

PRELIMINARY

Renesas Sound Processor

Notice ; This is not a final specification. Some parametric limits are subject to change.

R2S15902FP

CONFIDENTIAL

6-CHANNEL ELECTRONIC VOLUME

6ch ELECTRONIC VOLUME WITH 4 INPUT SELECTOR

APPLICATION

Receiver,AV Amp,Home Theater,Mini Stereo etc.

FEATURE

FUNCTION	FEATURE
Electronic Volume	· 6 channels independent Electronic Volume. (0 to -99dB/1dBstep,- dB)
Gain Control	· 6 channels independent Gain Control (0 to +14dB/2dB step)
Input Selector	· L/R channel 4 Input Selector. (Input Gain : 0 to +14dB/2dB step)
Multi Channel Input	· 6 channels Input
Tone Control	· Bass:-14 to +14dB(2dB step), · Treble:-14 to +14dB(2dB step)
REC Output	· Can use 1 Input for REC Output(REC Output Gain:0,+2,+4,+6dB)
ADC Out	· Built-in for ADC output(Input Att:0/-6/-12/-18dB)
L+R/L-R Output	· Built-in L+R/L-R block
Digital power supply	· Built-in Digital Power supply

OUTLINE

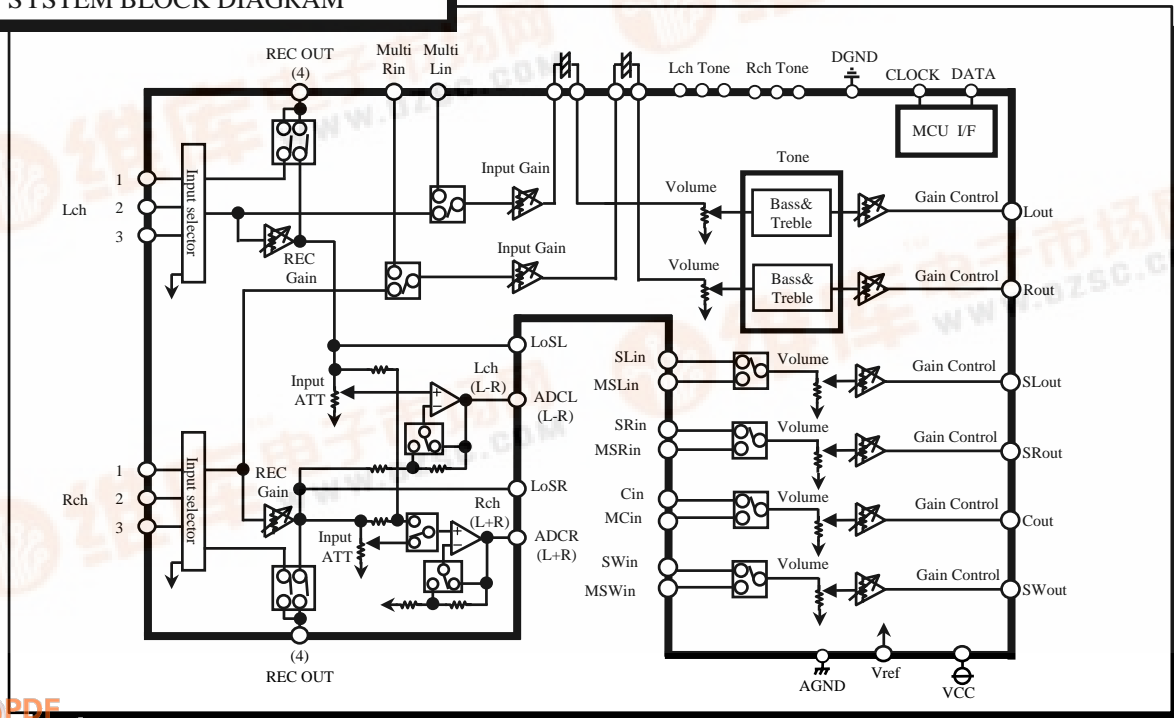


44Pin QFP
0.65mm Pitch

RECOMMENDED OPERATING CONDITION

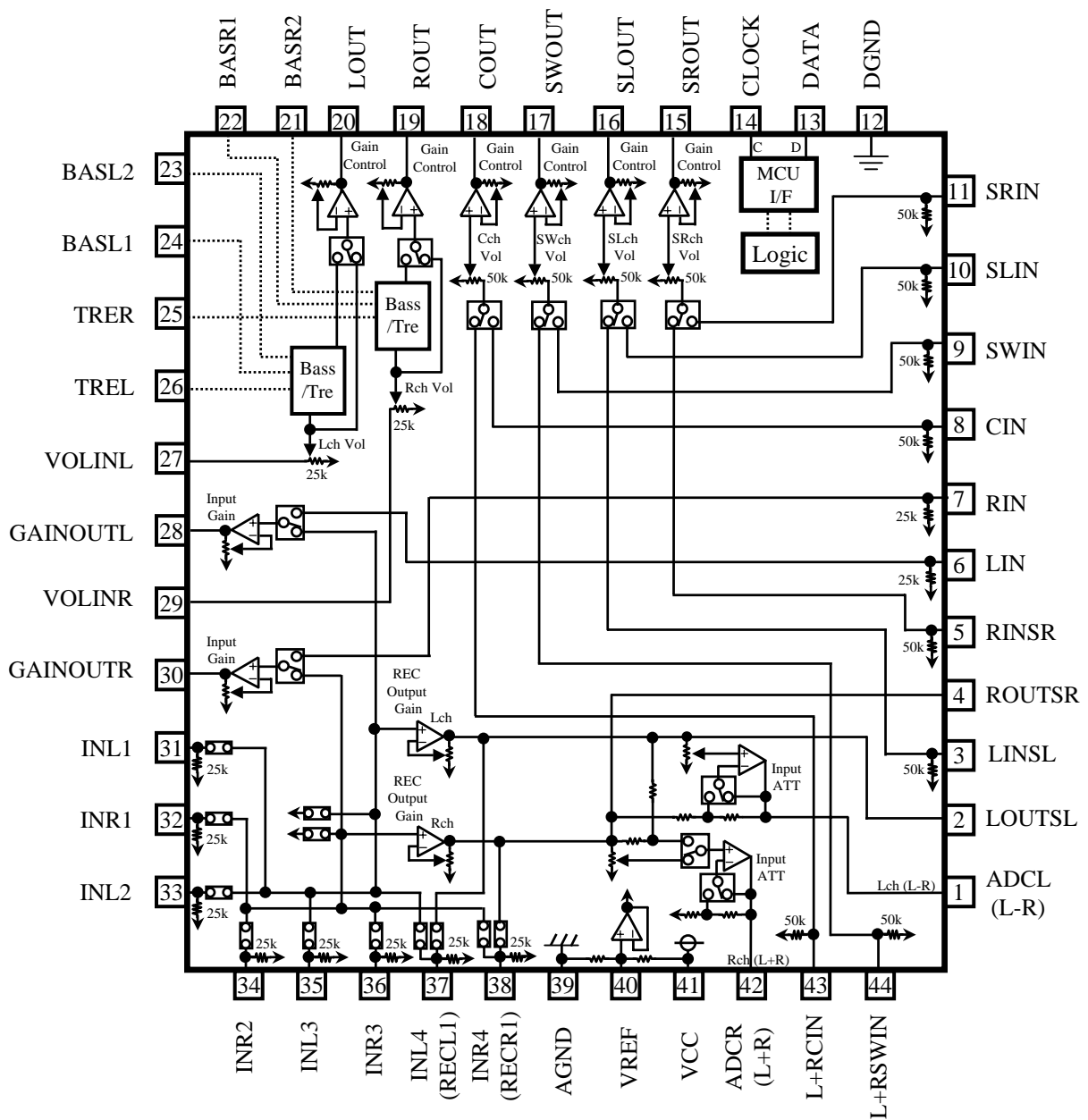
Supply Voltage Range VCC=8.0 to 10.0V :9.0V(typ)

SYSTEM BLOCK DIAGRAM





BLOCK DIAGRAM AND PIN CONFIGURATION (TOP VIEW)



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PIN DESCRIPTION

PIN No.	Name	Function
1	ADCL(L-R)	Output pin for ADC(and L-R Output)
