

To all our customers

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## **Regarding the change of names mentioned in the document, such as Mitsubishi Electric and Mitsubishi XX, to Renesas Technology Corp.**

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The semiconductor operations of Hitachi and Mitsubishi Electric were transferred to Renesas Technology Corporation on April 1st 2003. These operations include microcomputer, logic, analog and discrete devices, and memory chips other than DRAMs (flash memory, SRAMs etc.) Accordingly, although Mitsubishi Electric, Mitsubishi Electric Corporation, Mitsubishi Semiconductors, and other Mitsubishi brand names are mentioned in the document, these names have in fact all been changed to Renesas Technology Corp. Thank you for your understanding. Except for our corporate trademark, logo and corporate statement, no changes whatsoever have been made to the contents of the document, and these changes do not constitute any alteration to the contents of the document itself.

Note : Mitsubishi Electric will continue the business operations of high frequency & optical devices and power devices.

Renesas Technology Corp.  
Customer Support Dept.  
April 1, 2003

# PRELIMINARY

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

MITSUBISHI SOUND PROCESSORS

# M61510FP

DIGITAL SOUND CONTROLLER WITH SURROUND

## DESCRIPTION

The M61510FP is an optimum digital sound controller IC for home audio.

It has a 5ch input selector, input volume, surround(3 variation), tone control(3 band), loudness and 2ch master volume.

It can control all of these functions with serial data.

## FEATURES

- Built-in 5ch input selector.
- Built-in input volume (2dB step/3bit)
- IC for Dolby-pro-logic Interface
- Built-in Surround (ON/OFF, High/Middle/Low(3 variation))
- Tone control (Bass/Mid/Treble)
- Built-in Loudness.
- Main Volume (1 dB step (0 to -80dB, -∞))
- Microcomputer Interface

## PACKAGE

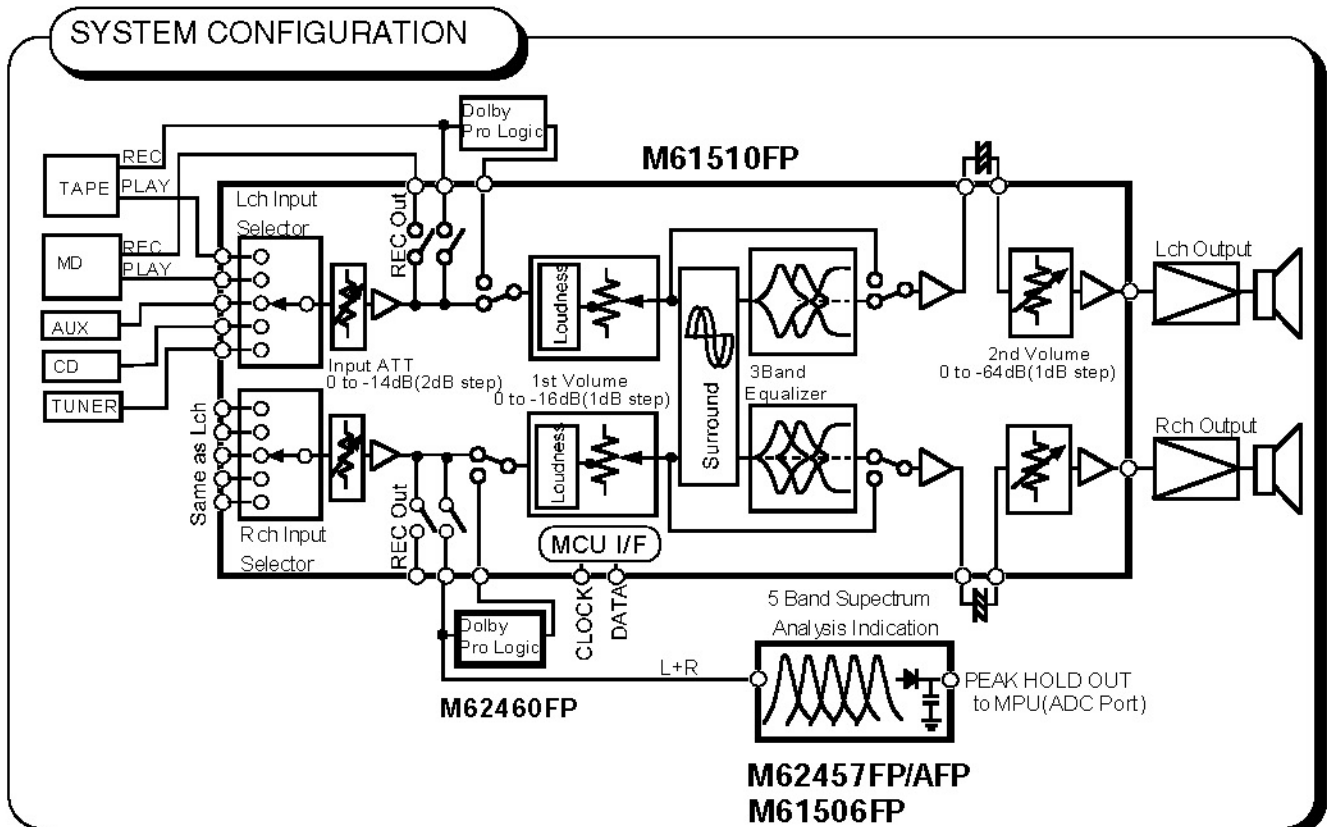


Outline 42P2R-A  
0.8mm Pitch 450mil SSOP  
(8.4mm x 17.5mm x 2.0mm)

