

To all our customers

---

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

---

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 PROCESSOR

# M62443SP/FP

SOUND CONTROLLER

## Tone and Volume Controller with 4 Input Selector

### OUTLINE

M62443SP/FP is the tone and volume controller with 4 input selector.  
 This IC can apply the broad application because of low noise and distortion.

### FEATURE

- TONE(Bass/Treble) control and 1dB step volume control are enabled .
- Low noise and low distortion .  
 $V_{NO} = 4.5\mu V_{rms}$ , THD=0.1% max
- 4 Input selector.
- Controlling by 2 Line serial data .

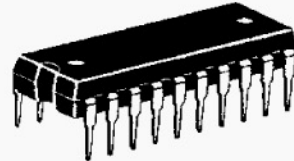
### APPLICATION

- Mini-Stereo , etc

### RECOMMENDED OPERATING CONDITION

- Supply voltage range 5.5~9.5V (analog) 4.5~5.5V (digital)
- Rated supply voltage 9V (analog) 5V (digital)

### PACKAGE OUTLINE

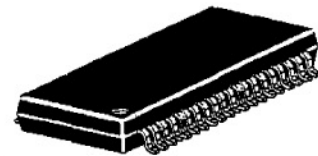


**28 P 4 B ( SP )**

(28pin Shrink DIP)