2	LOUTSL	L channel Pre-Output(REC Output) for SL channel
3	LINSL	SL channel input from L channel pre-output(REC Output)
4	ROUTSR	R channel Pre-Output(REC Output) for SR channel
5	RINSR	SR channel input from R channel pre-output (REC Output)
6,7,8, 9,10,11	LIN,RIN,CIN, SWIN,SLIN,SRIN	Input pin of L/R/C/SW/SL/SR channel (Multi)
12	DGND	Digital Ground
13	DATA	Input pin of control data
14	CLOCK	Input pin of control clock
15,16, 17,18, 19,20,	SROUT,SLOUT, SWOUT,COUT, ROUT,LOUT	Output pin of SR/SL/SW/C/R/L channel
21,22, 23,24	BASR1,BASR2, BASL1,BASL2	Frequency characteristic setting pin of R/L channel tone control (BASS)
25,26	TRER, TREL	Frequency characteristic setting pin of R/L channel tone control (Treble)
27,29	VOLINL,VOLINR	Input pin of L/R channel Volume
28,30	GAINOUTL, GAINOUTR	Output pin of L/R channel Input Gain
31,33,35, 32,34,36	INL1,2,3, INR1,2,3	Input pin of L/R channel (Input Selector)
37,38	INL4/RECL1, INR4/RECR1	Input pin of L/R channel (Input Selector) can use REC output pin
39	AGND	Analog Ground
40	VREF	½ Vcc input
41	VCC	Power supply to internal analog circuit
42	ADCR(L+R)	Output pin for ADC(and L+R Output)
43	L+RCIN	L+R input for C channel
44	L+RSWIN	L+R input for SW channel

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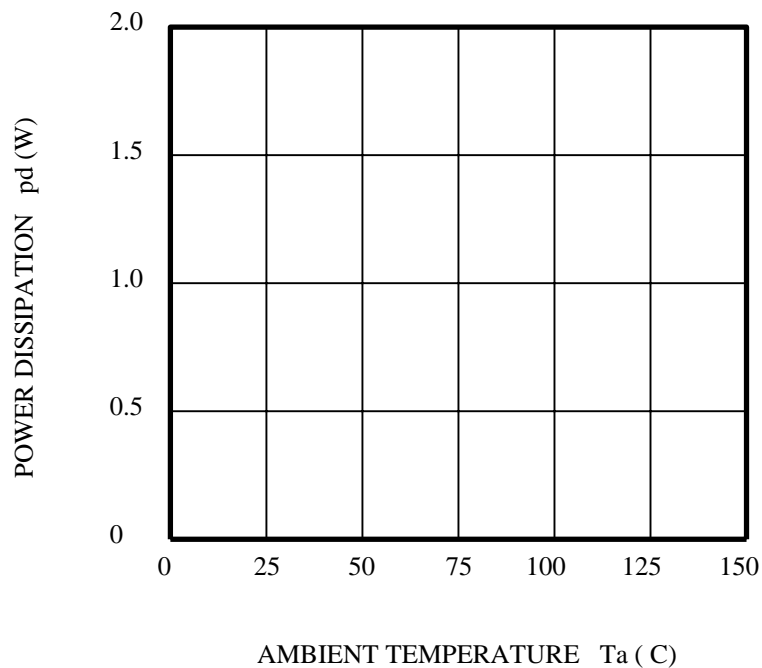
6-CHANNEL ELECTRONIC VOLUME