## RECOMMENDED OPERATING CONDITIONS

Supply voltage range ....Vcc= 4.5~5.5 Rated supply voltage.....Vcc=5V

## SYSTEM CONFIGURATION



**PRELIMINARY**

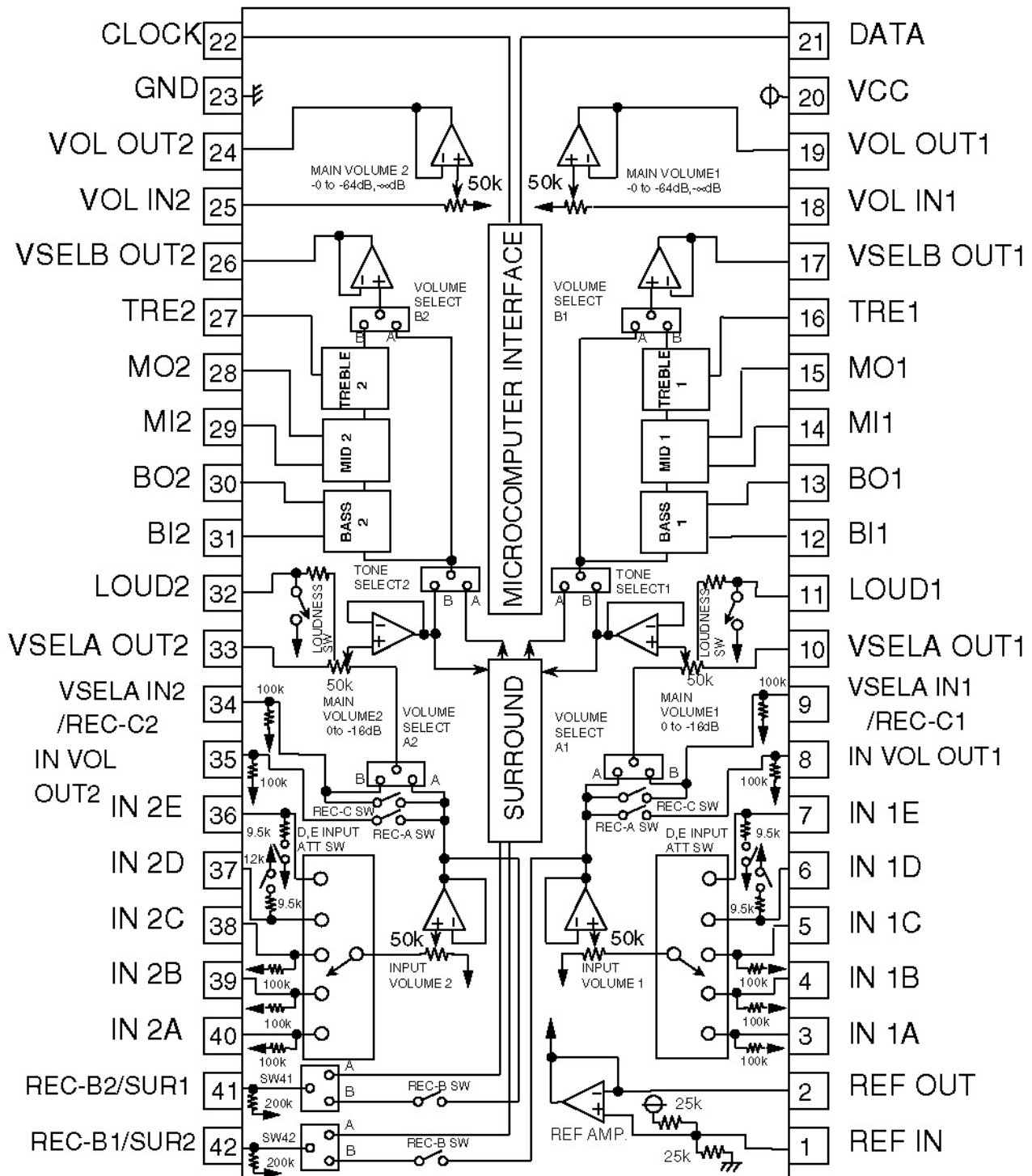
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MITSUBISHI SOUND PROCESSORS

**M61510FP**

DIGITAL SOUND CONTROLLER WITH SURROUND

**PIN CONFIGURATION AND IC INTERNAL BLOCK DIAGRAM**



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mitsubishi sound processors

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**PIN DESCRIPTION**

Pin No.	Symbol	Function
1	REF IN	Input pin of the reference Amp.
2	REF OUT	Output pin oh the reference Amp.
3,4,5,6,7, 36,37,38,39,40	IN 1A,1B,1C,1D,1E 2A,2B,2C,2D,2E	Input pin of the input selector Ch1 and Ch2
8,35	INVOL OUT1,2	Output pin of the input volume 1 and 2
9,34	VSELA IN1,2/REC-C1,2	Input pin of the volume input selector A1 and A2 /Output pin of the REC-C1 and 2
10,33	VSELA OUT1,2	Capacitor connection pin for the volume changing noise reduction
11,32	LOUD1,2	Frequency characteristic setting pin in the loudness part
12,31	BI1,2	Frequency characteristic setting pin in the tone control(Bass).
13,30	BO1,2	
14,29	MI1,2	Frequency characteristic setting pin in the tone control(Mid).
15,28	MO1,2	
16,27	TRE1,2	Frequency characteristic setting pin in the tone control(Treble).
17,26	VSELB OUT1,2	Output pin of the volume input selector B1 and 2
18,25	VOL IN1,2	Input pin of the main volume
19,24	VOL OUT1,2	Output pin of the main volume
20	VCC	The power supply
21	DATA	Input pin of the serial data
22	CLOCK	Clock input pin for the serial data forwarding
23	GND	GND
41	REC-B2/SUR1	Output pin of the REC-B2/Device connection pin for the surround external parts
42	REC-B1/SUR2	Output pin of the REC-B1/Device connection pin for the surround external parts

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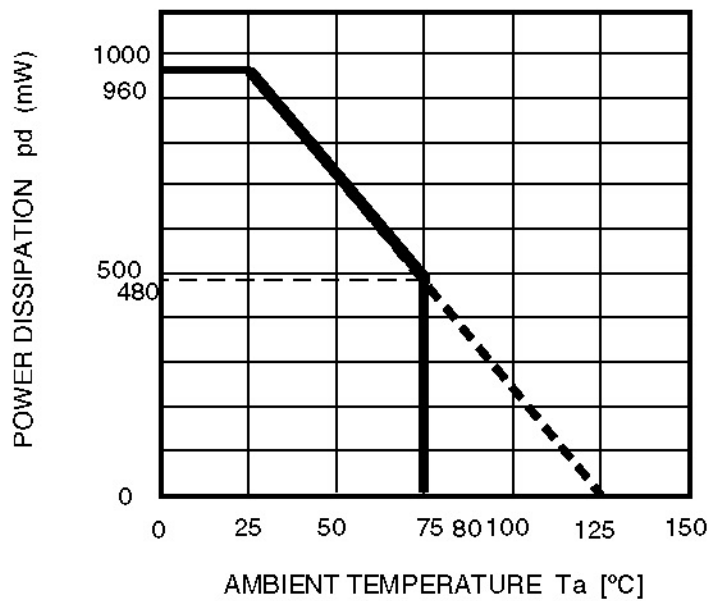
# M61510FP

DIGITAL SOUND CONTROLLER WITH SURROUND

## ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Conditions	Limits	Units
VCC	Supply voltage		6.0	V
Pd	Power dissipation	Ta≤25°C	960	mW
Kθ	Thermal derating	Ta>25°C	9.6	mW/°C
Topr	Operating temperature		-20 to +75	°C
Tstg	Storage temperature		-40 to +125	°C