PITCH : 1.778mm

SIZE : 19.0mmX6.3mmX3.3mm

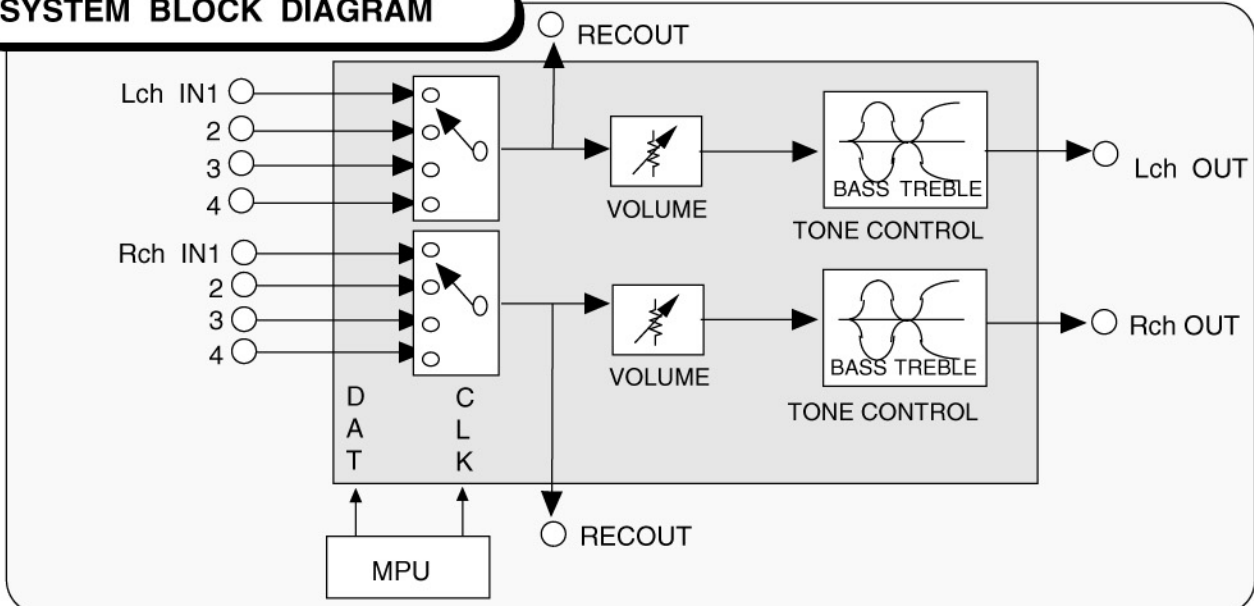


**28 P 2 W-A ( FP )**

PITCH : 1.27mm

SIZE : 8.4mmX17.5mmX2.0mm

### SYSTEM BLOCK DIAGRAM



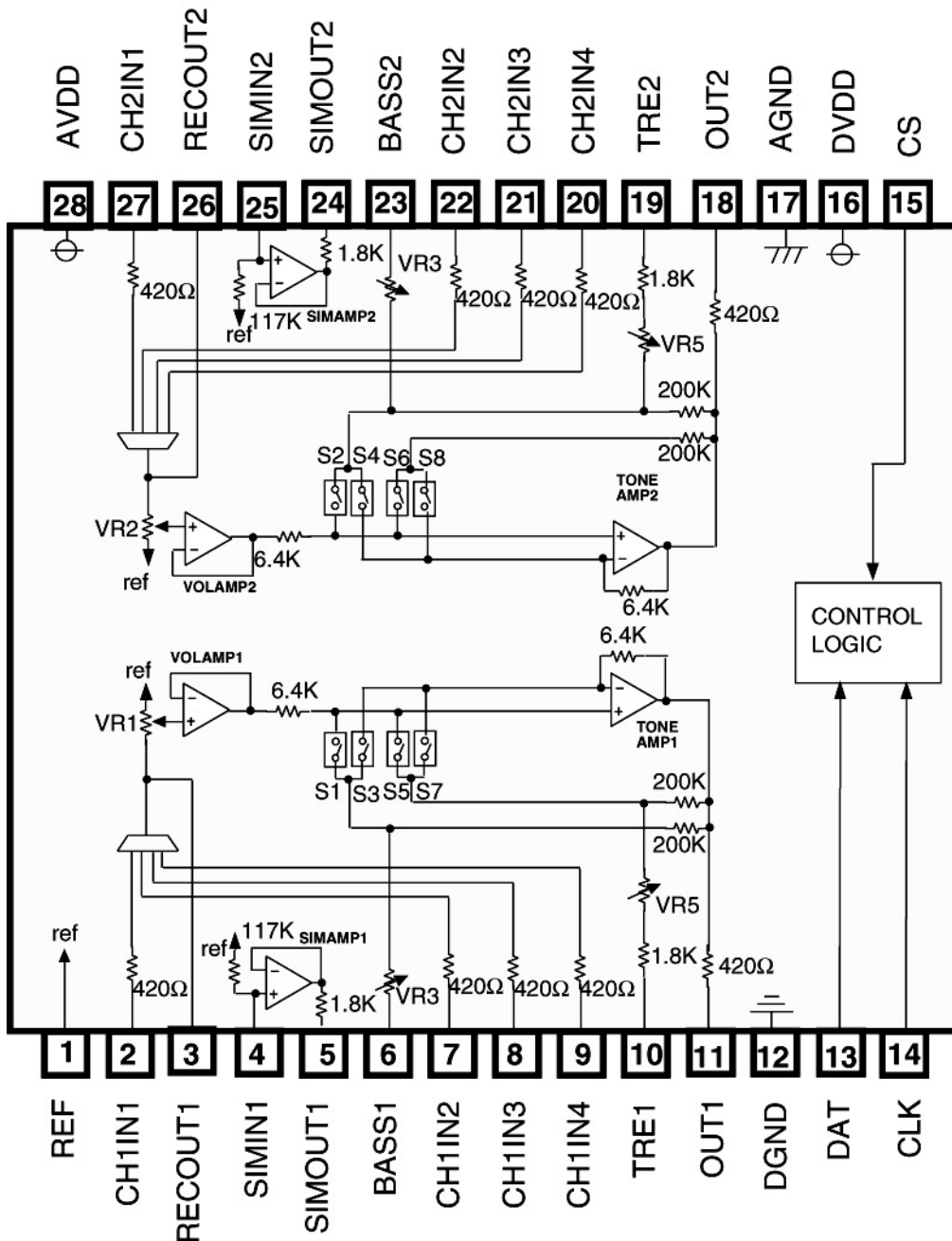
**PRELIMINARY**  
 Notice ; This is not a final specification.  
 some parametric limits are subject to change.