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Condition	Ratings	Unit
Supply voltage	Power supply	VCC	10.5	V
Pd	Power dissipation	Ta = 25	***	W
K	Thermal derating	Ta > 25	***	mW/
Topr	Operating temperature		***	
Tstg	Storage temperature		-40 ~ +125	

*** undecided

**THERMAL DERATINGS
(MAXIMUM RATING)**



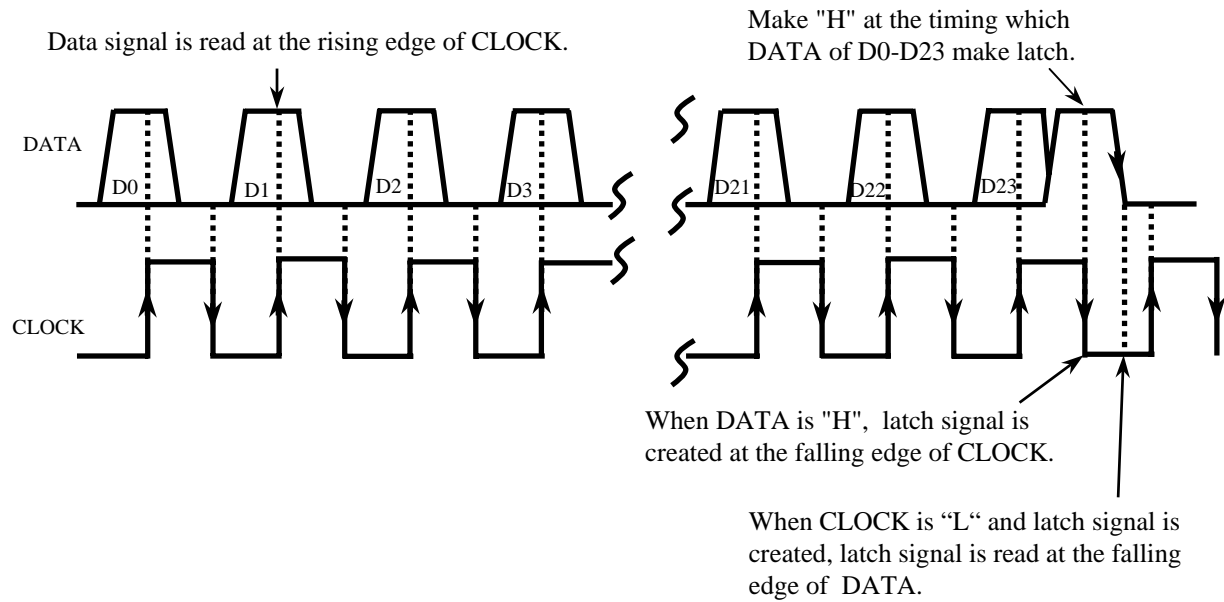


RECOMMENDED OPERATING CONDITIONS

(Ta=25°C, unless otherwise noted)

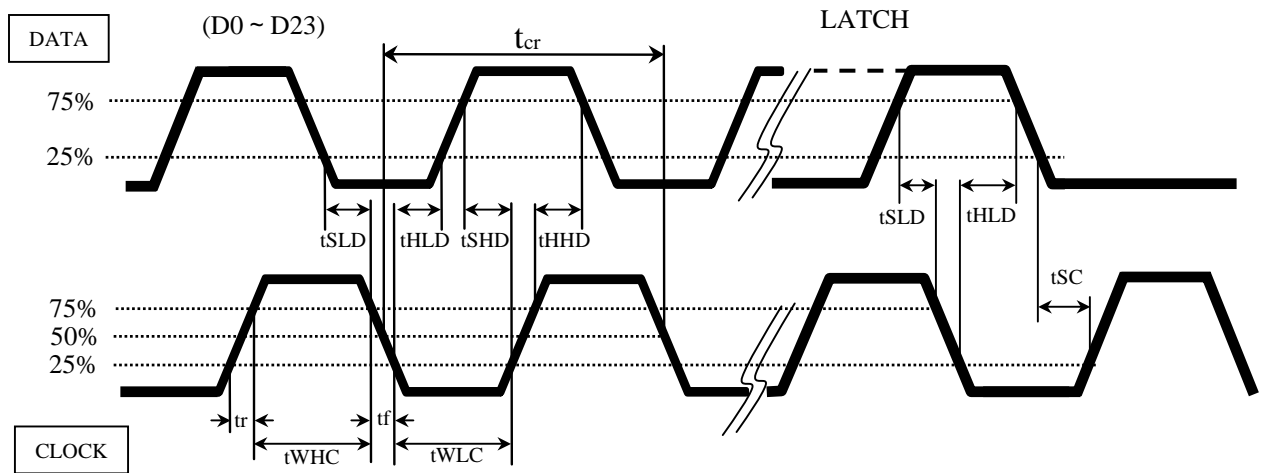
Parameter	Symbol	Condition	Min	Typ	Max	Unit
Supply voltage	VCC		8.0	9.0	10.0	V
Logic "H" level input voltage	VIH	VCC=9V	2.7	—	5.5	V
Logic "L" level input voltage	VIL	VCC=9V	0	—	0.7	V