## THERMAL DERATING



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MITSUBISHI SOUND PROCESSORS

# M61510FP

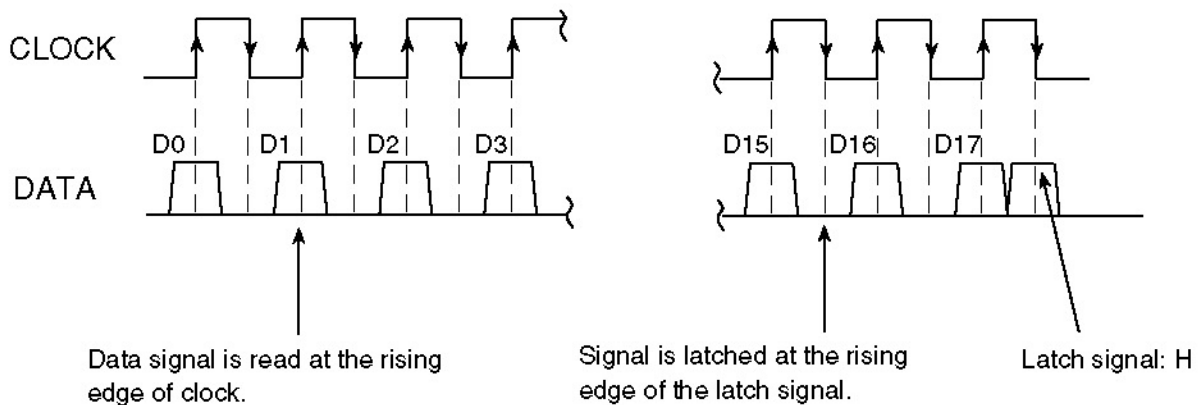
DIGITAL SOUND CONTROLLER WITH SURROUND

## RECOMMENDED OPERATING CONDITION

(Ta=25°C, unless otherwise noted)

Parameter	Symbol	Conditions	MIN	TYP	MAX	Units
Supply voltage	VCC		4.5	5.0	5.5	V
Logic"H"level input voltage	VIH	GND reference	2.4	—	VCC	V
Logic"L"level input voltage	VIL	GND reference	GND	—	0.7	V

## RELATIONSHIP BETWEEN DATA AND CLOCK



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**DATA CONTROL SPECIFICATION**

Four kinds of input format options are available by changing slot settings of D14,D15.

(When the IC is powered up,the internal setting are not fixed.)

<MUTE cancellation data> (x is optional setting)

D0d D1d D2d D3d D4d D5d D6d D7d D8d D9d D10d D11d D12d D13d D14 D15 D16 D17  
X X X 0 X 1 X X X X X X X 1 1 0 0

Chip address

(1)

D0a	D1a	D2a	D3a	D4a	D5a	D6a	D7a	D8a	D9a	D10a	D11a	D12a	D13a	D14	D15	D16	D17
TONE CONTROL TREBLE				TONE CONTROL MID				TONE CONTROL BASS				VOCAL CUT	0	0	0	0	0

(2)

D0b	D1b	D2b	D3b	D4b	D5b	D6b	D7b	D8b	D9b	D10b	D11b	D12b	D13b	D14	D15	D16	D17
A1 VOLUME CH1				B1 VOLUME CH1								INPUT D ATT SW	INPUT E ATT SW	0	1	0	0

(3)

D0c	D1c	D2c	D3c	D4c	D5c	D6c	D7c	D8c	D9c	D10c	D11c	D12c	D13c	D14	D15	D16	D17
A1 VOLUME CH2				B1 VOLUME CH2								TONE INPUT SELECTOR	D/E INPUT ATT SW -5/-8dB	1	0	0	0

(4)

Note1)

	D0d	D1d	D2d	D3d	D4d	D5d	D6d	D7d	D8d	D9d	D10d	D11d	D12d	D13d	D14	D15	D16	D17	
SURROUND OF OUTSIDE SETTING	INPUT SELECTOR			Note2) Mute	REC-B ON:1 OFF:0	1	INPUT VOLUME				A INPUT VOLUME SELECT OR	B INPUT VOLUME SELECT OR	REC-A ON:1 OFF:0	LOUDNESS SW	0	1	1	0	0
SURROUND OF INSIDE SETTING				SURROUND		0					REC-C ON:1 OFF:0								

Note1) Surround of outside setting, It becomes "D5d=1"--->SW41 and 42 setting = B fixation.Surround of inside setting (Surround of outside non setting), It becomes "D5d=0"--->SW41 and 42 setting = A fixation,It becomes volume input selector A setting = A fixation.

Note2) In power supply investing to Mute an output pin,it becomes setting like the following.Input selector = ALL OFF,Outside surround mode setting,REC-A~C SW=OFF,B1 main volume=-∞ setting.The similar MUTE setting can be done by setting D3d=D5d=1 at D14=D15=1,D16=D17=0.

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**M61510FP**

DIGITAL SOUND CONTROLLER WITH SURROUND

**SETTING CODE**

(1)TONE CONTROL (TREBLE/MID/BASS)

ATT	TREBLE	D0a	D1a	D2a	D3a
	MID	D4a	D5a	D6a	D7a
	BASS	D8a	D9a	D10a	D11a
+ 8dB		1	1	0	0
+ 6dB		1	0	1	1
+ 4dB		1	0	1	0
+ 2dB		1	0	0	1
0dB		0	0	0	0
- 2dB		0	0	0	1
- 4dB		0	0	1	0
- 6dB		0	0	1	1
- 8dB		0	1	0	0

(10)INPUT SELECTOR

INPUT	D0d	D1d	D2d
A ch	0	0	0
B ch	0	0	1
C ch	0	1	0
D ch	0	1	1
E ch	1	0	0
ALL OFF	1	1	1

(2)LOUDNESS

LOUDNESS	D12d
OFF	0
ON	1

(3)A VOL SELECTOR

Note) It is possible to control only at D5d="1" setting.

AVOL SELECTOR	D9d
BYPASS	0
OUTSIDE SURROUND INPUT	1

(11) REC-A,B,C SWITCH

Note) REC-B is possible to control only at D5d="1" setting.  
 REC-C is possible to control only at D5d="0" setting.

DATA	D11d	D4d	D9d
REC OUTPUT	A	B	C
0	OFF		
1	ON		

(4)B VOL SELECTOR

BVOL SELECTOR	D10d
BYPASS	0
TONE	1

(5)TONE INPUT SELECTOR

TONE INPUT	D12c
BYPASS	0
INSIDE SURROUND INPUT	1

(12)SURROUND

Note) It is possible to control only at D5d="0" setting.

SURROUND	D3d	D4d
OFF	0	0
L	1	0
M	0	1
H	1	1

(6) E INPUT ATT SW

E INPUT ATT SW	D13b
0dB	0
-5/-8dB	1

(7) D INPUT ATT SW

D INPUT ATT SW	D12b
0dB	0
-5/-8dB	1

(13)INPUT VOLUME

INPUT VOLUME	D6d	D7d	D8d
0 dB	0	0	0
-2 dB	0	0	1
-4 dB	0	1	0
-6 dB	0	1	1
-8 dB	1	0	0
-10 dB	1	0	1
-12 dB	1	1	0
-14 dB	1	1	1

(8) D/E INPUT ATT SW

D/E INPUT ATT SW	D13c
-8dB	0
-5dB	1

(9) VOCAL CUT SW

VOCAL CUT SW	D12a
OFF	0
ON	1

Note:Do not input other data than the above.