MITSUBISHI SOUND PROCESSOR

# M62443SP/FP

SOUND CONTROLLER

## BLOCK DIAGRAM



**PRELIMINARY**  
 Notice ; This is not a final specification.  
 some parametric limits are subject to change.

MITSUBISHI SOUND PROCESSOR

# M62443SP/FP

SOUND CONTROLLER

## PIN DESCRIPTION

PIN No.	PIN NAME	I/O	DESCRIPTION
1	REF	I	Reference voltage terminal for analog
2	CH1 IN1	I	Input terminal (ch1,select 1)
3	RECOUT1	O	Through output terminal (ch1)
4	SIMIN 1	I	Pin for capacitor of simulated inductor 1
5	SIMOUT 1	O	Pin for capacitor of simulated inductor 1
6	BASS1	I	Pin for capacitor of ch1-side bass setting
7	TRE1	I	Pin for capacitor of ch1-side treble setting
8	CH1 IN2	I	Input terminal (ch1,select 2)
9	CH1 IN3	I	Input terminal (ch1,select 3)
10	CH1 IN4	I	Input terminal (ch1,select 4)
11	OUT1	O	Output terminal (ch1)
12	DGND	—	Digital GND
13	DAT	I	I/O terminal of DATA 2 line bus format
14	CLK	I	Input terminal of CLOCK 2 line bus format
15	CS	I	Chip select terminal
16	DVDD	—	VDD for digital circuit
17	AGND	—	GND for analog circuit
18	OUT2	O	Output terminal (ch2)
19	TRE2	I	Pin for capacitor of ch2-side treble setting
20	CH2 IN4	I	Input terminal (ch2,select 4)
21	CH2 IN3	I	Input terminal (ch2,select 3)
22	CH2 IN2	I	Input terminal (ch2,select 2)
23	BASS2	I	Pin for capacitor of ch2-side bass setting
24	SIMOUT2	O	Pin for capacitor of simulated inductor 2
25	SIMIN 2	I	Pin for capacitor of simulated inductor 2
26	RECOUT2	O	Through output terminal (ch2)
27	CH2 IN1	I	Input terminal (ch2,select 1)
28	AVDD	—	VCC for analog circuit

**PRELIMINARY**  
 Notice ; This is not a final specification.  
 some parametric limits are subject to change.

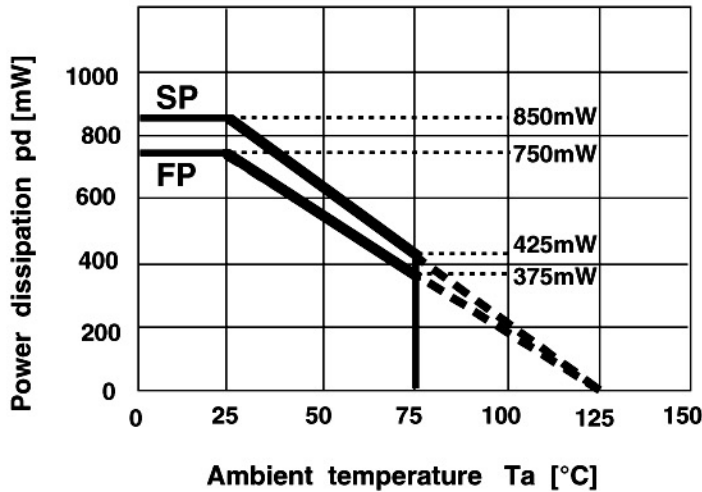
# M62443SP/FP

SOUND CONTROLLER

## ABSOLUTE MAXIMUM RATINGS

SYMBOL	PARAMETER	CONDITION	LIMITS	UNIT
AVdd	Analog supply voltage		10.0	V
DVdd	Digital supply voltage		7.0	V
Pd	Power dissipation	Ta ≤ 25°C	850(SP) 750(FP)	mW
Kθ	Thermal Derating ratio	Ta > 25°C	8.5(FP) 7.5(FP)	mW/°C
Topr	Operating temperature		-20~+75	°C
Tstg	Storage temperature		-40~+125	°C

### Thermal Derating



**PRELIMINARY**  
Notice ; This is not a final specification.  
some parametric limits are subject to change.

MITSUBISHI SOUND PROCESSOR

# M62443SP/FP

SOUND CONTROLLER

## RECOMMENDED OPERATING CONDITION

( Ta=25°C unless otherwise noted )

ITEM	SYMBOL	CONDITION	MIN	TYP	MAX	UNIT
Analog supply voltage	AVDD		5.5	9.0	9.5	V
Digital supply voltage	DVDD		4.5	5.0	5.5	V
H level input voltage (logic circuit)	VIH		0.7 DVDD	—	VDD	V
L level input voltage (logic circuit)	VIL		0	—	0.3 DVDD	V

**PRELIMINARY**  
 Notice ; This is not a final specification.  
 some parametric limits are subject to change.

# M62443SP/FP

SOUND CONTROLLER

## ELECTRIC CHARACTERISTICS

( Ta=25°C, AVDD=9V, DVDD=5V and bass and treble=0dB unless otherwise noted )

