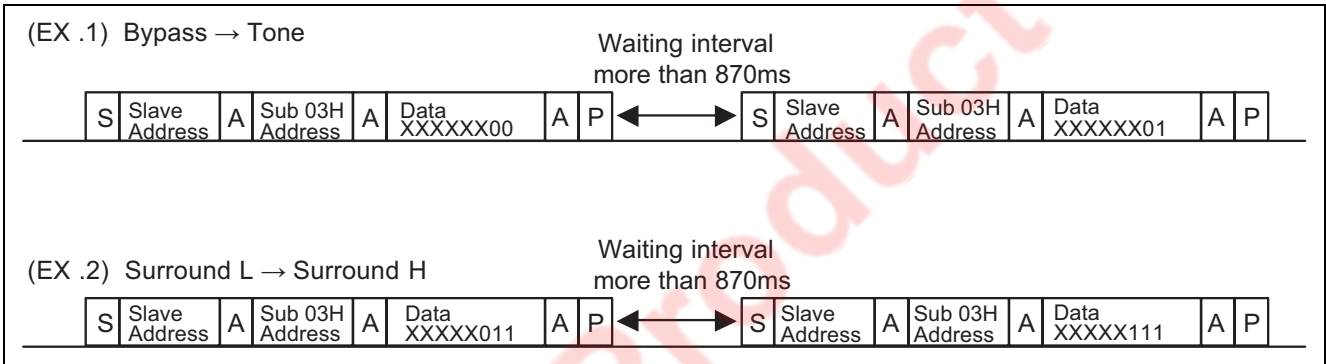
*No guarantee except for these codes.

Note

1. When power supply is turned on

■ Please do not transmit I^{2}C data during 870ms when you turn on the power supply.
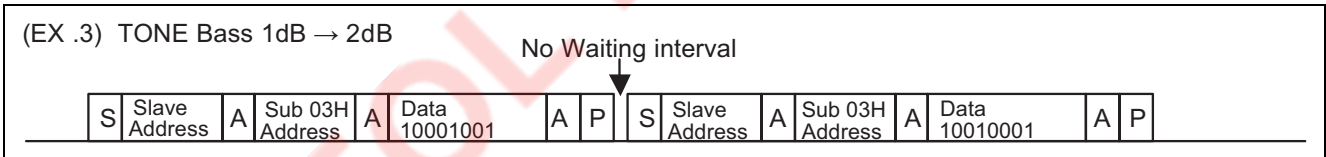
(Cext(15pin)=0.22μF , Rext(15-16pin)=33kΩ)
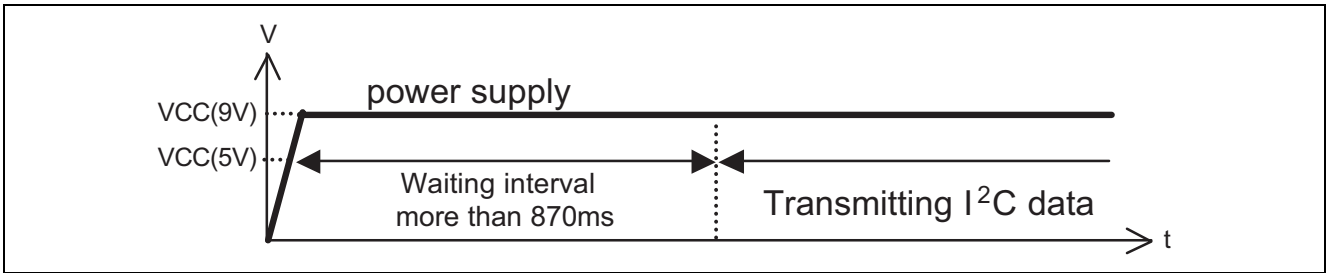
2.When mode is changed

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

(Cext(15pin)=0.22μF , Rext(15-16pin)=33kΩ)

(EX .1) Bypass → Tone

Waiting interval more than 870ms

| S | Slave Address | A | Sub 03H Address | A | Data XXXXXX00 | A | P | ◄——► | S | Slave Address | A | Sub 03H Address | A | Data XXXXXX01 | A | P |

(EX .2) Surround L → Surround H

Waiting interval more than 870ms

| S | Slave Address | A | Sub 03H Address | A | Data XXXXX011 | A | P | ◄——► | S | Slave Address | A | Sub 03H Address | A | Data XXXXX111 | A | P |

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

(EX .3) TONE Bass 1dB → 2dB

No Waiting interval

| S | Slave Address | A | Sub 03H Address | A | Data 10001001 | A | P | S | Slave Address | A | Sub 03H Address | A | Data 10010001 | A | P |

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