RELATIONSHIP BETWEEN DATA AND CLOCK





CLOCK AND DATA TIMINGS



TIMING DEFINITION OF DIGITAL BLOCK

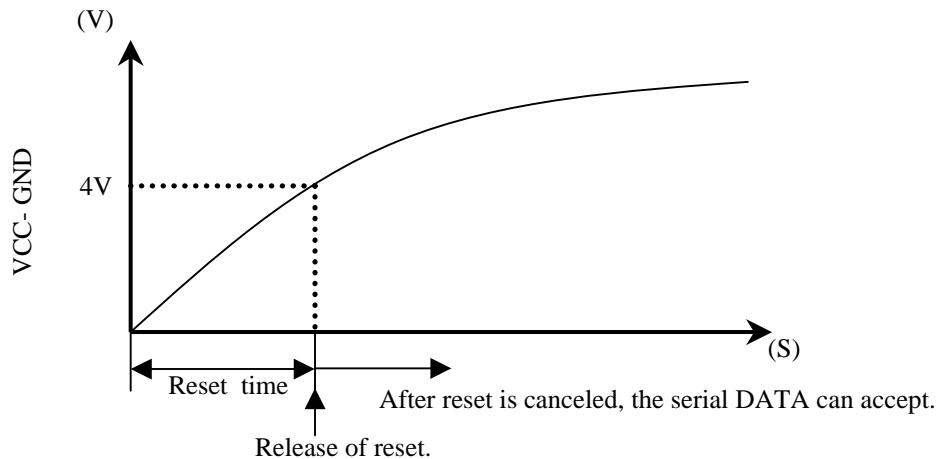
Symbol	Parameter	Limits			Units
		Min	Typ	Max	
tcr	CLOCK cycle time	8	-	-	μs
tWHC	CLOCK pulse width ("H" level)	3.2	-	-	
tWLC	CLOCK pulse width ("L" level)	3.2	-	-	
tr	Rising time of clock and data	-	-	0.8	
tf	Falling time of clock and data	-	-	0.8	
tSHD	DATA setup time (Rising time of clock)	1.6	-	-	
tSLD	DATA setup time (Falling time of clock)	1.6	-	-	
tHHD	DATA hold time ("H" level)	1.6	-	-	
tHLD	DATA hold time ("L" level)	1.6	-	-	
tSC	CLOCK setup time	1.6	-	-	



POWER ON RESET

This IC built-in the power on reset function.

The voltage of **VCC -GND** less than 4V, the serial DATA can not accept.



DATA CONTROL SPECIFICATION

Initialize all data of the 4 formats when Digital Power supply (VCC) turn on.

Prohibit using except specified Data code as follows.

Slot1																							
D0a	D1a	D2a	D3a	D4a	D5a	D6a	D7a	D8a	D9a	D10a	D11a	D12a	D13a	D14a	D15a	D16a	D17a	D18a	D19a	D20a	D21a	D22	D23
(1)Input Selector			(2) REC Out	(3) REC-Output Gain Control		(4) ADC Input ATT		(5) L/R Input	(6) Bass/ Tone control Bypass				(7) Treble				(8) SL/SR/C/SW Input	(9) Input Gain			0	0	0

Slot2																							
D0b	D1b	D2b	D3b	D4b	D5b	D6b	D7b	D8b	D9b	D10b	D11b	D12b	D13b	D14b	D15b	D16b	D17b	D18b	D19b	D20b	D21b	D22	D23
(10) Lch Gain Control			(11)Lch Volume						(10) Rch Gain Control			(11)Rch Volume						0	0	0	1		

Slot3																							
D0c	D1c	D2c	D3c	D4c	D5c	D6c	D7c	D8c	D9c	D10c	D11c	D12c	D13c	D14c	D15c	D16c	D17c	D18c	D19c	D20c	D21c	D22	D23
(10) Cch Gain Control			(11)Cch Volume						(10) SWch Gain Control			(11)SWch Volume						0	0	1	0		

Slot4																							
D0d	D1d	D2d	D3d	D4d	D5d	D6d	D7d	D8d	D9d	D10d	D11d	D12d	D13d	D14d	D15d	D16d	D17d	D18d	D19d	D20d	D21d	D22	D23
(10) SLch Gain Control			(11)SLch Volume						(10) SRch Gain Control			(11)SRch Volume						0	0	1	1		

* No guarantee except for these code.

CONFIDENTIAL

SETTING CODE

(1) Input Selector

Setting	D0a	D1a	D2a
ALL OFF	0	0	0
IN1	0	1	0
IN2	1	0	0
IN3	1	1	0
IN4 *1	0	0	1

No guarantee except for these code.

(2) REC Output

REC Output	REC1
Setting	D3a
OFF	0
ON	1 *1

*1 When IN4 selected, REC1 can not use.

IN4	REC1	D0a	D1a	D2a	D3a
ON	OFF	0	0	1	1

(3) REC-Output Gain Control

Gain Setting	D4a	D5a
0dB	0	0
+2dB	0	1
+4dB	1	0
+6dB	1	1

(4) ADC Input ATT *3

ATT Setting	D6a	D7a
0dB	0	0
-6dB	0	1
-12dB	1	0
-18dB	1	1

(5) L/R Input

Setting	D8a
Selector In	0
Multi In	1


(8) SL/SR/C/SW Input

Setting	D17a
L ± R In	0 *3
Multi In	1

*3 When L ± R selected, ADC Input ATT can not use.

(9) Input Gain

Gain setting	D18a	D19a	D20a
0dB	0	0	0
+2dB	0	0	1
+4dB	0	1	0
+6dB	0	1	1
+8dB	1	0	0
+10dB	1	0	1
+12dB	1	1	0
+14dB	1	1	1

 It's initial setting when power is turned on.