### ( 1 ) SUPPLY VOLTAGE

ITEM	SYMBOL	CONDITION	LIMIT			UNIT
			Min	typ	Max	
Analog supply current	Icc	•AVdd=9.0V •measure terminal=28 pin •no signal input	—	10	20	mA
Digital supply current	Idd	•DVdd= 5V •measure terminal=16 pin •no signal input	—	0	2	μA

### ( 2 ) I / O CHARACTERISTICS

ITEM	SYMBOL	CONDITION	LIMIT			UNIT
			Min	typ	Max	
Maximum input voltage	VIM	2,27pin input 11,18pin output RL=10KΩ, THD=1%, f=1kHz ATT=-6dB	2.0	3.2	—	Vrms
Output voltage	Vodc	11pin, 18pin, no signal	4.35	4.5	4.65	V
Gain	Gv	Vin=0dBm, FLAT, f=1kHz 2- 11PIN 27-18PIN gain	-2	0	2	dB
Output noise voltage	Vono	IHF-A filter no signal Rg=10KΩ 11,18pin	—	4.5	10	μ Vrms
Total harmonic distortion	THD	11pin, 18pin f=1kHz Vo=0.5Vrms , RL=10KΩ LPF=30kHz	—	0.007	0.1	%
Channel separation	CT	RL=10KΩ S:Vin=1Vrms, f=1kHz M:Rg=10kΩ, IHF-A filter	—	-100	-70	dB

**PRELIMINARY**  
 Notice ; This is not a final specification.  
 some parametric limits are subject to change.

**M62443SP/FP**

SOUND CONTROLLER

( 3 ) TONE CHARACTERISTICS

ITEM	SYMBOL	CONDITION	LIMIT			UNIT
			Min	typ	Max	
Tone control gain (bass)	Gbassb	f=100Hz	9	12	15	dB
	Gbassc		-15	-12	-9	dB
Tone control gain (treble)	Gtrebb	f=10KHz	9	12	15	dB
	Gtrebc		-15	-12	-9	dB

( 4 ) VOLUME CHARACTERISTICS

ITEM	SYMBOL	CONDITION	LIMIT			UNIT
			Min	typ	Max	
Maximum attenuation	ATTmax	f=1KHz, Vin=0dBm 2pin~11pin	-108	-100	-80	dB
Minimum attenuation	ATTmin	27pin~18pin gain IHF-A-filter	-1.5	0	1.5	dB

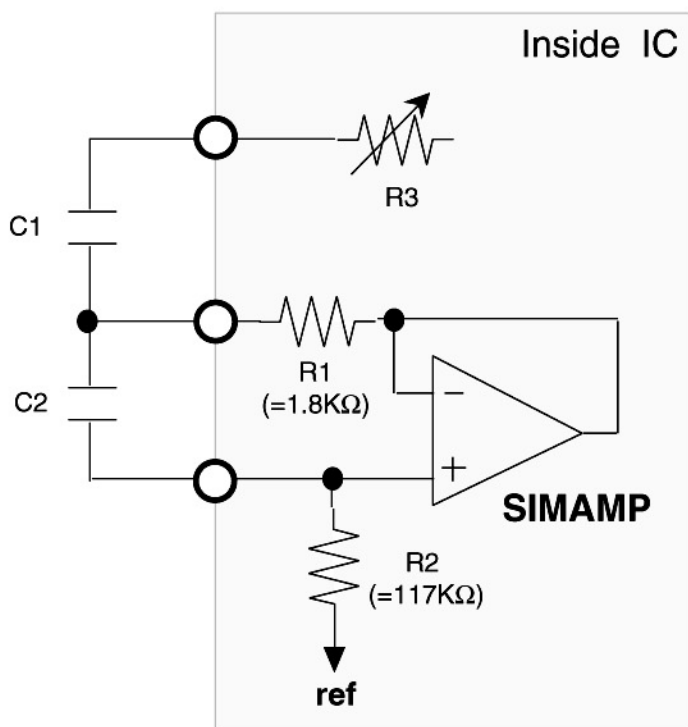


**PRELIMINARY**  
 Notice ; This is not a final specification.  
 some parametric limits are subject to change.

**FUNCTION EXPLANATION**

( 1 ) EQUIVALENT CIRCUIT OF TONE CONTROL

The resonance circuit is able to construct by using built-in amplifier for simulated inductor. (Shows the constant as follow)



Center frequency

$$f_0 = 1 / 2\pi \sqrt{C1 \cdot C2 \cdot R1 \cdot R2} \text{ [Hz]}$$

$$Q = \sqrt{(C2 \cdot R2) / (C1 \cdot R1)}$$

( EX ) BASS band (  $f \approx 100\text{Hz}$  )  
 $R1=1.8\text{K}\Omega$  ,  $R2=117\text{K}\Omega$   
 $C1=0.47\mu$  ,  $C2=0.022\mu$

FIG1. The circuit used simulated inductor.