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(14)A MAIN VOLUME

ATT	FRONT STEP VOL. CH1	D0b	D1b	D2b	D3b	D4b
	FRONT STEP VOL. CH2	D0c	D1c	D2c	D3c	D4c
0dB		0	0	0	0	0
-1dB		0	0	0	0	1
-2dB		0	0	0	1	0
-3dB		0	0	0	1	1
-4dB		0	0	1	0	0
-5dB		0	0	1	0	1
-6dB		0	0	1	1	0
-7dB		0	0	1	1	1
-8dB		0	1	0	0	0
-9dB		0	1	0	0	1
-10dB		0	1	0	1	0
-11dB		0	1	0	1	1
-12dB		0	1	1	0	0
-13dB		0	1	1	0	1
-14dB		0	1	1	1	0
-15dB		0	1	1	1	1
-16dB		1	0	0	0	0

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## DIGITAL SOUND CONTROLLER WITH SURROUND

### (15)B MAIN VOLUME

ATT	BACK STEP VOL. CH1	D5b	D6b	D7b	D8b	D9b	D10b	D11b
	BACK STEP VOL. CH2	D5c	D6c	D7c	D8c	D9c	D10c	D11c
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
-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

ATT	BACK STEP VOL. CH2	D5b	D6b	D7b	D8b	D9b	D10b	D11b
	BACK STEP VOL. CH2	D5c	D6c	D7c	D8c	D9c	D10c	D11c
-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
-47dB		0	1	0	1	1	1	1
-48dB		0	1	1	0	0	0	0
-49dB		0	1	1	0	0	0	1
-50dB		0	1	1	0	0	1	0
-51dB		0	1	1	0	0	1	1
-52dB		0	1	1	0	1	0	0
-53dB		0	1	1	0	1	0	1
-54dB		0	1	1	0	1	1	0
-55dB		0	1	1	0	1	1	1
-56dB		0	1	1	1	0	0	0
-57dB		0	1	1	1	0	0	1
-58dB		0	1	1	1	0	1	0
-59dB		0	1	1	1	0	1	1
-60dB		0	1	1	1	1	0	0
-61dB		0	1	1	1	1	0	1
-62dB		0	1	1	1	1	1	0
-63dB		0	1	1	1	1	1	1
-64dB		1	0	0	0	0	0	0
-∞dB		1	0	0	0	0	0	1

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**ELECTRICAL CHARACTERISTICS**

(Ta=25°C,VCC=5.0V,f=1kHz,unless otherwise noted.  
 INPUT VOLUME=0dB,SURROUND,LOUDNESS=OFF,VOL.INPUT SELECTOR A,B  
 setting=Bypass.TONE INPUT SELECTOR=Bypass. Refer to the application circuit example.)

(1)Power supply characteristics

Parameter	Symbol	Test condition	Limits			Units
			MIN	TYP	MAX	
Circuit current	Aldd	No signal setting	—	35	60	mA

(2)Input/Output characteristics (Total) Ta=25°C

Parameter	Symbol	Test condition	Limits			Units
			MIN	TYP	MAX	
Input impedance	Rin	3~5pin,38~40pin	22	33	48	KΩ
Maximum input Amplitude	VIMt	(Input pin to3~5,38~40) Output pin to 19,24,A main Vol=-2dB RL=10KΩ,THD=1%	1.2	1.4	—	Vrms
	VIMtDE	(Input pin to 6,7,36,37)Output pin to 19,24 <small>Note</small> Rin=12KΩ,RL=10Ω,THD=1% D,Ech ATT SW=-8dB,Input VOL=-2dB	2.8	3.1	—	Vrms
Maximum output Amplitude	VOMt	(Input pin~3,40)Output pin to19,24 RL=10Ω,THD=1%	1.0	1.25	—	Vrms
Gain	Gvt	Vi=0.5Vrms,FLAT, Pin(3~6,37~40pin)-19,24gains	-2.0	0	2.0	dB
Total harmonic distortion	THDA	(Input pin to 3,40) Output pin to19,24 DIN-AUDIO,Vi=0.5Vrms ,RL=30Ω	—	0.006	0.07	%
	THDB	B Volume input selector THDA:Bypass THDB:Tone	—	0.009	0.09	%
Output noise level	NoA	19,24pin,Rg=0Ω,JIS-A, Main volume=-∞	—	2.5	6	μVrms
		19,24pin,Rg=0Ω,JIS-A, Main volume=0dB	—	5	10	μVrms
	NoB	19,24pin,Rg=0Ω,JIS-A, B V volume input selector:Tone	—	7	15	μVrms
		19,24pin,Rg=0Ω,JIS-A,B Volume input select:Tone,Tone input select:Surround	—	10	20	μVrms
Cross talk between channels	CT	Vo=0.5Vrms , RL=10KΩ,JIS-A Pin19 to 24gains Rg=10KΩ	—	-80	-65	dB
Volume maximum attenuation quantity	ATTmax	Vi=1Vrms ,JIS-A Main volume= -∞	—	—	-80	dB

Note) Insert 12KΩ Input Resistance to the pins in series.

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DIGITAL SOUND CONTROLLER WITH SURROUND

### (3)Tone control characteristics

$V_i=0.2V_{rms}$ , Input pin to 9 and 34, Output pin to 17 and 26, A VOL input selector: Input to outside surround, Tone input selector: Bypass, B VOL input selector: Tone, unless otherwise noted.

Parameter	Symbol	Test conditions	Limits			Units
			MIN	TYP	MAX	
Value of Boost(Bass)	G(BASS)B	f=100Hz Tone bass setting +8dB	6	8	10	dB
Value of Cut(Bass)	G(BASS)C	f=100Hz Tone bass setting -8dB	-10	-8	-6	dB
Value of Boost(Mid)	G(MID)B	f=1kHz Tone mid setting +8dB	6	8	10	dB
Value of Cut(Mid)	G(MID)B	f=1kHz Tone mid setting -8dB	-10	-8	-6	dB
Value of Boost(Treble)	G(TRE)B	f=10kHz Tone treble setting +8dB	6	8	10	dB
Value of Cut(Treble)	G(TRE)B	f=10kHz Tone treble setting -8dB	-10	-8	-6	dB
Balance between channels	BALT	boost condition +8,-8dB	-2	0	+2	dB

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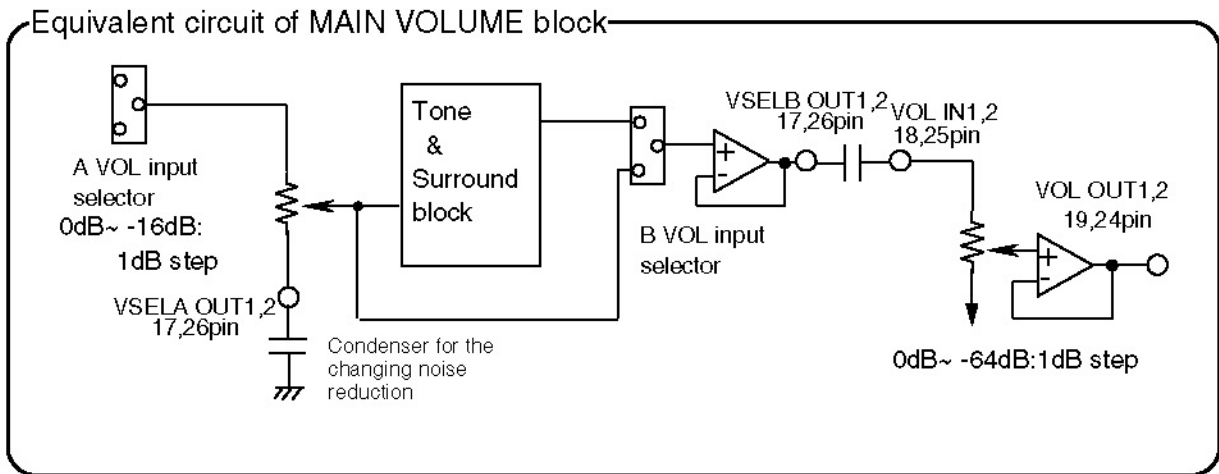
### FUNCTION DESCRIPTION

#### (1) Main volume

This IC has 2 system independence electron volume of low warp percentage and low noise.  
0dB~ $-\infty$ dB attenuation quantity can be set with 1dB step.  
-77dB ~ -80dB:1dB step).