(6) Bass/ Bypass(Tone control is bypass)

Gain Setting	D9a	D10a	D11a	D12a
+14dB	1	1	1	1
+12dB	1	1	1	0
+10dB	1	1	0	1
+8dB	1	1	0	0
+6dB	1	0	1	1
+4dB	1	0	1	0
+2dB	1	0	0	1
0dB	1	0	0	0
-2dB	0	0	0	1
-4dB	0	0	1	0
-6dB	0	0	1	1
-8dB	0	1	0	0
-10dB	0	1	0	1
-12dB	0	1	1	0
-14dB	0	1	1	1
Bypass *2	0	0	0	0

*2 Tone control is bypass.

(7) Treble

Gain Setting	D13a	D14a	D15a	D16a
+14dB	1	1	1	1
+12dB	1	1	1	0
+10dB	1	1	0	1
+8dB	1	1	0	0
+6dB	1	0	1	1
+4dB	1	0	1	0
+2dB	1	0	0	1
0dB	1/0	0	0	0
-2dB	0	0	0	1
-4dB	0	0	1	0
-6dB	0	0	1	1
-8dB	0	1	0	0
-10dB	0	1	0	1
-12dB	0	1	1	0
-14dB	0	1	1	1



(10)Gain Control

Gain Setting	Lch	D0b	D1b	D2b
	Rch	D10b	D11b	D12b
	Cch	D0c	D1c	D2c
	SWch	D10c	D11c	D12c
	SLch	D0d	D1d	D2d
	SRch	D10d	D11d	D12d
0dB	0	0	0	
+2dB	0	0	1	
+4dB	0	1	0	
+6dB	0	1	1	
+8dB	1	0	0	
+10dB	1	0	1	
+12dB	1	1	0	
+14dB	1	1	1	

(11) 6 channels Volume

ATT	Lch	D3b	D4b	D5b	D6b	D7b	D8b	D9b
	Rch	D13b	D14b	D15b	D16b	D17b	D18b	D19b
	Cch	D3c	D4c	D5c	D6c	D7c	D8c	D9c
	SWch	D13c	D14c	D15c	D16c	D17c	D18c	D19c
	SLch	D3d	D4d	D5d	D6d	D7d	D8d	D9d
	SRch	D13d	D14d	D15d	D16d	D17d	D18d	D19d
0dB	0	0	0	0	0	0	0	
-1dB	0	0	0	0	0	0	1	
-2dB	0	0	0	0	0	1	0	
-3dB	0	0	0	0	0	1	1	
-4dB	0	0	0	0	1	0	0	
-5dB	0	0	0	0	1	0	1	
-6dB	0	0	0	0	1	1	0	
-7dB	0	0	0	0	1	1	1	
-8dB	0	0	0	1	0	0	0	
-9dB	0	0	0	1	0	0	1	
-10dB	0	0	0	1	0	1	0	
-11dB	0	0	0	1	0	1	1	
-12dB	0	0	0	1	1	0	0	
-13dB	0	0	0	1	1	0	1	
-14dB	0	0	0	1	1	1	0	
-15dB	0	0	0	1	1	1	1	
-16dB	0	0	1	0	0	0	0	
-17dB	0	0	1	0	0	0	1	
-18dB	0	0	1	0	0	1	0	

ATT	Lch	D3b	D4b	D5b	D6b	D7b	D8b	D9b
	Rch	D13b	D14b	D15b	D16b	D17b	D18b	D19b
	Cch	D3c	D4c	D5c	D6c	D7c	D8c	D9c
	SWch	D13c	D14c	D15c	D16c	D17c	D18c	D19c
	SLch	D3d	D4d	D5d	D6d	D7d	D8d	D9d
	SRch	D13d	D14d	D15d	D16d	D17d	D18d	D19d
-19dB	0	0	1	0	0	1	1	
-20dB	0	0	1	0	1	0	0	
-21dB	0	0	1	0	1	0	1	
-22dB	0	0	1	0	1	1	0	
-23dB	0	0	1	0	1	1	1	
-24dB	0	0	1	1	0	0	0	
-25dB	0	0	1	1	0	0	1	
-26dB	0	0	1	1	0	1	0	
-27dB	0	0	1	1	0	1	1	
-28dB	0	0	1	1	1	0	0	
-29dB	0	0	1	1	1	0	1	
-30dB	0	0	1	1	1	1	0	
-31dB	0	0	1	1	1	1	1	
-32dB	0	1	0	0	0	0	0	
-33dB	0	1	0	0	0	0	1	
-34dB	0	1	0	0	0	1	0	
-35dB	0	1	0	0	0	1	1	
-36dB	0	1	0	0	1	0	0	
-37dB	0	1	0	0	1	0	1	
-38dB	0	1	0	0	1	1	0	
-39dB	0	1	0	0	1	1	1	
-40dB	0	1	0	1	0	0	0	
-41dB	0	1	0	1	0	0	1	
-42dB	0	1	0	1	0	1	0	
-43dB	0	1	0	1	0	1	1	
-44dB	0	1	0	1	1	0	0	
-45dB	0	1	0	1	1	0	1	
-46dB	0	1	0	1	1	1	0	