FIG1 is equal to FIG2.  
 The following relation is concluded.

$$L=C2 \cdot ER1 \cdot ER2$$

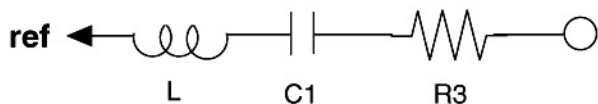


FIG2. The equivalent circuit used L.

**PRELIMINARY**  
 Notice ; This is not a final specification.  
 some parametric limits are subject to change.

# M62443SP/FP

SOUND CONTROLLER

## INPUT DATA FORMAT

← Input direction

D0	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	
0/1	0/1	VOLUME						0/1	0	0	0/1		
TREBLE		BASS					INPUT SELECTOR		1	0	0/1		

0: BOTH  
 1: ONLY 1CHANNEL

0: 1ch  
 1: 2ch

These functions are effective only VOLUME data.

\*(Notice1)

0:MUTE OFF  
 1:MUTE ON

DATA SELECT  
 0: VOLUME/MUTE  
 1: BASS/TREBLE

If CS PIN(15 PIN) is  
 "L"→ 0,  
 and if "H"→ 1.

\*(Notice1)

**INPUT SELECTOR**

D8	D9	SELECT
1	1	IN1
0	1	IN2
1	0	IN3
0	0	IN4

**PRELIMINARY**  
 Notice ; This is not a final specification.  
 some parametric limits are subject to change.

# M62443SP/FP

SOUND CONTROLLER

## (3) -1: volume control

### VOLUME CODE

ATT	D2	D3	D4	D5	D6
0dB	H	L	H	L	H
-4dB	L	L	H	L	H
-8dB	H	H	L	L	H
-12dB	L	H	L	L	H
-16dB	H	L	L	L	H
-20dB	L	L	L	L	H
-24dB	H	H	H	H	L
-28dB	L	H	H	H	L
-32dB	H	L	H	H	L
-36dB	L	L	H	H	L
-40dB	H	H	L	H	L
-44dB	L	H	L	H	L
-48dB	H	L	L	H	L
-52dB	L	L	L	H	L
-56dB	H	H	H	L	L
-60dB	L	H	H	L	L
-64dB	H	L	H	L	L
-68dB	L	L	H	L	L
-72dB	H	H	L	L	L
-76dB	L	H	L	L	L
-80dB	H	L	L	L	L
-∞dB	L	L	L	L	L

ATT	D7	D8
0dB	H	H
-1dB	L	H
-2dB	H	L
-3dB	L	L

**PRELIMINARY**  
 Notice ; This is not a final specification.  
 some parametric limits are subject to change.

**M62443SP/FP**

SOUND CONTROLLER

( 4 ) -2 : tone level control

TONE CODE

	BASS				TREBLE			
	D7	D6	D5	D4	D3	D2	D1	D0
12dB	L	H	H	L	L	H	H	L
10dB	L	H	L	H	L	H	L	H
8dB	L	H	L	L	L	H	L	L
6dB	L	L	H	H	L	L	H	H
4dB	L	L	H	L	L	L	H	L
2dB	L	L	L	H	L	L	L	H
0dB	L	L	L	L	L	L	L	L
-2dB	H	L	L	H	H	L	L	H
-4dB	H	L	H	L	H	L	H	L
-6dB	H	L	H	H	H	L	H	H
-8dB	H	H	L	L	H	H	L	L
-10dB	H	H	L	H	H	H	L	H
-12dB	H	H	H	L	H	H	H	L

NOT USED HHHH  
 LHHH  
 HLLL

( 4 ) -3 : MUTE CONTROL

On condition D9=1,MUTE can be set up.  
 In MUTE,VOLUME LEVEL is set up  
 VOL=-∞automatically.