The attenuation quantity to 0~-16dB can be set in A1 Vol.

The attenuation quantity to 0~-64dB can be set in B1 Vol.They are able to control independently.

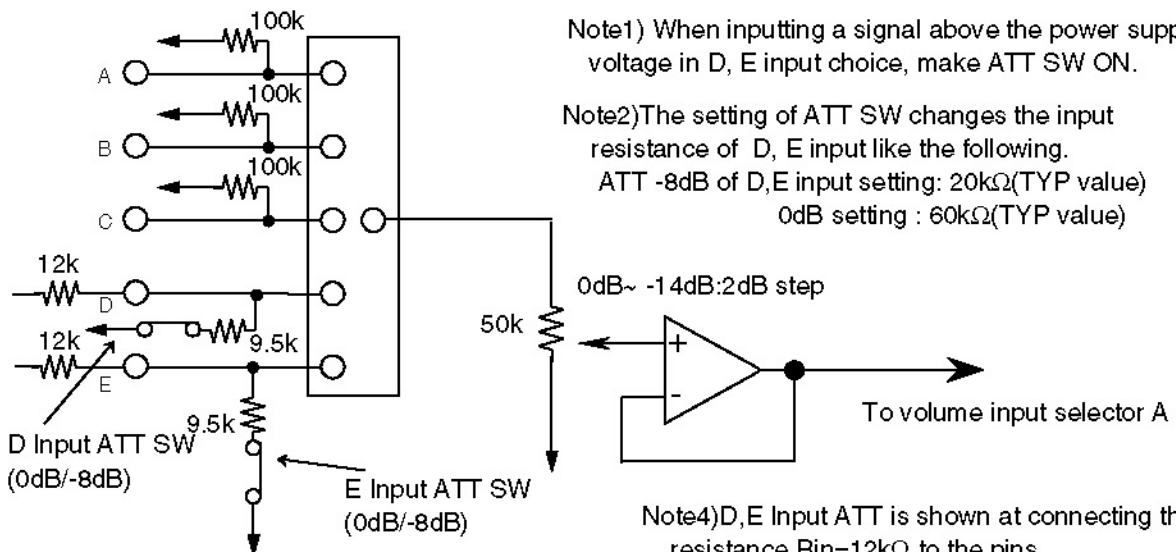


#### (2) Input selector, Input volume

This IC has 5 input selector of 2ch and Input volume of 2ch for Input TRIMMER.

The input selector D, E input is either of -8 dB of 0dB/ a choice in the input level with ATT SW at Input Resistance 12k.

The input volume of 0~-14dB can be set with the 2 dB step.



Note1) When inputting a signal above the power supply voltage in D, E input choice, make ATT SW ON.

Note2) The setting of ATT SW changes the input resistance of D, E input like the following.  
ATT -8dB of D, E input setting: 20k $\Omega$ (TYP value)  
0dB setting : 60k $\Omega$ (TYP value)

Note3) At the time of input selector A~C, E or ALL OFF  
D input ATT SW becomes -8dB setting.

At the time of input selector A~D or ALL OFF D input  
ATT SW becomes -8dB setting.

Note4) D, E Input ATT is shown at connecting the input resistance  $R_{in}=12k\Omega$  to the pins.

Note5) When delete the external resistance 12k $\Omega$ ,  
D, E Input ATT is as follows  
ATT SW 0dB setting : 1.87dB  
-8dB setting : 0dB

**PRELIMINARY**

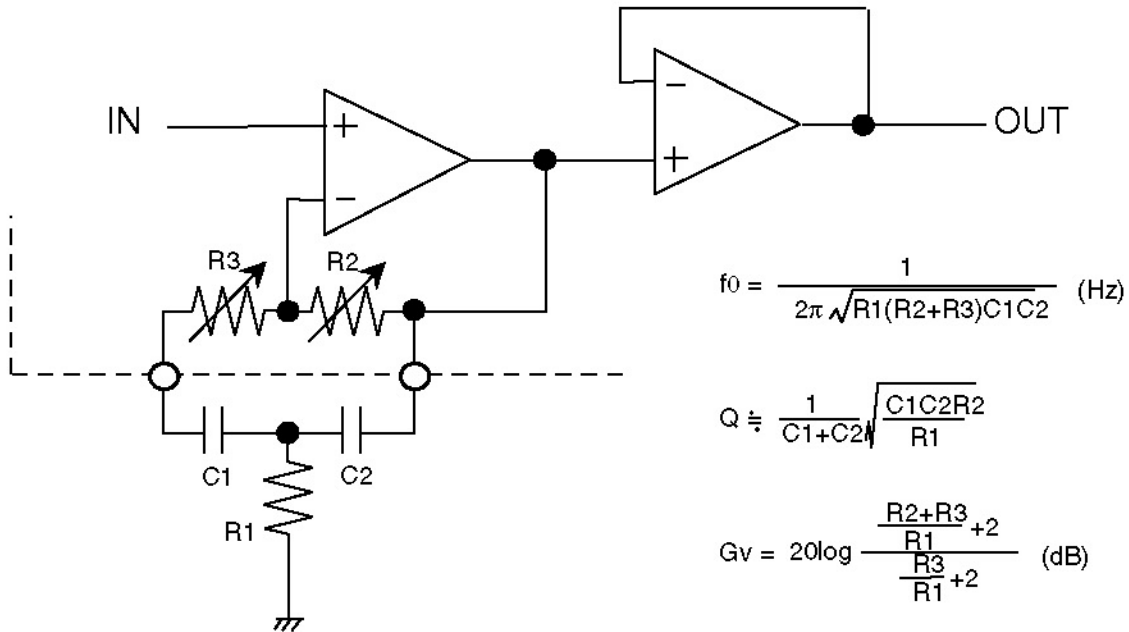
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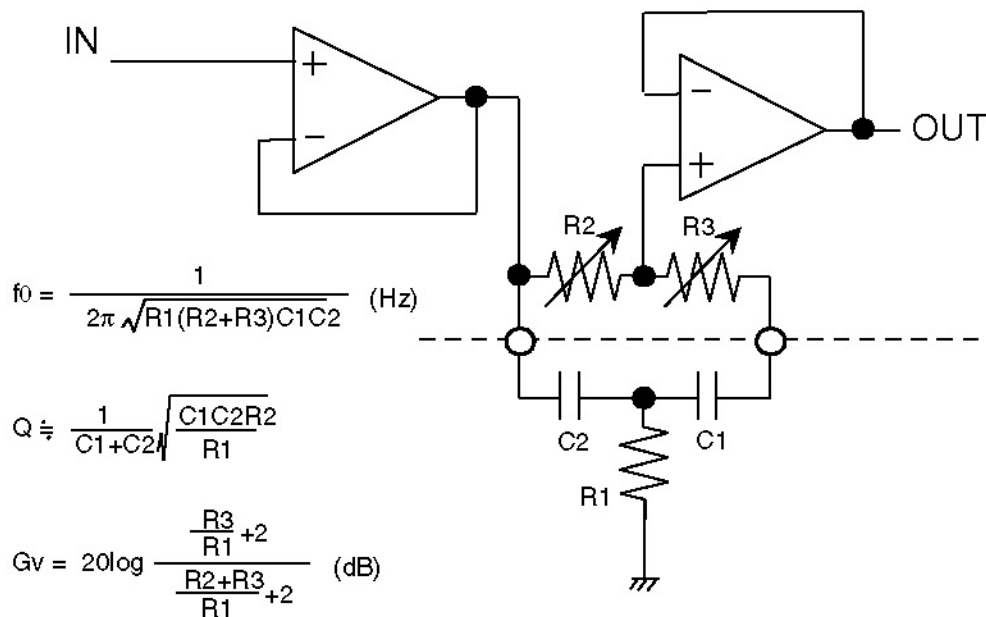
**M61510FP**