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ATT	Lch	D3b	D4b	D5b	D6b	D7b	D8b	D9b
	Rch	D13b	D14b	D15b	D16b	D17b	D18b	D19b
	Cch	D3c	D4c	D5c	D6c	D7c	D8c	D9c
	SWch	D13c	D14c	D15c	D16c	D17c	D18c	D19c
	SLch	D3d	D4d	D5d	D6d	D7d	D8d	D9d
	SRch	D13d	D14d	D15d	D16d	D17d	D18d	D19d
	-47dB	0	1	0	1	1	1	1
-48dB	0	1	1	0	0	0	0	0
-49dB	0	1	1	0	0	0	0	1
-50dB	0	1	1	0	0	1	1	0
-51dB	0	1	1	0	0	1	1	1
-52dB	0	1	1	0	1	0	0	0
-53dB	0	1	1	0	1	0	0	1
-54dB	0	1	1	0	1	1	1	0
-55dB	0	1	1	0	1	1	1	1
-56dB	0	1	1	1	0	0	0	0
-57dB	0	1	1	1	0	0	0	1
-58dB	0	1	1	1	0	1	1	0
-59dB	0	1	1	1	0	1	1	1
-60dB	0	1	1	1	1	0	0	0
-61dB	0	1	1	1	1	0	0	1
-62dB	0	1	1	1	1	1	1	0
-63dB	0	1	1	1	1	1	1	1
-64dB	1	0	0	0	0	0	0	0
-65dB	1	0	0	0	0	0	0	1
-66dB	1	0	0	0	0	1	1	0
-67dB	1	0	0	0	0	1	1	1
-68dB	1	0	0	0	1	0	0	0
-69dB	1	0	0	0	1	0	0	1
-70dB	1	0	0	0	1	1	1	0
-71dB	1	0	0	0	1	1	1	1
-72dB	1	0	0	1	0	0	0	0
-73dB	1	0	0	1	0	0	0	1

ATT	Lch	D3b	D4b	D5b	D6b	D7b	D8b	D9b
	Rch	D13b	D14b	D15b	D16b	D17b	D18b	D19b
	Cch	D3c	D4c	D5c	D6c	D7c	D8c	D9c
	SWch	D13c	D14c	D15c	D16c	D17c	D18c	D19c
	SLch	D3d	D4d	D5d	D6d	D7d	D8d	D9d
	SRch	D13d	D14d	D15d	D16d	D17d	D18d	D19d
	-74dB	1	0	0	1	0	1	0
-75dB	1	0	0	1	0	1	1	1
-76dB	1	0	0	1	1	0	0	0
-77dB	1	0	0	1	1	0	1	1
-78dB	1	0	0	1	1	1	1	0
-79dB	1	0	0	1	1	1	1	1
-80dB	1	0	1	0	0	0	0	0
-81dB	1	0	1	0	0	0	0	1
-82dB	1	0	1	0	0	1	0	0
-83dB	1	0	1	0	0	1	1	1
-84dB	1	0	1	0	1	0	0	0
-85dB	1	0	1	0	1	0	1	1
-86dB	1	0	1	0	1	1	1	0
-87dB	1	0	1	0	1	1	1	1
-88dB	1	0	1	1	0	0	0	0
-89dB	1	0	1	1	0	0	0	1
-90dB	1	0	1	1	0	1	0	0
-91dB	1	0	1	1	0	1	1	1
-92dB	1	0	1	1	1	1	0	0
-93dB	1	0	1	1	1	1	0	1
-94dB	1	0	1	1	1	1	1	0
-95dB	1	0	1	1	1	1	1	1
-96dB	1	1	0	0	0	0	0	0
-97dB	1	1	0	0	0	0	0	1
-98dB	1	1	0	0	0	0	1	0
-99dB	1	1	0	0	0	0	1	1
-∞	1	1	1/0	1/0	1	1/0	1/0	1/0

* No guarantee except for these code.

 It's initial setting when power is turned on.



ELECTRICAL CHARACTERISTICS

Unless otherwise noted, Ta=25°C , Vcc=9V, f=1kHz , Volume=0dB , Input Selector=IN1, Input Gain=0dB, Gain Control=0dB , ADC Input ATT=0dB , Tone=Bypass, L/R Input=Selector In , SL/SR/C/SW Input=L ± R In

(1) Power supply characteristics

Parameter	Symbol	Test condition	Limits			Unit
			Min	Typ	Max	
Analog power supply circuit current	Icc	With Vcc=9V VCC current,when no signal is provided	—			mA

(2) Input/Output characteristics (OVER ALL)

Parameter	Symbol	Test Condition	Limits			Unit	
			Min	Typ	Max		
Input resistance	Rin	6~11, 31~36 pin	17	25	33	kohm	
Maximum output voltage	VOM	6~11pin input,15~20pin output, THD=1%,RL=10kohm,Output Gain Control=+6dB	1.8	2.2	—	Vrms	
Pass gain	Gv	6~11pin input,15~20pin output, Vi=0.3Vrms,FLAT	-2.0	0	2.0	dB	
Total harmonic distortion	THD	6~11pin input,15~20pin output, BW:400Hz~30kHz,f=1kHz, Vo=0.5Vrms, RL=10k ohm	—	0.005	0.02	%	
Balance of mutual channels	CBAL	31,32pin input,19,20pin output, Vi=0.3Vrms	-0.5	0	0.5	dB	
Output noise voltage	Vono1	JIS-A ,Rg=0ohm,19,20pin output, Volume=- dB setting	Output Gain Control=0dB	—	2	6	uVrms
			Output Gain Control=+14dB	—	9	18	
	Vono2	JIS-A ,Rg=0ohm,19,20pin output, Volume=0dB setting	Output Gain Control=0dB	—	2	6	
			Output Gain Control=+14dB	—	9	18	
	Vono3	JIS-A ,Rg=0ohm,15~18pin output, Volume=0dB setting	Output Gain Control=0dB	—	2	6	
			Output Gain Control=+14dB	—	9	18	



Parameter	Symbol	Test Condition	Limits			Unit
			Min	Typ	Max	
Selector separation	SS1	< Input Selector > Vo=1Vrms , Rg=0ohm , RL=10kohm , JIS-A	—	-90	-70	dB
	SS2	< Multi Input Selector > Vo=1Vrms , Rg=0ohm , RL=10kohm , JIS-A,	—	-90	-70	
Channel separation	CS	Vo=1Vrms , Rg=0ohm , RL=10kohm , JIS-A	—	-90	-70	