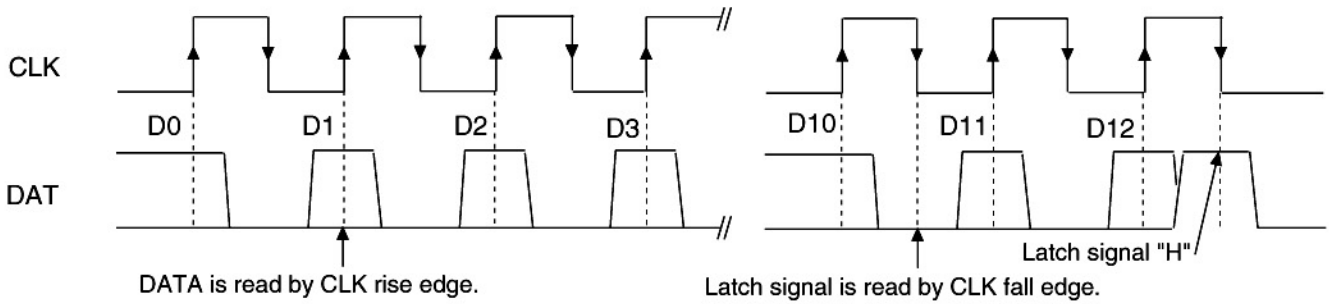
**PRELIMINARY**  
Notice ; This is not a final specification.  
some parametric limits are subject to change.

MITSUBISHI SOUND PROCESSOR

# M62443SP/FP

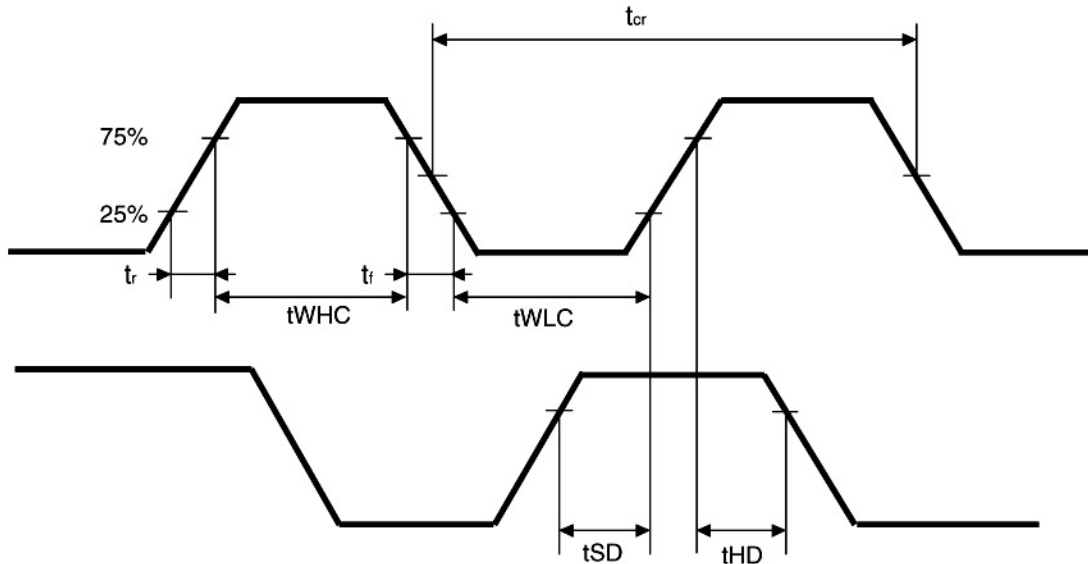
SOUND CONTROLLER

## DATA and CLOCK



**PRELIMINARY**  
 Notice ; This is not a final specification.  
 some parametric limits are subject to change.

**BUS LINE TIMING SPECIFICATION**



Parameter	Symbol	MIN	MAX	Units
CLK clock frequency	$t_{cr}$	4	-	$\mu s$
The HIGH period of the clock	$t_{WHC}$	1.6	-	$\mu s$
The LOW period of the clock	$t_{WLC}$	1.6	-	$\mu s$
Rise time of CLK line	$t_r$	-	0.4	$\mu s$
Fall time of CLK line	$t_f$	-	0.4	$\mu s$
Set-up time DATA	$t_{SD}$	0.8	-	$\mu s$
Hold time DATA	$t_{HD}$	0.8	-	$\mu s$