DIGITAL SOUND CONTROLLER WITH SURROUND

(3)Equivalent circuit of tone control  
3-1 Bass, Mid (Boost mode)



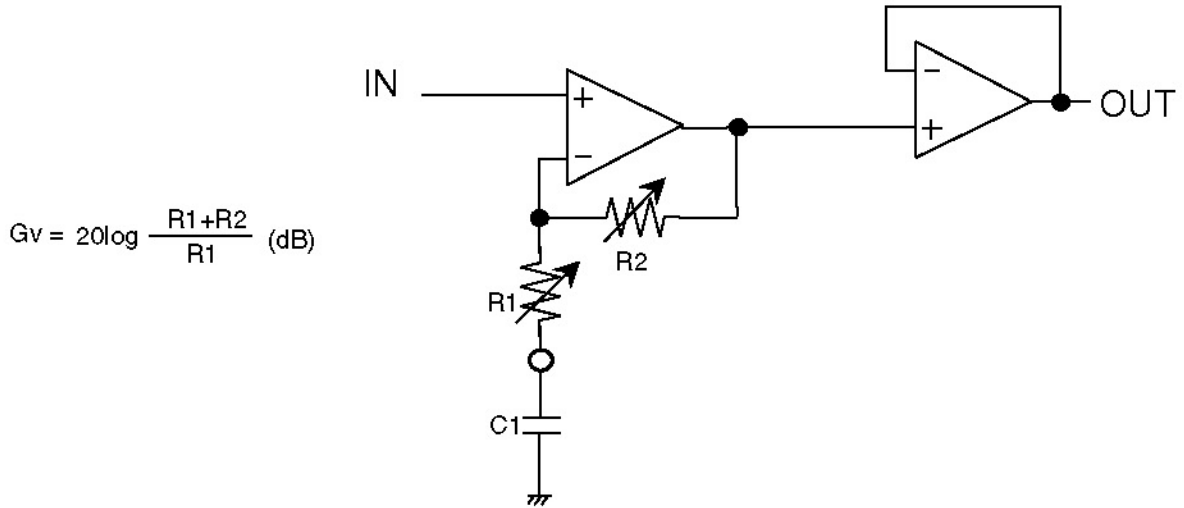
3-2 Bass, Mid (Cut mode)



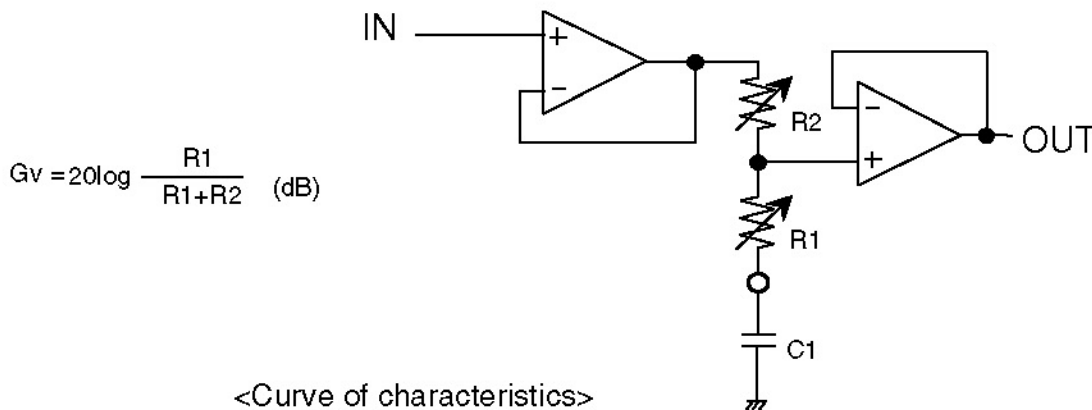
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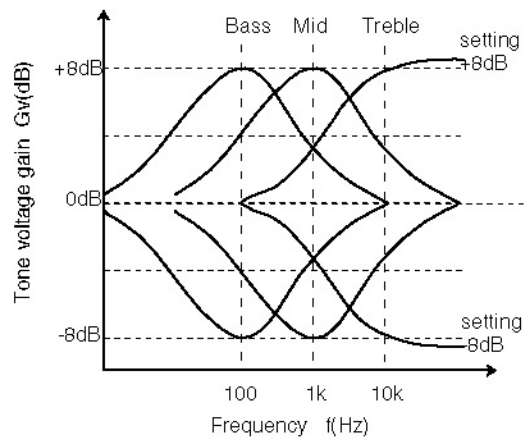
### 3-3 Treble (Boost)