(3) 6 channel Volume characteristics

Parameter	Symbol	Test condition	Limits			Unit
			Min	Typ	Max	
Maximum attenuation	ATTmax	Vi=2Vrms,JIS-A,VOL=- dB	—	-105	-95	dB
Volume gain gang error of mutual channels	Dvol	Volume=0dB	-0.5	0	+0.5	dB

(4)Tone control characteristics

Unless otherwise noted, Tone ON/OFF=ON

Parameter	Symbol	Test condition	Limits			Unit
			Min	Typ	Max	
Tone control voltage gain (Boost/Bass)	G(BASS)B	f=100Hz Bass +14dB setting	+11	+14	+17	dB
Tone control voltage gain (Cut/Bass)	G(BASS)C	f=100Hz Bass -14dB setting	-17	-14	-11	dB
Tone control voltage gain (Boost/Treble)	G(TRE)B	f=10kHz Treble +14dB setting	+11	+14	+17	dB
Tone control voltage gain (Cut/Treble)	G(TRE)C	f=10kHz Treble -14dB setting	-17	-14	-11	dB
Balance of mutual channels	BALT	Bass setting +14,-14dB Treble setting +14,-14dB	-2	0	+2	dB

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Renesas Sound Processor

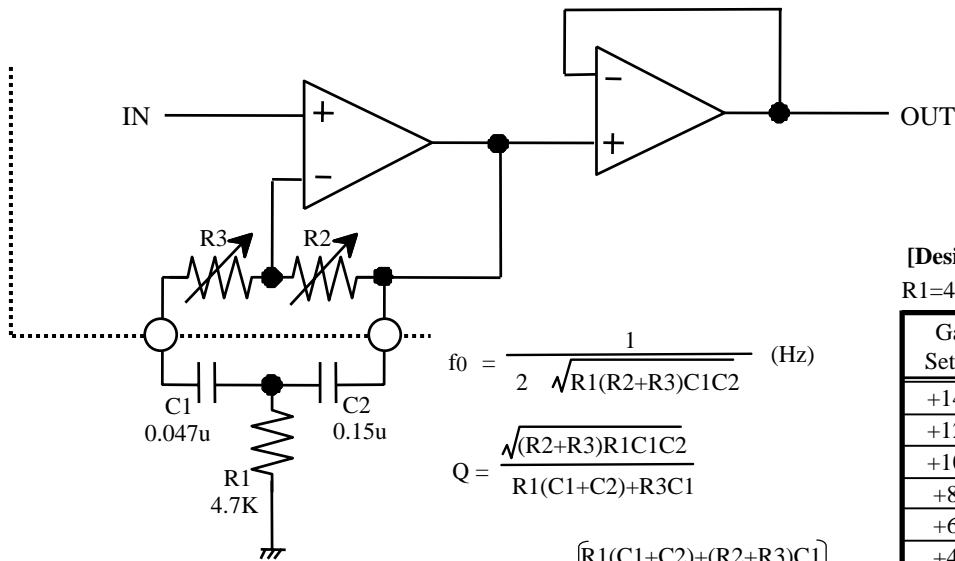
R2S15902FP

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6-CHANNEL ELECTRONIC VOLUME

(1) Bass

<Boost>



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

$$Q = \frac{\sqrt{(R_2+R_3)R_1C_1C_2}}{R_1(C_1+C_2)+R_3C_1}$$

$$G_v = 20 \log \left\{ \frac{R_1(C_1+C_2)+(R_2+R_3)C_1}{R_1(C_1+C_2)+R_3C_1} \right\}$$

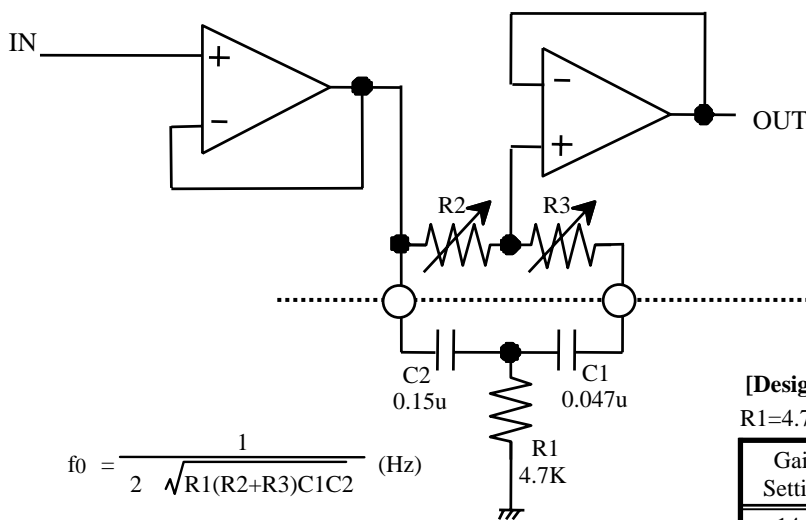
[Designed Parameter]

R1=4.7k , C1=0.047uF, C2=0.15uF

Gain Setting	Designed Parameter	
	R3(k)	R2(k)
+14dB	0.19	79.81
+12dB	5.21	74.66
+10dB	11.83	68.17
+8dB	19.99	60.01
+6dB	30.27	49.73
+4dB	43.21	36.79
+2dB	59.49	20.51

(dB)

<Cut>



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

$$Q = \frac{\sqrt{(R_2+R_3)R_1C_1C_2}}{R_1(C_1+C_2)+R_3C_1}$$

$$G_v = 20 \log \left\{ \frac{R_1(C_1+C_2)+R_3C_1}{R_1(C_1+C_2)+(R_2+R_3)C_1} \right\} \text{ (dB)}$$

[Designed Parameter]