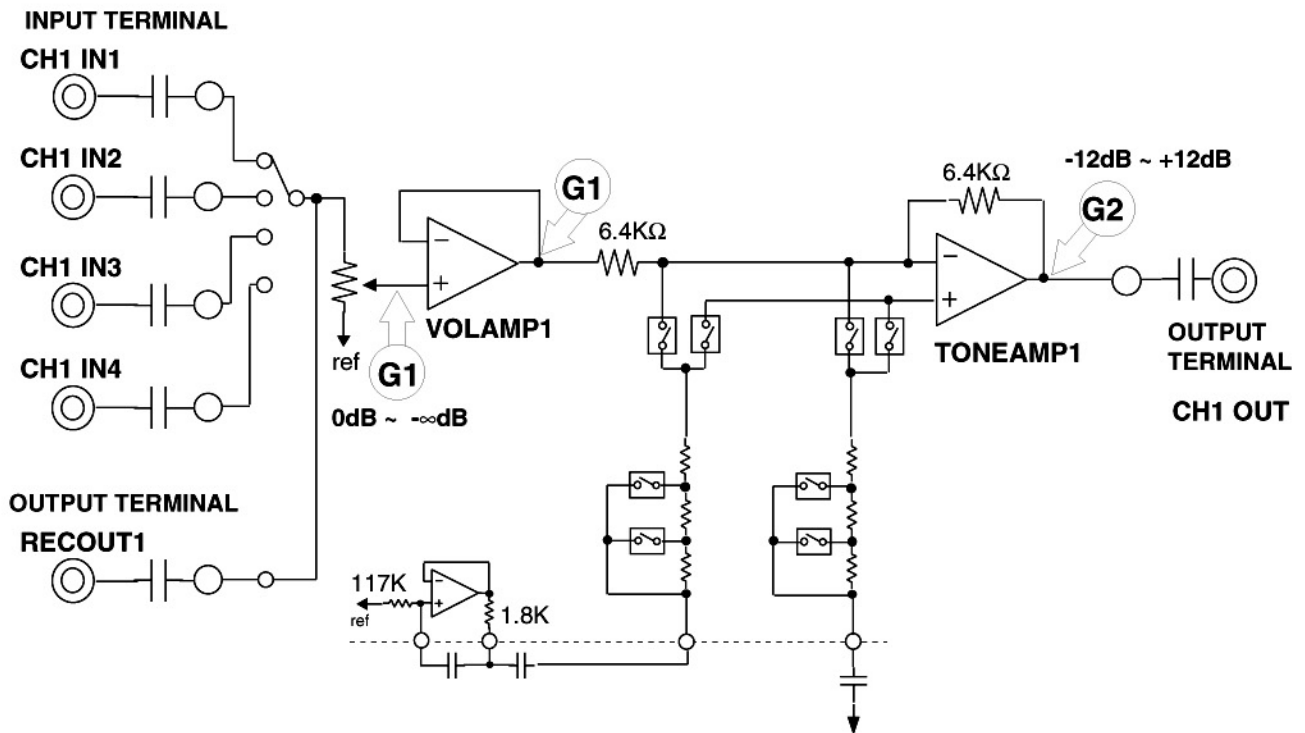
**PRELIMINARY**  
 Notice ; This is not a final specification.  
 some parametric limits are subject to change.