### 3-4 Treble (Cut)



<Curve of characteristics>



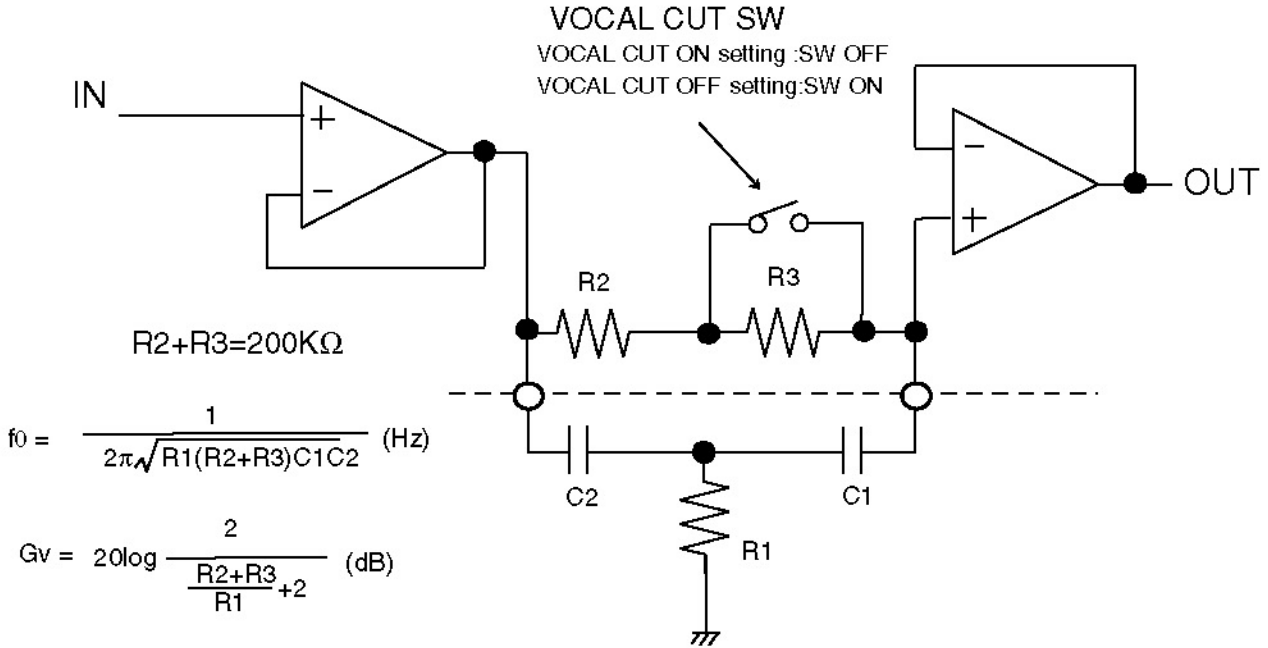
**PRELIMINARY**

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(4) Equivalent circuit of Vocal cut

This IC incorporates the circuit which realizes a vocal cut function simply by lowering gain in the area using the mid circuit of the tone control.

But be careful because vocal cut ON setting, the mid of the tone control can not used.



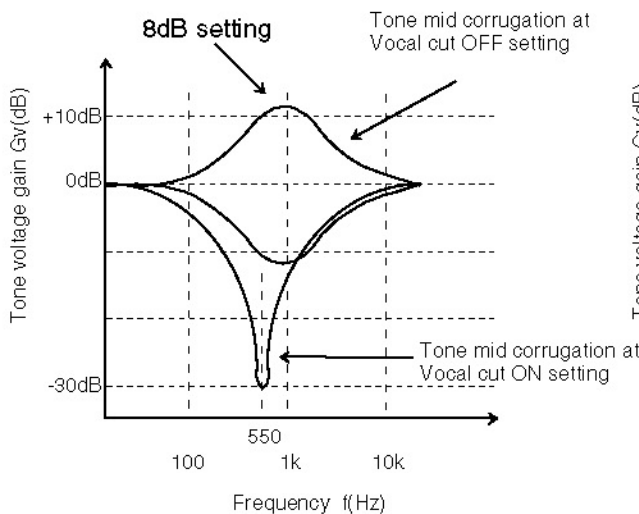
At vocal cut ON setting, the frequency characteristic can be set like the following, by the resistance of putting outside: The fixed number of R1 and C1, C2.

<CHARACTERISTIC CURVE>

1. Vocal cut characteristic edition

$f_0=550\text{Hz}$   
 $G_v=-30\text{dB}$

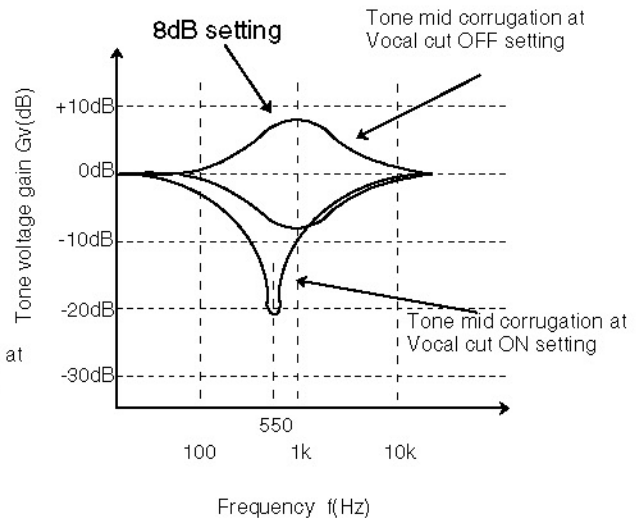
$R=3K\Omega, C1=C2=0.012\mu\text{F}$



2. Tone control mid characteristic edition

$f_0=530\text{Hz}$   
 $G_v=-20\text{dB}$

$R=10K\Omega, C1=C2=6800\text{pF}$





**PRELIMINARY**

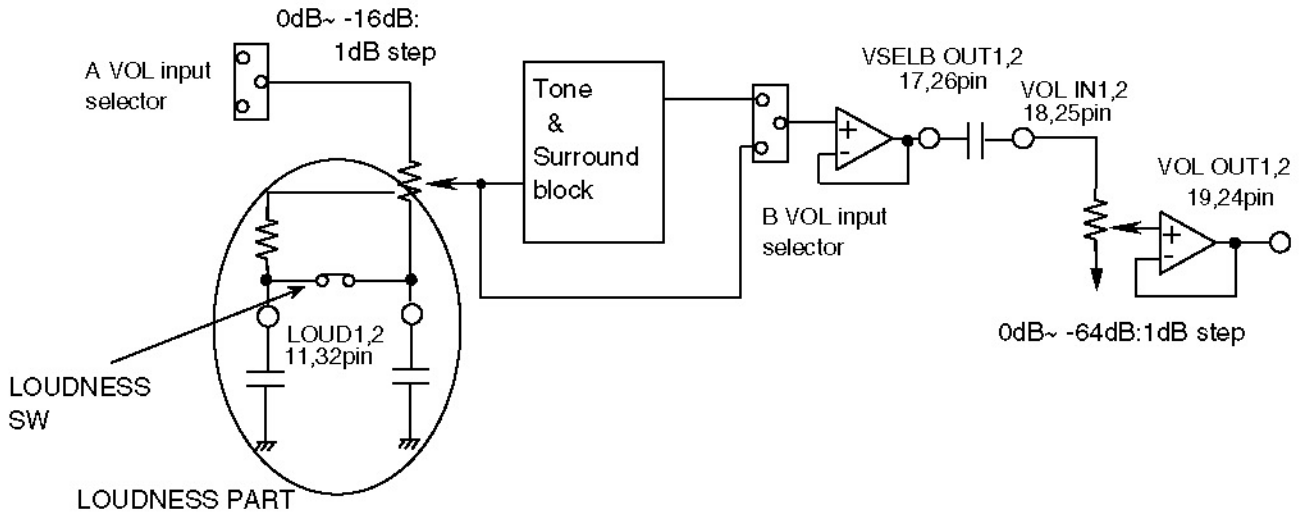
Notice ; This is not a final specification.  
Some parametric limits are subject to change.