R1=4.7k , C1=0.047uF, C2=0.15uF

Gain Setting	Designed Parameter	
	R2(k)	R3(k)
-14dB	79.81	0.19
-12dB	74.66	5.21
-10dB	68.17	11.83
-8dB	60.01	19.99
-6dB	49.73	30.27
-4dB	36.79	43.21
-2dB	20.51	59.49

PRELIMINARY

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Renesas Sound Processor

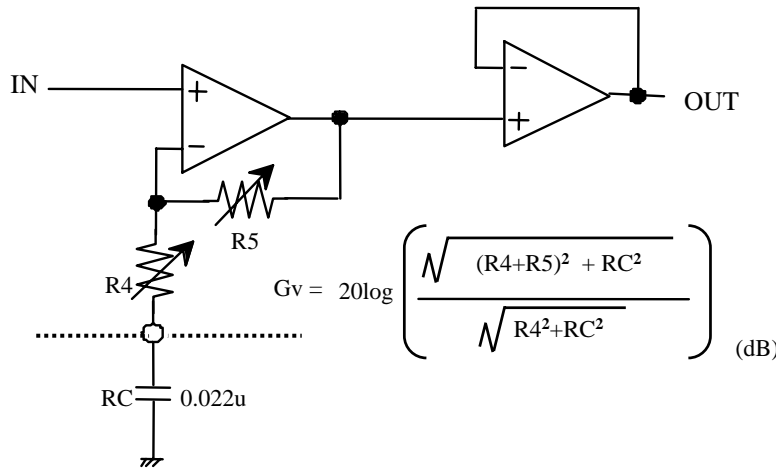
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6-CHANNEL ELECTRONIC VOLUME

(2)Treble

<Boost>

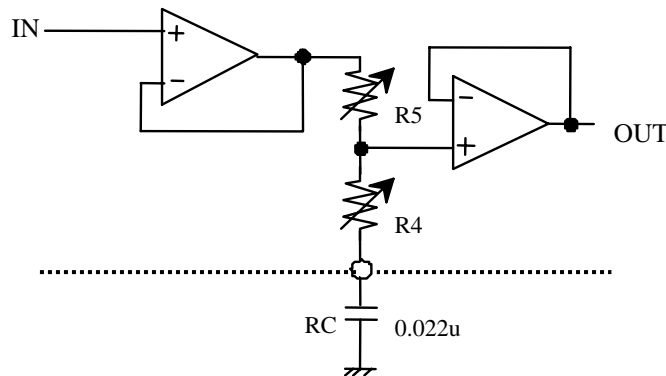


[Designed Parameter]

RC=0.022uF

Gain Setting	Designed Parameter	
	R4(k)	R5(k)
+14dB	1.03	5.23
+12dB	1.41	4.85
+10dB	1.86	4.40
+8dB	2.40	3.86
+6dB	3.06	3.20
+4dB	3.90	2.36
+2dB	4.95	1.31

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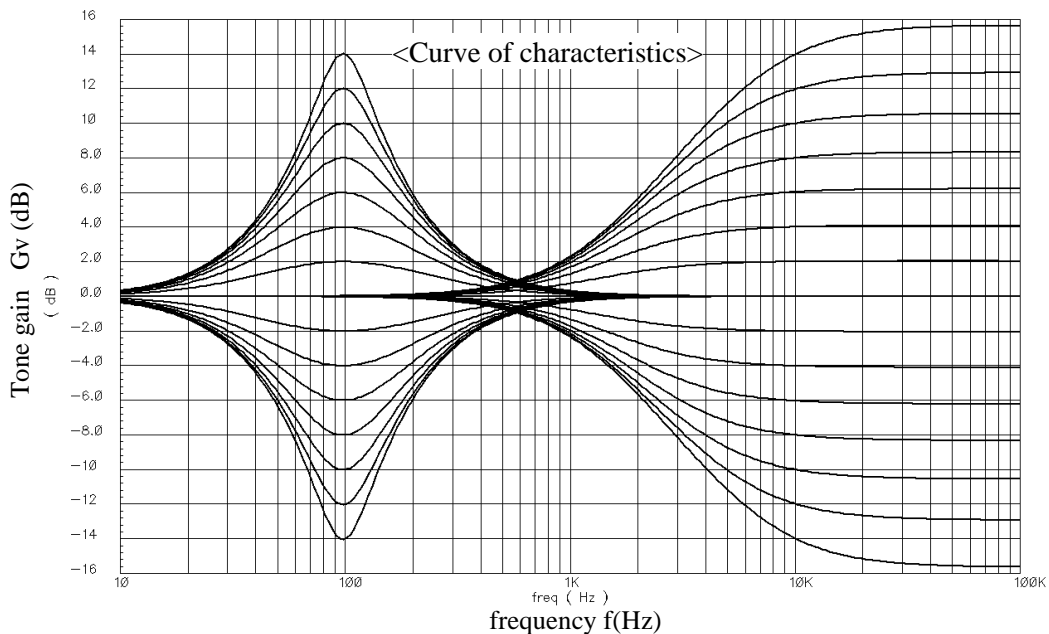


$$Gv = 20\log \left(\frac{\sqrt{R4^2 + RC^2}}{\sqrt{(R4+R5)^2 + RC^2}} \right) \text{ (dB)}$$

[Designed Parameter]

RC=0.022uF

Gain Setting	Designed Parameter	
	R5(k)	R4(k)
-14dB	5.23	1.03
-12dB	4.85	1.41
-10dB	4.40	1.86
-8dB	3.86	2.40
-6dB	3.20	3.06
-4dB	2.36	3.90
-2dB	1.31	4.95



PRELIMINARY

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Renesas Sound Processor

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6-CHANNEL ELECTRONIC VOLUME

APPLICATION EXAMPLE