MITSUBISHI SOUND PROCESSOR

# M62443SP/FP

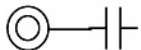
SOUND CONTROLLER

## LEVEL DIAGRAM

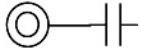


INPUT TERMINAL

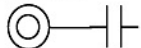
CH2 IN1



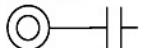
CH2 IN2



CH2 IN3

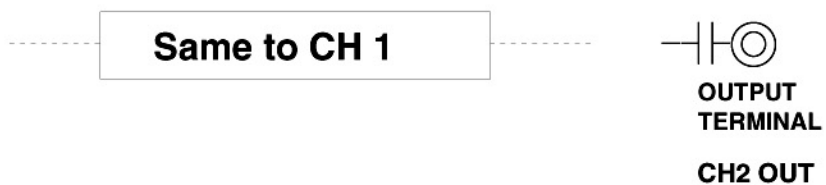


CH2 IN4



OUTPUT TERMINAL

RECOUT2



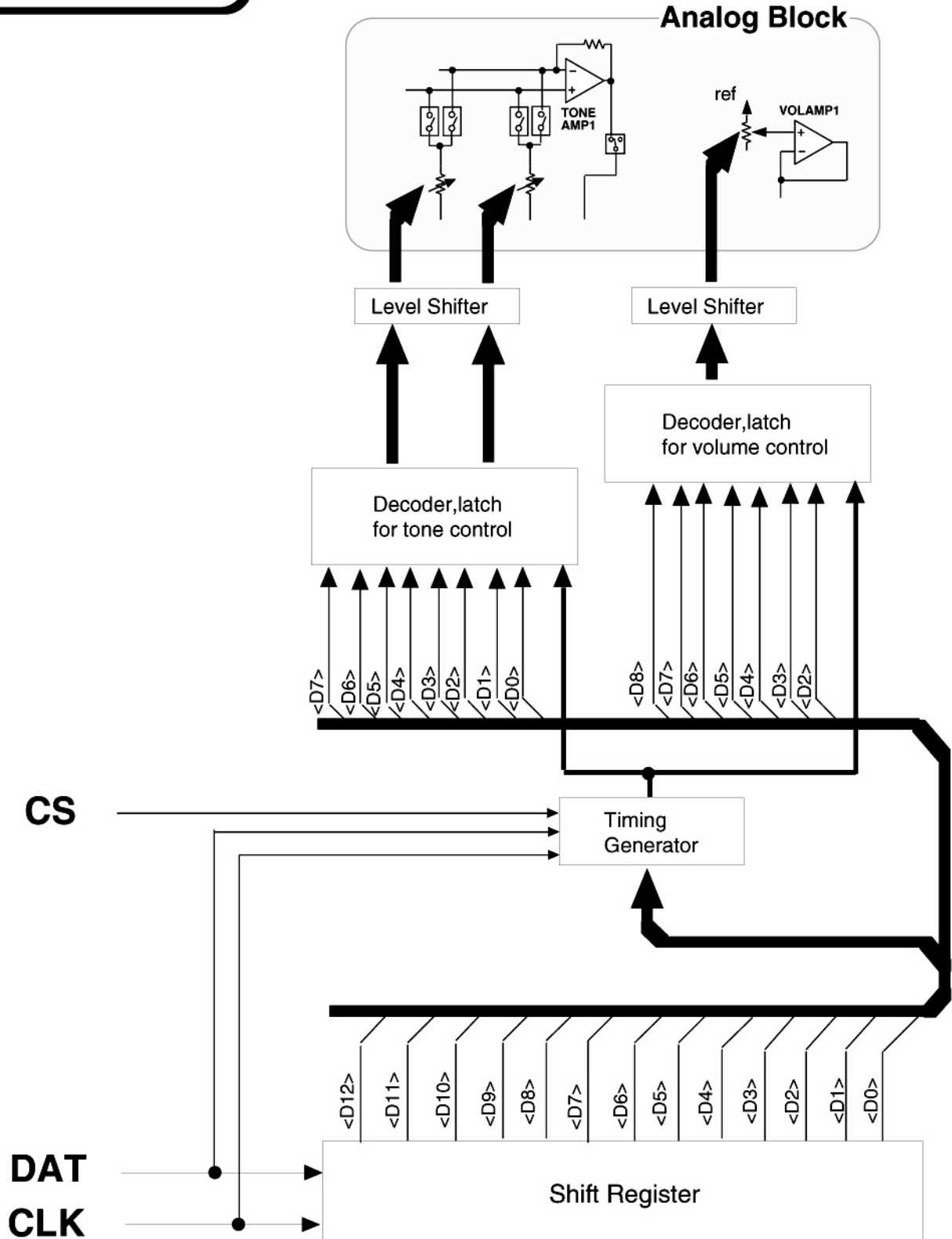
**PRELIMINARY**  
 Notice ; This is not a final specification.  
 some parametric limits are subject to change.

MITSUBISHI SOUND PROCESSOR

# M62443SP/FP

SOUND CONTROLLER

## LOGIC CIRCUIT





**PRELIMINARY**  
 Notice ; This is not a final specification.  
 some parametric limits are subject to change.

MITSUBISHI SOUND PROCESSOR

# M62443SP/FP

SOUND CONTROLLER

## APPLICATION EXAMPLE