**M61510FP**

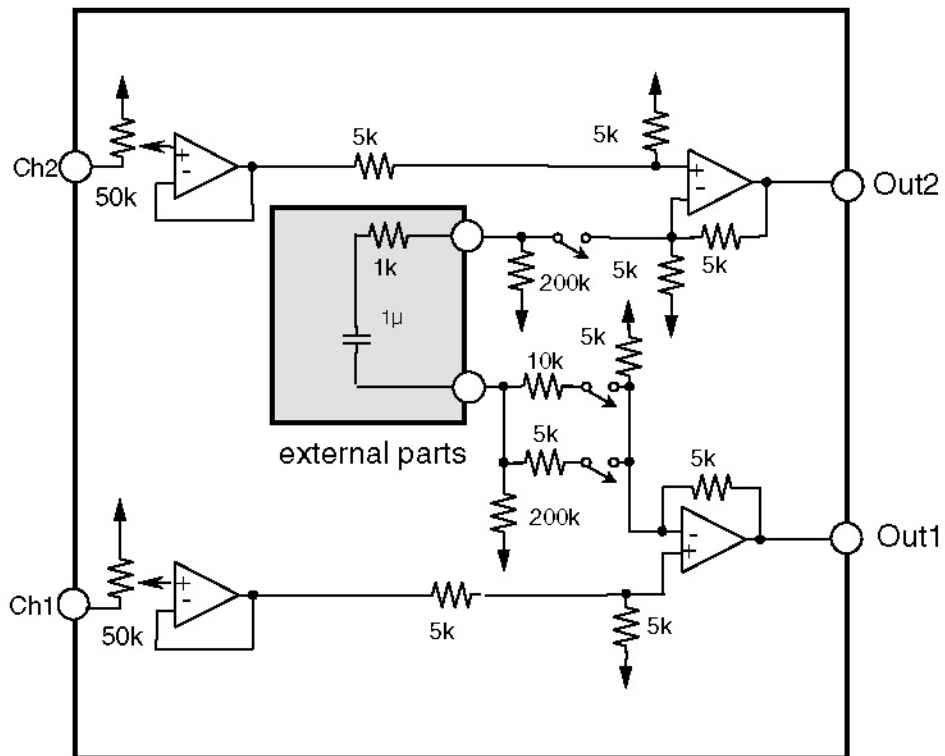
DIGITAL SOUND CONTROLLER WITH SURROUND

(5) LOUDNESS

This IC built-in a center tap -type loudness circuit.



(6)Equivalent circuit of surround block



**PRELIMINARY**

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

MITSUBISHI SOUND PROCESSORS

**M61510FP**

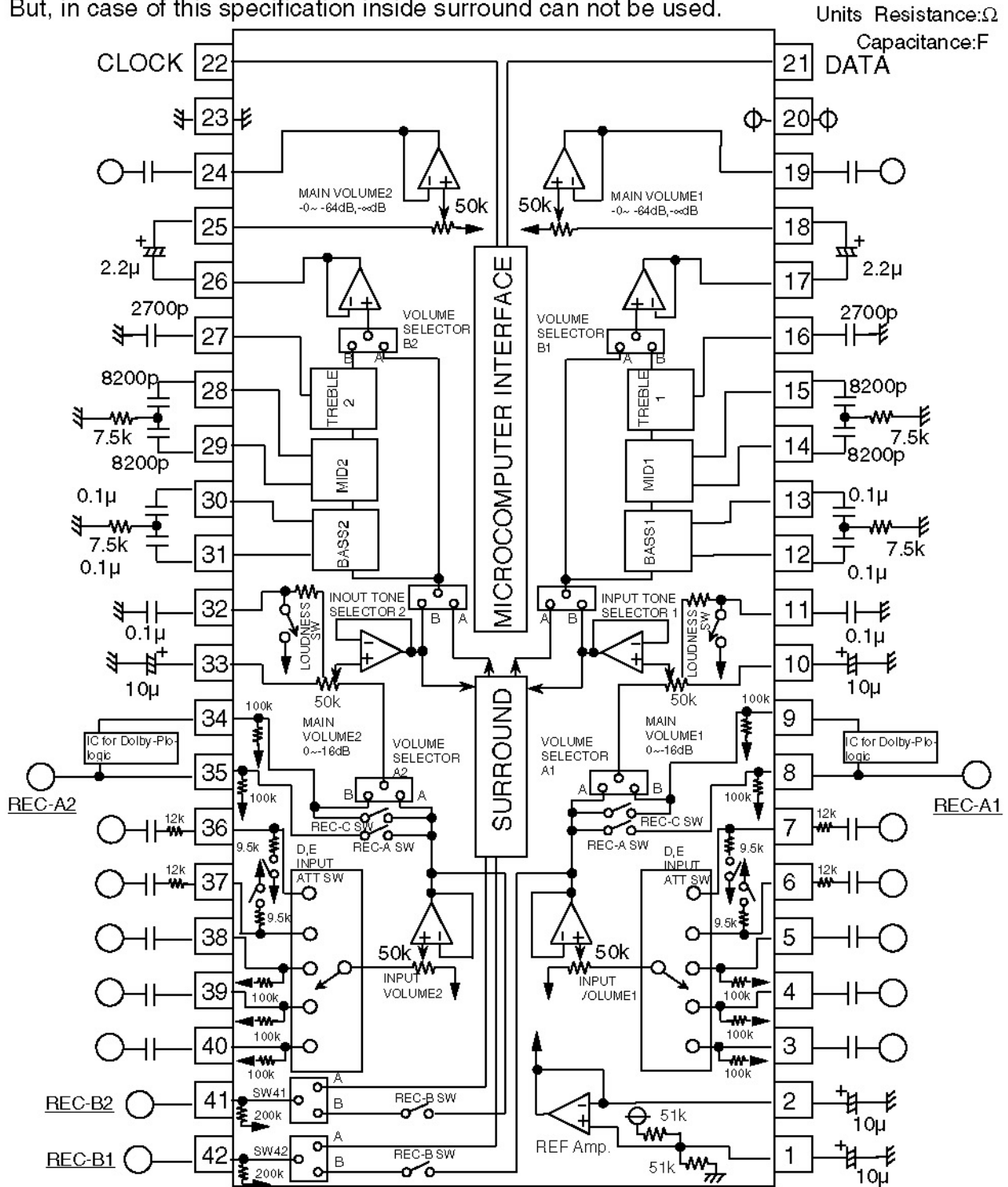
DIGITAL SOUND CONTROLLER WITH SURROUND

**APPLICATION EXAMPLE**

(1) Surround of outside setting (for Dolby-Pro-logic)

<"D5d=1"--->SW41, 42 setting = B fixation.>

But, in case of this specification inside surround can not be used.



**PRELIMINARY**

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Some parametric limits are subject to change.

MITSUBISHI SOUND PROCESSORS

# M61510FP

DIGITAL SOUND CONTROLLER WITH SURROUND

(2) Surround of outside non setting(for Dolby-Pro-logic)

<"D5d=0"--->SW41, 42 setting = A fixation, Volume input selector A setting=A fixation.>

